# Fire Ecology

GUIDE TO ENVIRONMENTALLY SUSTAINABLE BUSHFIRE MANAGEMENT IN VICTORIA

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This publication is based on the original concept and information prepared for CFA by Helen Bull of obliqua pty ltd, published by CFA in 2011.

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Cover image: Austral Grass Tree, Xanthorrhoea australis, after planned fire.
Photo courtesy of Owen Gooding

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# ABOUT THIS GUIDE

## Purpose of this Guide

The Fire Ecology Guide (the Guide) will help people make bushfire management planning and operations as ecologically sustainable as possible. The land may be private, a municipal reserve, crown reserve under committee of management, or a rail or road reserve.

This Guide is specifically aimed at bushfire preparedness and prevention, as well as managing fire use to maintain or improve biodiversity (fire regime management).

This Guide can be used at any scale to inform planning and operations, from the property to the local, municipal or statewide level.

## Who may find this Guide helpful?

This document has been developed as a reference to guide the work of CFA staff and volunteers who plan and deliver CFA's vegetation management services for and with the community, as shown in the table, opposite.

While this Guide may be used directly, its primary purpose is to provide a resource that can be used to develop further tools, training and guidance for integration in relevant CFA programs.

This Guide may also be of benefit to other users including:

- rail and road reserve managers
- municipal fire, emergency and biodiversity staff
- organisations that provide services to rural landowners (such as the Department of Energy, Environment and Climate Action, Agriculture Victoria, Catchment Management Authorities, and not-for-profit organisations such as Trust for Nature)
- environmental groups
- private landowners.

## CFA providers of vegetation management services to the community

| | CFA positions | | | | | | |
|---|---|---|---|---|---|---|---|
| Services | Policy and planning staff | Community safety managers | Operations officers | Vegetation management staff | Community engagement staff | Wildfire instructors | brigades |
| Contribute to other strategic fire management projects | • | • | • | • | | | • |
| Provide advice on management at the property or small reserve level | | | | • | • | | • |
| Lead or contribute to development of prescribed burn plans or other vegetation management treatments | | | • | • | | • | • |
| Develop or contribute to policy or statewide guidance on vegetation management | • | • | • | • | • | • | • |
| Train others in vegetation management | • | | | | | • | |

## How this Guide relates to other programs and policy

This Guide builds on and brings together in one document information obtained from a range of sources, including fire behaviour, fire safety and environmental programs, guidelines and training tools developed by CFA and the Department of Environment, Land, Water and Planning (now called Department of Energy, Environment and Climate Action (DEECA)).

This Guide, which focuses on fire management on private land and reserves where CFA is the responsible fire authority, complements and builds on guidance provided for public land that is the responsibility of DEECA.

Sustainability in fire management on public land, which is undertaken for DEECA by Forest Fire Management Victoria (FFMVic), is guided by the *Code of Practice for Bushfire Management on Public Land* (amended 2022) (DSE 2012).

The Code requires the avoidance and minimisation of harm to the environment during fire management operations, rehabilitation of damage, and implementation of ecologically appropriate fire regimes.

Fire regime management on public land is guided by tools developed through the Victorian Fire Ecology Program (a partnership between DEECA, Parks Victoria and CFA), and resources developed since under the framework of the Victorian bushfire policy Safer Together. These tools form the basis of Step 6 of this Guide.

The 2009 Victorian Bushfires Royal Commission received submissions about fuel management, in the difficulties around processes to reconcile community safety and environmental objectives, on public land including road reserves. The Commission's final report included recommendations to resolve these matters.

The Victorian Government adopted the Safer Together bushfire policy in 2015 that articulates a response to recommendations adopted from the Bushfires Royal Commission and the independent inquiry into the Lancefield-Cobaw fire (DELWP 2015).

Safer Together sets out strategic directions for fuel management which requires Victorian fire management agencies to work together with community to plan, deliver and monitor fuel management and bushfire risk reduction across all land tenures.

Following the impacts of the 2019-20 Black Summer bushfires, bushfire inquiries by the Victorian Auditor-General's Office (VAGO 2020) and Inspector-General for Emergency Management (IGEM 2020) identified the need for increased effort to manage risk on private land, and increased community awareness and participation in reducing their exposure to bushfire risk on their land.

First Nations people throughout the world look after the natural environment using fire. The Federation of Victorian Traditional Owner Corporations has developed a Cultural Fire Strategy that sets the vision and approach required to enable the use of cultural fire.

First Nations Australians fire knowledge (and traditional ecological knowledge more broadly) differs from western scientific methods in approach. However, CFA and the other Victorian fire management agencies value the contribution that cultural knowledge can make to achieve sustainable fire management objectives. The fire agencies encourage partnerships with First Nations Australians to enable cultural outcomes, and to promote sharing of information between the knowledge systems.

## 2009 Victorian Bushfires Royal Commission recommendations

This Guide contributes to the implementation of the following recommendations.

| Recommendation | Contribution |
|---|---|
| 43 | |
| The Department of Sustainability and Environment conduct biodiversity mapping identifying flora, fauna and any threatened species throughout Victoria and make the results publicly available. The format used should be compatible with that used for Bushfire-prone Area mapping. | This Guide provides information about how to use this mapping in fire management decision-making. |
| 61 | |
| The State and Commonwealth provide for municipal councils adequate guidance on resolving the compete tensions arising from the legislation affecting roadside clearing and, where necessary amend environment protection legislation to facilitate annual bushfire-prevention activities by the appropriate agencies. | This Guide provides information about how to resolve existing tensions in roadside vegetation management and other vegetation management situations. |

## Safer Together policy

This 2023 edition of the Guide uses the tools that are currently available. In doing so it enables CFA to build its capability and that of the land managers on whose behalf it conducts fire management work.

The tools, systems and specialist resources used to undertake sustainable fire management in this Guide are applied by fire agencies for the management of private and public land.

In accordance with the Safer Together approach the degree of fire service cohesion for service delivery across all land tenure will increase over time as new systems, training and decision support tools are implemented. Published products, including this Guide, will evolve to reflect and enable this approach.

## Recommendations from the 2019-20 bushfires inquiries

The VAGO final report (VAGO 2020) concluded that "reducing risk across the state also requires a stronger focus on, and allocation of resources to, treating private land, to complement that applied to public land". It recommends that CFA:

> 'improves its values checks by providing ongoing statewide support to regional vegetation management officers and leveraging any relevant systems or capabilities from DELWP to conduct values checks through guidance, training and ongoing funding".

This Guide provides a framework and sets out steps that enable values checking processes. The approach is consistent with public land practice and policy and uses the same information resources and decision support tools that public land managers use.

## How sustainable bushfire management relates to cultural fire management

The Guide regards western scientific knowledge and traditional ecological knowledge systems as complementary.

The Guide does not cover the process prescribed for cultural heritage protection, or the actions of fire agencies that are required to enable cultural fire practice. An understanding of cultural knowledge and consultation with local First Nations Australians is a component of the overall community safety and environmental assessments in Steps 3, 5 and 6.

# ABOUT SUSTAINABLE FIRE MANAGEMENT

## What is sustainable fire management?

Sustainable fire management meets community safety objectives for protecting life and property while:

- avoiding or, if that is not possible or practical, minimising harm to the environment, including the quality of air, land, water and biodiversity
- maintaining or improving biodiversity (through fire regime management) where practical
- using fire regime management to reduce the occurrence and intensity of bushfire across the landscape
- meeting legal and policy obligations for environmental care.

## Sustainable fire management principles

- Fire management activities have the potential to harm the environment through pollution of air, water and land, damage to biodiversity, and use of water and other scarce resources.
- Harm should be avoided. If not possible or practical, steps should be taken to minimise harm by reducing its impact, rehabilitating affected areas or compensating for the harm caused.
- Fire management activities may benefit some ecosystem functions and species. For example, by creating habitat diversity, triggering breeding cycles or germination and for use in weed control.
- Opportunities to protect and improve the environment should be identified as part of every fire management activity.
- Fire is a natural part of the Australian environment. Fire of the appropriate regime (frequency, intensity, season, extent and type) is necessary for the health of most native vegetation and the habitat it provides.
- Protecting the environment is an important part of protecting the community, which depends upon the environment for its life and livelihood. Where practical, fire should be planned to achieve both environmental and community safety outcomes.
- Fire management should be guided by an understanding of the environmental assets present on a site, the possible effects of fire and fire management on these assets, and an assessment of options based upon risk.
- Environmental information should be obtained from science-based tools and confirmed with relevant experts.
- Using the ‘precautionary principle’, lack of information on environmental assets and their needs should not prevent fire management from being carried out with care, but monitoring should be undertaken to learn from the experience.
- All fire management activities should be monitored to determine if management objectives were achieved, to evaluate if the methods used were effective, and to understand how species and ecosystems respond to a given treatment.
- Monitoring data should be centrally housed so that the wider fire management community is able to benefit.
- Landholder involvement in planning and decision-making for fire management should be supported, and community values accounted for.

## Why manage fire sustainably?

There is strong community and brigade support for protecting the environment.

This is backed by legislation and policy at the local, state and commonwealth levels.

## Environmental legislation and policy

Key environmental legislation and policy relevant to bushfire management in rural areas is summarised in Appendix 1.

Environmental legislation and policy generally aim to achieve:

- clean air
- clean and sufficient water for the community and the environment
- stable and productive soil
- viable populations and diverse communities of flora and fauna
- functional, sustainable ecosystems.

At times, fire management may impact these objectives. This Guide outlines steps that will assist users to identify and manage potential conflicts.

## Fire management policy and the environment

Fire management policy emphasises the need to manage risks to the environment appropriately.

The *State Fire Management Strategy* (Government of Victoria 2009) outlines a vision for the future of fire management in Victoria that delivers a healthy environment as well as fire safety outcomes.

The *Living with Fire Strategy* (Government of Victoria 2008) provides directions for achieving this vision, including better integration of ecological needs in fire management planning to promote ecosystem health and resilience.

The *Fire Ecology Strategic Directions 2009–11* document (DSE 2009b) calls for "increased participation by private landowners, local councils and relevant statutory authorities in planning and implementing ecologically-sound fire management plans, including ecological burns".

The CFA Chief Officer's *Standing Order Environmental Care SO 16 – Version 1* applies to all CFA members. It states:

- In any activity, CFA members shall consider the effects of their activities on the environment where practical, taking steps to minimise negative effects and maximise benefits.

The *CFA Chief Officer's SOP9-07 Foams, Wetting Agents and other Additives – Firefighting - version 3* (CFA 2009) states:

- Minimise the use of firefighting foams to reduce environmental impacts.
- Every effort shall be taken to ensure that firefighting foam or wetting agent does not enter bodies of water. Consider this when filling tanks.
- Where possible, the use of firefighting foam and wetting agent on organic and certified properties should be avoided. Every reasonable effort shall be made to alert organic and certified property owner/occupier(s) to potential issues that may result from contact with, or contamination from, firefighting foam and wetting agent.
- Notify EPA in cases of substantial or significantly polluted fire water runoff.
- Batch mixing of firefighting foam is not permitted.

The *CFA Chief Officer's SOP 9-28: Strategy and tactics – version 2* (CFA 2006) states:

- Consider the environment in developing your control strategies and in your operations.
- Seek specialist advice where required to help you with these issues. Include environmental precautions in SMEACS-Q (situation, mission, execution, administration, command/communications, safety and questions) briefings.
- Be aware of water and debris runoff.
- If your operations are likely to cause disturbance requiring rehabilitation, notify the appropriate agencies to help a smooth transition to the recovery phase.

Environmental notes in the *CFA Chief Officer's SOP 9.39: Planning and conducting a planned burn* (CFA 2021a) state:

- During the planning process burn planners must seek advice from internal, and where necessary external, advisers on matters of heritage and biodiversity values checks and updated as required.
- When necessary identified values should be addressed in the burn plan.
- Class A foam to be used in accordance with CFA procedures.
- The planned burn must be managed to minimise the impact of smoke on the community. Appropriate notifications should be made in advance.
- Plan control lines to minimise soil disturbance, and plan for rehabilitation of control lines where necessary after the burn has been declared safe.

# USING THIS GUIDE

## Guide steps

This Guide is divided into eight steps for taking environmental issues into account when planning and implementing fire management in the rural landscape. These are shown in the diagram, below.

- Steps 1 to 6 set out how to identify what is needed to avoid or minimise environmental harm and maintain or improve ecosystem resilience.
- Step 7 contains guidance, including case studies, about how to use this information for sustainable fire management in a range of typical scenarios faced by CFA and the land owners and land managers on whose behalf it conducts fire management work.
- Step 8 provides guidance on monitoring, learning and improving performance.
- Sources of information and assistance are listed for each step. The appendices include a glossary to assist with any unfamiliar terms.

The Guide is designed to be modular so that people use only the sections applicable to their requirements. However, it is recommended that users check Steps 1 to 6 before using Steps 7 and 8.

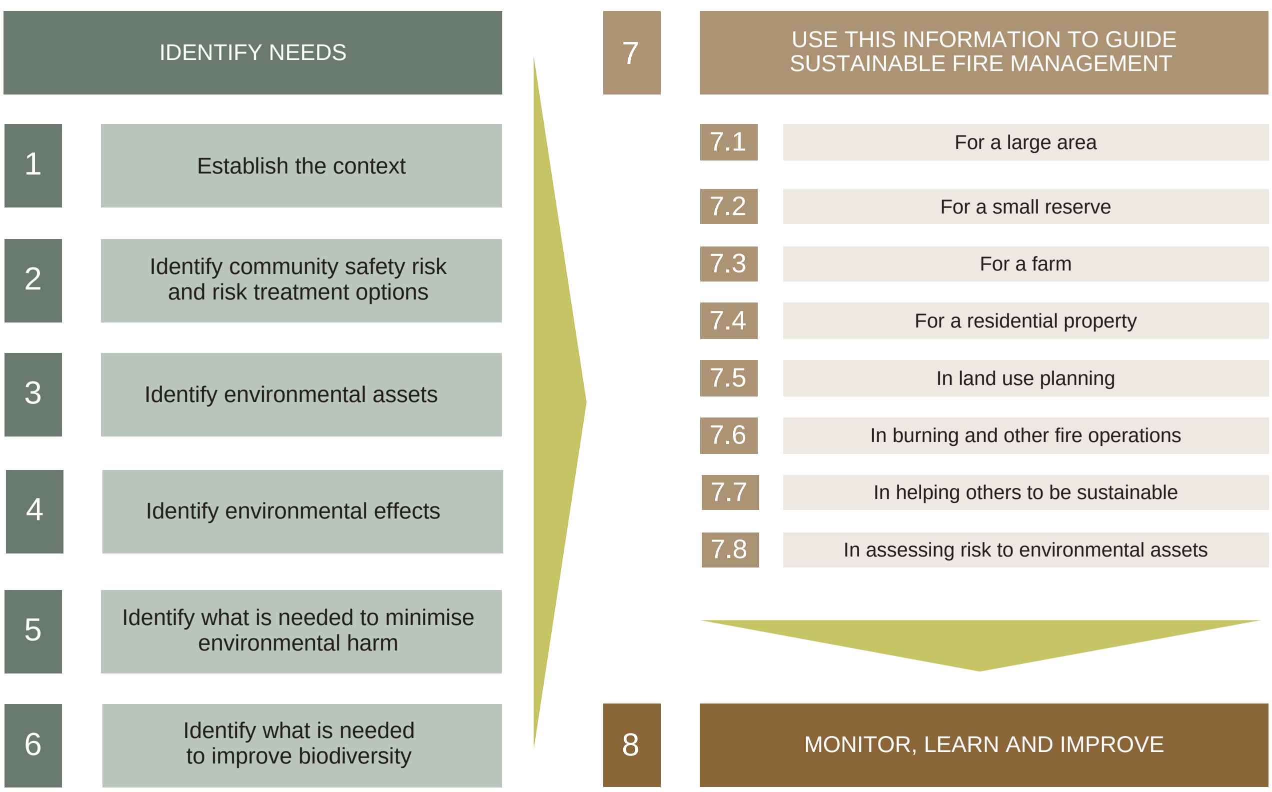
## Skill requirements and roles

Use of this Guide directly, particularly Steps 6 and 8, requires familiarity with both environmental and fire management.

To ensure that the appropriate skills are available, before using the Guide users should clarify who will provide and assess the environmental information to be taken into consideration.

Guide users should seek advice and data from published sources (including those listed in the appendices), DEECA, CMAs or the local council's biodiversity experts, or ask the land manager to do this. For example, CFA's Vegetation Management staff across the state work closely with local DEECA, CMA and council biodiversity officers to obtain information on biodiversity assets and threats when reviewing fire management plans and preparing burn plans.

For project work such as a reserve or local area fire management plan, a team approach is the best way to share the workload, and ensure local knowledge is incorporated. A team preparing a plan typically includes CFA, DEECA, Parks Victoria, local council




and local residents or interest groups such as Field Naturalists, ensuring a mix of fire, environmental and community engagement expertise. Step 7 of the Guide has case studies that demonstrate the success of many of the projects, largely because of the cooperative approach and the community engagement skill sets used.

## Status of tools

Some tools outlined in this Guide including those used in Steps 6 and 8 are under development or will be replaced as new resources tools and databases become available. Tools are also continually improved. It is important to verify with specialists which tools are the most appropriate. Specialist advice may supplement or validate predictions generated by the tools.

Monitoring the results of vegetation management operations may assist with future planning and decision-making.

# STEP 1: Establish the context

**This step will help you to identify the area you need to consider, the broad land management objectives that fire management objectives need to complement, and the history of fire management or other disturbance to the vegetation.**

## 1.1 Identify the area that you need to consider

The site you are working with may be a residential block, a farming property, a park or reserve, a road or rail corridor, a local area or a municipality.

The fire management works that you plan or implement on this land will affect the environment beyond the boundaries of the land that you are directly dealing with.

For example, fire management may affect the waterway downhill of your site. The site may be home to wildlife that requires continuous cover to reach other parts of its home range. Or the site may support an invasive weed that, if slashed or burned, may spread elsewhere.

It is important that you define the planning area that you need to consider to ensure you take all relevant environmental issues into account.

The size of this planning area will vary depending on the community safety issues (Step 2), the environmental assets (Step 3) and environmental effects (Step 4) to be considered. Further information is provided in these steps.

## 1.2 Identify broad management objectives for the site and surrounding area

It is important that your fire management proposals are integrated with and contribute to achievement of the community safety, environmental and other management objectives for the land you are working on, and the surrounding area that it may affect.

Community safety objectives may be found in:

- municipal emergency management plans or fire sub-plans
- reserve management plans
- local government planning schemes for the relevant zone or overlay (eg Bushfire Management Overlay)
- brigade and group engagement plans.

Environmental management objectives may be found in a range of documents, including those listed in the following table.

Land managers may have additional objectives such as recreation, production or development that are not documented. It is important that these be documented and included in the planning process.

| Planning for | Key sources of environmental objectives |
|---|---|
| Large areas, eg municipal | Regional catchment strategies<br>Regional biodiversity and native vegetation strategies and plans<br>River health strategies<br>Roadside management plans<br>Pest management strategies and plans |
| Small reserves | Land use recommendation reports (Land Conservation Council, Environment Conservation Council, Victorian Environment Assessment Council)<br>Park and reserve management plans (which may also help guide management of connected vegetation) |
| Farms | Property management plans, including whole farm plans<br>Conservation agreements such as Land for Wildlife, Trust for Nature, Native Vegetation Credit (offset), or carbon credit agreements<br>Local government planning schemes for the relevant zone or overlay (eg Environmental Significance Overlay, Vegetation Protection Overlay, Heritage or Significant Landscape Overlay) |
| Residential property | Local government planning schemes for the relevant zone or overlay (eg Environmental Significance Overlay, Vegetation Protection Overlay or Significant Landscape Overlay), or Precinct Plans |
| Operations | Park, reserve or plan local government laws (eg relating to air quality, roadside disturbance) |

## 1.3 Identify the fire, land use and disturbance history

Fire, past land use and past disturbance history can help you to assess the likelihood of fire in the future and to identify the fire needs of native vegetation.

Collate information on the history of bushfire or planned fire (noting the year, season, intensity and patchiness of the fire if possible) or estimate from site assessment. Note any other significant disturbance to vegetation such as regular fire management, logging, grazing, drought or insect attack.

It is often difficult to determine fire history in the rural landscape. Refer to Appendix 1-2 for further information on data sources.

# STEP 2: Identify community safety risk and risk treatment options

**This step helps you to identify the community safety risks using science-based tools. The information will allow you to set community safety objectives for the area of interest and identify which are the most appropriate treatment options.**

## 2.1 Human assets and risk

Identify:

- human assets (including homes, businesses, transport, education, medical, recreation, cultural heritage) likely to be affected by bush and grassfire
- the likely risk (likelihood and consequences) posed by bush and grassfire to these assets
- site-specific community safety objectives that will assist protection of life and property, including the level of risk that is acceptable and practical to manage.

## 2.2 Risk treatment options

Identify:

- how success in achieving risk management objectives will be measured
- treatment options for achieving these objectives including community engagement and management of physical assets and vegetation on adjoining land.

Tools that may help you to do this are listed in Appendix 2-1.

The treatment options that you identify in this step should be considered as provisional until you can assess the achievability and the possible environmental implications of each.

### Case study: Nillumbik Shire Council

Professors Hill Reserve is a four-hectare site located in Warrandyte North that is managed for conservation of its significant flora and fauna.

The surrounding area supports extensive native vegetation and a mixture of high and low-density housing. The overall fuel hazard has been assessed as ‘extreme’ over much of the reserve.

Nillumbik Council, in consultation with CFA, has identified this as an area where, under severe fire weather conditions, fires may occur that pose a significant threat to life and property.

One option for reducing a bushfire’s impact on houses is to create an asset protection zone with an overall fuel hazard of ‘moderate’ for a depth of 60 metres in the reserve. This treatment is predicted to reduce the radiant heat impact from a fire in the reserve to ‘low’.

Professors Hill Reserve hosted a diverse Orchid cover including this Spider Orchid

Other vegetation management options include reducing fuel over a wider area, but to a higher overall fuel hazard rating, or accepting a higher level of radiant heat exposure.

Candling the trees in the asset protection zone of Professors Hill Reserve to reduce bark hazard.

# STEP 3: Identify environmental assets and their significance

**This step helps you to identify environmental assets that may be affected by the community safety treatment proposals identified in Step 2, and their significance.**

Environmental assets that may be affected (positively or negatively) by fire or fire management may include the air, land, water and the biodiversity they support. These assets may be located on the site or some distance away. Sources of information on environmental assets and their significance are listed in Appendix 3-1. Significance ratings will help you determine the most appropriate risk treatment option.

To prevent the risk of vandalism, the public should communicate the location of significant environmental assets in a way that precludes identification.

## Biodiversity assets

Biodiversity is the variety of all living things on Earth–all the creatures, plants, fungi and microorganisms, as well as their genetic information. These all work together in ecosystems like an intricate web, maintaining balance and supporting life and wellbeing, including for humans.

Source: VAGO 2021

Fire can improve ecosystem resilience by enhancing reproduction and altering behaviour. Absence and suppression of fire can sometimes lead to decline in the biodiversity of fire-responsive and fire-dependant species. Other species and ecosystems may need to be protected from fire.

## Pyrodiversity and biodiversity

Diversity of fire (pyrodiversity) is the differing fire frequencies, extents, intensity, seasonal timing and patchiness. It is generally believed to promote the broadest range of species populations, functioning communities and ecological processes. However, the very long time periods and breadth of observations and data collection required to measure the relationship means there is little conclusive evidence in scientific literature.

Any fire management intervention that is implemented with the objective of promoting biodiversity should include a monitoring procedure that records species presence, population trajectory and habitat structure.

Step 6 will help you determine treatment options including fire use which will protect or enhance biodiversity

### Case study: Kilsyth South spider orchid

Located in CFA District 13, Kilsyth South is in the urban interface Its local government area is the City of Maroondah. Approximately half of the Kilsyth South area is urban housing with a few larger blocks less than five hectares. There is also an industrial area, a golf course and a creek and retarding basin within a bushland reserve. The reserve has very high biodiversity values with several Flora and Fauna Guarantee Act listed species as well as an Environment Protection and Biodiversity Conservation Act listed species, the Kilsyth South spider orchid, Caladenia sp. aff. venusta Kilsyth South. Including a Trust for Nature property and land that Maroondah council recently purchased the bushland measures approximately 15 hectares.

Elena Bakharev

Biodiversity assets may be located on the subject land, adjacent to the land, or in or adjacent to waterways. Consider the following.

## Ecological communities and species

- Threatened species (*Environment Protection and Biodiversity Conservation Act 1999/Flora and Fauna Guarantee Act 1988*) or ecological vegetation classes.
- Threatened species advisory lists (DEECA).
- Other regionally or locally rare or endemic species.
- Protected under treaties (Japan Australia Migratory Bird Agreement/China Australia Migratory Bird Agreement).
- Fire sensitive (see Step 6).
- Charismatic (eg platypus, koala, orchids).

## Other sites of biodiversity significance

- Wetlands, other waterways and the marine environment.
- Biosites (sites of biological significance).
- Reference areas, old growth forests, heritage rivers, refugia.
- Policy areas, eg flagship areas and biolinks.
- Land subject to conservation agreements eg Trust for Nature, Land for Wildlife, Bush Heritage, Bush Tender, EcoTender, Bush Broker and native vegetation offset sites.

Biodiversity assets that may benefit most from fire or fire management include fire-prone species or communities. See Step 6 for more information.

## Biodiversity priorities

To prioritise biodiversity assets, it is important to be able to determine those that have the most significance. The following table summarises the most significant from a statewide perspective.

| | |
|---|---|
| Conservation status | Ecological vegetation classes (EVCs)<br>EVCs that are 'endangered' at the bioregional level (Bioregional Conservation Status)<br>Species/communities<br>Listings under EPBC Act or FFG Act Endangered/Critically Endangered Victorian Rare or Threatened (VROT) status<br>Listings under treaties for migratory species (JAMBA, CAMBA and Ramsar)<br>Flagship areas and biolinks<br>Other categories assigned 'very high' conservation status in the Native Vegetation Framework (DNRE 2002a and Appendix 3-2) |
| Potential impact of fire management | Most of the asset (EVC or species records or sensitive habitat) occurs within the area to be treated or downstream in an area likely to be affected by fire management. The proportion affected will vary with the asset concerned. |

## Other biodiversity assets of importance

Other assets may be important from a regional or local point of view and should also be considered.

Diverse ecosystems provide environmental and economic services. Many private landowners and authorities (such as councils and water authorities) are entering into agreements to manage native vegetation on their land for these purposes. For example, through schemes such as DEECA's Bush Broker, landowners are contracted to maintain native vegetation in perpetuity to offset native vegetation removed under a planning permit. Similarly, Trust for Nature covenants require ongoing native vegetation protection and Landcare funding requires protection of native vegetation for a 10-year period.

Inappropriate fire or fire management (including fire exclusion) could not only affect the biodiversity value of vegetation managed under these agreements, but also have an impact on the landowner's business.

Flora and fauna need continuity of vegetation of appropriate growth stages to meet their needs for food, shelter, breeding and migration. Small or narrow strips of native vegetation can support a diverse range of species and may be locally important. Roadsides, riparian zones and small blocks of native vegetation can support a diversity of species in many of Victoria's heavily cleared bioregions. Roadside vegetation provides a substantial proportion of the native vegetation and often the only remaining habitat in the most heavily cleared bioregions.

At a site level, waterways, tree hollows, native grass stands, rocks, logs and woody debris are important habitats. A large proportion of significant species are associated with these habitats.

Single trees are also important. As noted by the Victorian Environmental Assessment Council (VEAC) (2010), "Single trees contribute to the viability of wildlife populations by providing habitat and connectivity between larger patches, and they perform a number of other ecosystem functions such as the mitigation of salinity and soil erosion and aiding in nutrient cycling. Single trees in agricultural landscapes are utilised by many guilds of birds (Fischer et al, 2002), and are important landscape features for bats (Lumsden et al 2005) and arboreal mammals (van der Ree et al 2004)".

VEAC (2010) also confirms the importance of roadsides, riparian zones and small blocks of native vegetation in many of Victoria's heavily cleared bioregions. Roadside vegetation provides a substantial proportion of the native vegetation and often the only remaining habitat in the most heavily cleared bioregions.

The *Victorian State of the Environment Biodiversity Update 2021 Report* assessed the status of the goal of Net gain in extent of condition of native vegetation as 'Poor' and the trend as 'Deteriorating'.

## Land, waterways and water assets

Clean, stable and productive land is important to agriculture as well as the environment. Land that is most vulnerable to fire or fire management is steep, erodible and affected by salinity or acidity.

Waterways, including rivers, creeks, lakes, estuaries, wetlands and groundwater, provide clean water for domestic, industrial and agricultural use, recreation, food, fibre, energy, carbon pollution reduction, a range of diverse habitat and a range of other benefits.

All wetlands are important areas for conservation of wildlife, including species protected under international treaties.

Wetlands are also important places for storage of carbon, contributing to carbon pollution reduction. Notable wetlands in Victoria include the Gippsland Lakes, Werribee sewage treatment works, the volcanic lakes in the Western District and wetlands along the Murray River.

Rivers have an important environmental role in the wider landscape. They:

- replenish floodplains by depositing soil and nutrients
- have healthy river bank vegetation, which stabilises banks, filters water and slows erosion
- move carbon from decomposing material on the floodplain to wetland storages
- replenish groundwater storages
- provide and link a diversity of habitats to support a variety of plants and animals.

The 2002 assessment of river health found that only 27 per cent of Victoria's major rivers were in good or excellent condition and 34 per cent were in poor or very poor condition (DNRE 2002b).

The report card for 2009 (DSE 2010a) indicates that while there have been substantial improvements in river health since 2002, the quality of water (particularly in the lower reaches of many rivers) does not meet objectives set out in the State Environment Protection Policy (Waters of Victoria).

The *Victorian State of the Environment Biodiversity Update 2021 Report* (CES 2021) assessed the overall river health and riparian vegetation extent status as 'Poor' and 'Deteriorating'.

This means it is increasingly important for CFA to continue to minimise its impact on waterways and the vegetation and other habitat it provides.

## Air assets

Clean air is critical to community health. EPA monitoring carried out in 2008 against the standards set out in the National Environment Protection (Ambient Air Quality) Measure indicates that Victoria has relatively clean air (EPA 2009).

The 2022 Victorian Clean Air Strategy identified better management of smoke impacts from land burning (including planned burning on private and public land, including agricultural burning) as an objective. It is essential to consider the smoke impacts and how to mitigate them when planning to undertake any burning.

# STEP 4: Identify possible environmental effects

**This step will help you to identify the potential effects of your provisional fire management proposals on the environmental assets you identified in Step 3.**

The fire management works that you plan or implement may have effects on the environment beyond the boundaries of the land you are directly dealing with. For example, fire management may affect the waterway downhill of your site, the site may be home to wildlife that requires continuous cover in order to reach other parts of its home range, or the site may support an invasive weed that if slashed may spread elsewhere.

In working through Step 4, it is important to identify any 'offsite' effects. Sources of information about environmental effects are listed in Appendix 4-1.

## Vulnerability of environmental assets in the rural environment

Studies confirm that Australia's biodiversity is under considerable pressure from vegetation clearing, pests and weeds, highly-modified and overcommitted water resources, widespread use of fertiliser and other chemicals, changed fire regimes, urbanisation, mining, and over-harvesting (VEAC 2010). Climate change, with higher temperatures, reduction in water flows and increases in extreme weather events, will add to these pressures.

The effect of disturbance is increased as native vegetation becomes more fragmented. Smaller areas of vegetation have a larger perimeter-to-core-area ratio, increasing the exposure of native vegetation, waterways and the wildlife they support to environmental conditions (such as fire, drought, and climate change), human influences, weeds, grazing and predators.

Isolated patches support fewer and lower densities of wildlife. There is a greater chance of isolated populations becoming extinct as a result of the effects of events such as drought or fire or other disturbance.

However, isolated patches, as well as linear corridor and single paddock trees, are important in biodiversity conservation because they provide habitat as well as 'stepping stones' to other areas of habitat.

All small or linear patches of vegetation, including small reserves or bush blocks, roadsides and river frontages, are particularly vulnerable to disturbance. On private land, there are additional pressures from use of water and native vegetation (eg collection of timber for personal use), which can reduce vegetation condition.

Because of this vulnerability, it is particularly important that fire management is carried out in a way that does not further increase the pressure on native vegetation and waterways and the habitat it provides through reducing habitat quality or connections.

VEAC (2010) provides some guidance about the sensitivity of vegetation to disturbance. This report notes that the main determinant of ecosystem health is the extent of remnant native vegetation (which also determines how well the remnants are connected).

VEAC divides Victoria's bioregions into three main groups: most cleared, moderately cleared and least cleared.

This rating of bioregions can be used to provide a landscape scale guide to the vulnerability of vegetation to management activities (such as fire management) that may reduce vegetation quality or connection between patches. Particular care should be taken to avoid harm in the most-cleared bioregions.

## Victoria's environment is stressed

The *Victorian Catchment Condition and Management Report* (VCMC 2017) states that most of Victoria's catchments were rated 'Moderate' to 'Poor' in a number of assessment categories, reflecting a general decline in condition of land, water and biodiversity since 2002.

Approximately half of Victoria's native vegetation has been cleared, including 80 per cent of private land (VEAC 2010).

Vegetation on private land supports about 30 per cent of Victoria's threatened species (CSE 2008).

Victoria has the highest proportion (48 per cent) of sub-bioregions in Australia in poor condition, with four out of Australia's five most cleared bioregions found in western Victoria (CES 2008).

54 per cent of remaining vegetation is fragmented. Only 6 per cent of fragmented landscapes are in conservation reserves (VEAC 2010).

88 per cent of the 2.72 million native vegetation patches in Victoria are less than one hectare in size (VEAC 2010).

Victoria is losing native vegetation at a rate of 4,000 hectares each year, mostly from endangered grasslands (VEAC 2010).

Victoria is losing vegetation quality at the rate of 15,830 habitat hectares each year, 80 per cent of this from private land (VEAC 2010).

The highest number of threatened species in any one region in Australia occurs in north western Victoria (VEAC 2010).

Exotic species represent about 30 per cent of Victoria's flora (VEAC 2010).

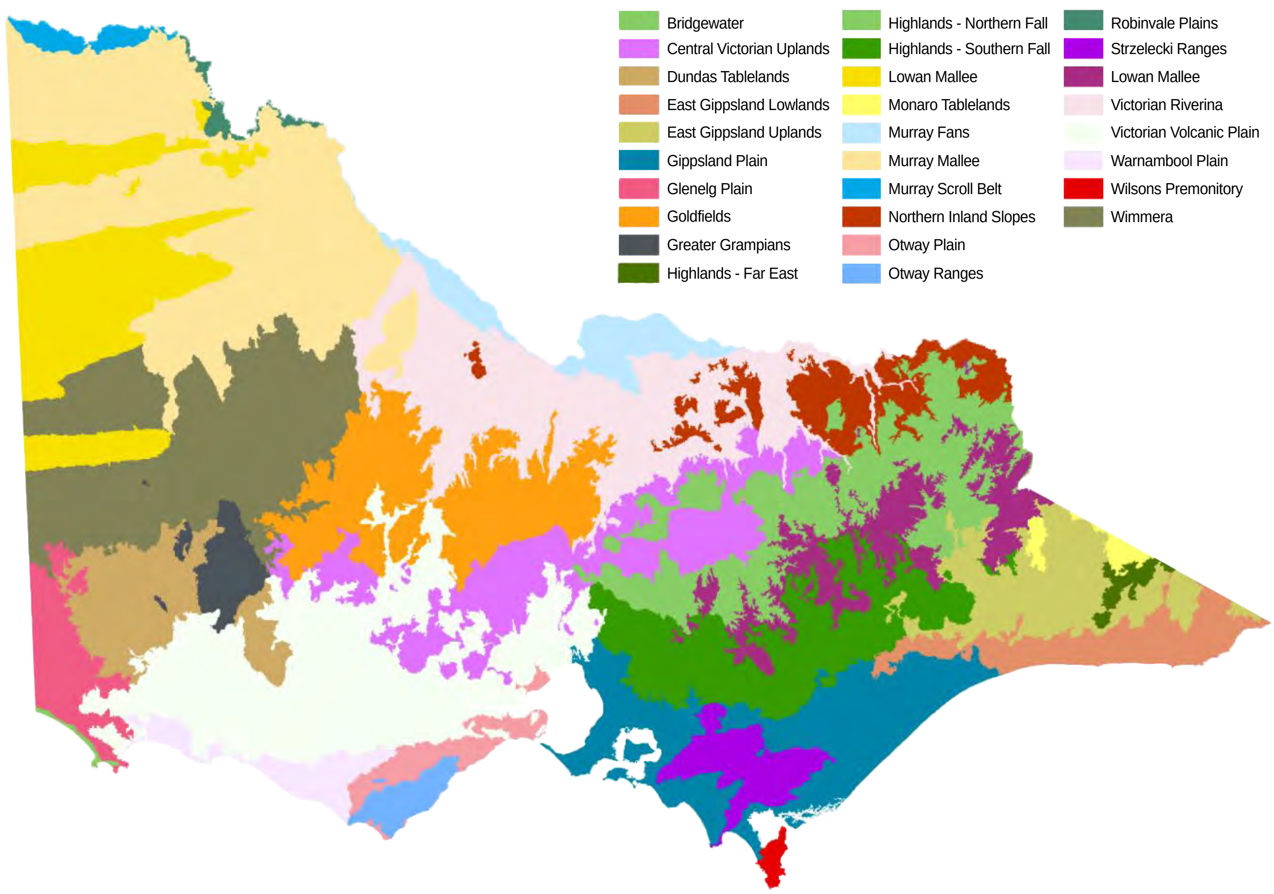
One-third of Victoria's major streams are in poor or very poor condition. Two-thirds of wetlands have been either lost or degraded, mostly on private land (VCMC 2007).

Bioregions are large, geographically distinct areas of land characterised by landscape-scale natural features and environmental processes that influence the function of entire ecosystems.

Bioregions provide a useful means to report on underlying complex patterns of biodiversity for regional-scale conservation planning.

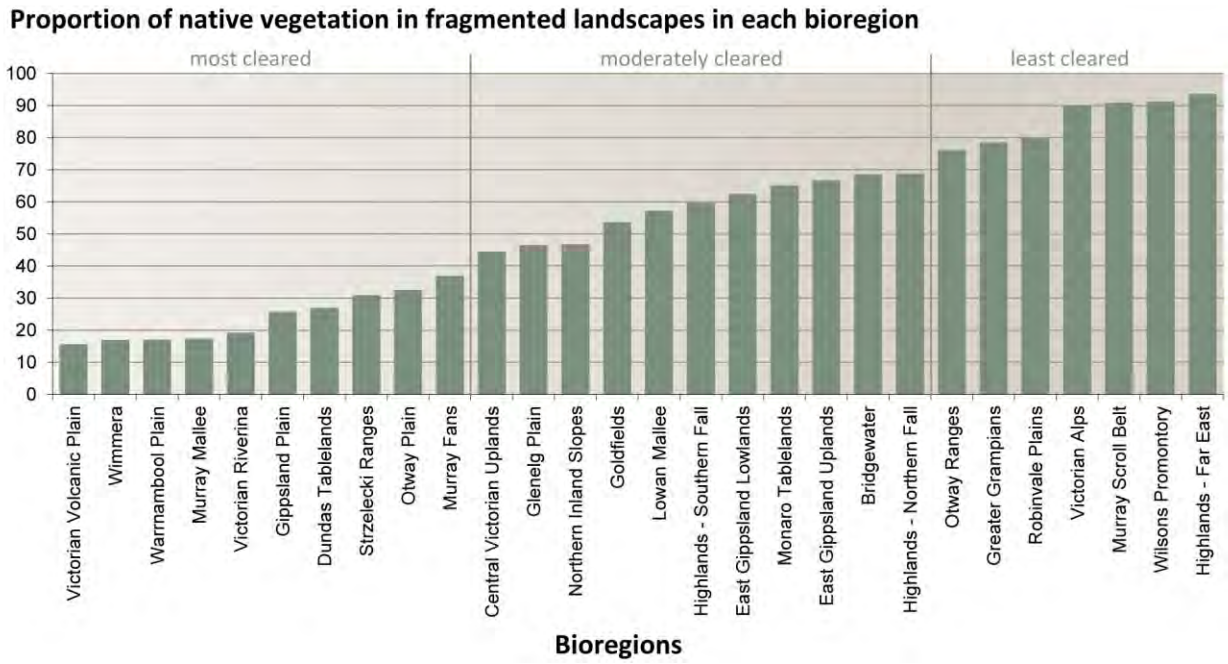
Bioregions are separated by physical characteristics such as geology, natural landforms and climate, which are correlated to ecological features, plant and animal groupings and landscape scale ecosystem processes. There are 28 bioregions in Victoria, as shown below

### Bioregions in Victoria




Source: DSE Victorian Biodiversity Strategy 2010–2015

**Bioregions and sensitivity of vegetation to disturbance**




Source: VEAC Remnant Native Vegetation Investigation Discussion Paper (2010)

## Fire management effects

Fire and fire management can have positive effects on the environment.

For example, fire applied at the appropriate frequency, intensity, season and extent can help maintain or improve plant and habitat diversity. Fire can be used to stimulate reproduction germination and flowering of native plant species, or weed regeneration in preparation for treatment with herbicide or other methods.

Inappropriate fire and fire management can cause harm to the environment.

VAGO (2021) lists bushfires or poorly planned and managed controlled burns as a threat to habitat that supports threatened species.

The table on page 18 lists potential effects on the environment from fire and fire management.

**Summary of environmental assets, effects and events**

| Environmental Asset | Effects<br>From FFG Act listed threatening process (DSE 2009d) unless marked # | Initiating event |
|---|---|---|
| Communities and species<br>Protected under treaties (JAMBA/ CAMBA)<br>Threatened under EPBC Act and FFG Act<br>Fire sensitive<br>Charismatic (eg platypus)<br>Ecological vegetation classes (EVCs)<br>– threatened<br>– fire sensitive<br>Other sites of biodiversity significance<br>Soil<br>Water<br>Air | Native vegetation degradation<br>Degradation of native riparian vegetation<br>Inappropriate fire regimes<br>Water, water body and waterway degradation<br>Alteration to natural flows<br>Increase in sediment input<br>Input of toxic substances<br>Wetland loss and degradation<br>Loss of habitat<br>Habitat fragmentation<br>Loss of coarse woody debris<br>Loss of hollow-bearing trees<br>Pest impact<br>– weed invasion<br>– pest animai<br>*Phytophthora cinnamomi*<br>Pollution of air (smoke and greenhouse gases)<br>Soil degradation<br>– chemical change<br>– erosion<br>– loss of nutrients | Fire<br>Bushfire<br>Planned fire<br>Blacking out<br>Vegetation clearance or disturbance from control lines and inappropriate rehabilitation<br>Other infrastructure, eg stream crossings<br>Chemical use<br>– retardant foam<br>– wetting agent<br>Oil/fuel spills<br>Vehicle and machine use<br>Aircraft water<br>Use of environmental water<br>Use of recycled water/salt water |

## Effects on biodiversity

The effect of fire on plants and animals generally depends on the fire or management regime and whether they are adapted to it.

Suppression and prevention efforts over the past 200 years (leading to absence of fire where ecological process require it) combined with the extensive fires of the recent decade have meant that the fire regimes in many areas of native vegetation are inappropriate for species and habitat diversity.

'Inappropriate fire regimes' and 'high frequency fire' are listed as potentially threatening processes under the *Flora and Fauna Guarantee Act 1988* (DSE 2009d).

## Flora

The effects of fire or other disturbance on flora can be predicted by considering the vital attributes of species.

DSE's *Floral Vital Attributes Database* (DSE 2009a) lists a range of characteristics for each species, including how it regenerates after fire (by seed or resprouting), time to reproductive maturity, life span of individual plants and time to extinction. This information can be used to identify the response of individual species to fire and fire management and, in particular, the frequency of disturbance.

The interval between fires or other disturbance possibly has the most significant influence on vegetation composition and structure. Plant species may become locally extinct if disturbance occurs before a plant can reproduce or after individual plants have died out (and their seed store is depleted).

The *season* in which fire management is carried out may affect the plants because of fire intensity as well as timing. Burning or slashing may inhibit flowering and seed set in the following season. Species that regenerate from short-lived seed may require a fire to occur soon after seed set. Good rain after fire can lead to prolific growth of weeds, which can smother native species. Dry conditions after fire may lead to deep-rooted resprouters dominating.

High fire intensity may scorch or kill tree crowns and trunks. It may also result in the loss of hollows and logs. However, fire also helps to develop tree hollows, which are important habitat. High-intensity fire may favour germination of plants from seed stored in the soil and with hard seed coats (eg wattles).

The risk of harm from fire to roots and tubers in the soil is considered low. For example, Coates et al (2006) concluded that because the tubers of the orchid they studied *(Prasophyllum correctum)* were more than three centimetres below the soil surface and soil heating during a fire "is negligible below the immediate surface… it is unlikely that mycorrhizal fungi (associated with the orchid's tubers) are directly affected by grass fires".

Similarly, fire is not thought to kill the water mould *Phytophthora cinnamomi*, which is considered a significant threat to biodiversity and a range of trees and crops. This disease is spread by the movement of water and soil, so fire and fire management can spread it quite readily. It is commonly found in areas of poor sub-surface drainage. Early indicators include dead or dying grass trees (*Xanthorrhoea* species).

The type of disturbance may also be important. Fire may be preferable to other fire management techniques such as slashing. For example, many plant species can only regenerate following fire and many beneficial effects such as stimulation of flowering (for example, grass trees) are not reproduced by other means. However, hand removal of shrubs may be more appropriate on smaller projects to reduce fuel hazard and to make subsequent burning safer. The Wannon case study in Step 7 is a good example.

The extent of fire and the scale and patchiness is also important. Even small unburnt patches provide important refuges for plants to recolonise burnt areas.

Having plants at different life stages (eg young, mature and old) across the landscape provides diversity of habitat that improves the capacity to recover from fire or other disturbance. DSE's report on growth stages (Cheal 2010) can be used to help identify growth stages for each ecological vegetation division (EVD).

## Fauna

The effects of fire or other disturbance on fauna can be predicted by considering changes in habitat.

MacHunter et al (2009) use four 'response curves' to describe the effects of fire on fauna species. These are shown below.

| | |
|---|---|
| **A – species quickly benefit from fire** | These are mostly species that move into the burnt area and remain until the resources that attracted them decline below a threshold level, eg some raptors. |
| **B – species show an initial decline following fire and then increase** | This is the most likely response and is expected to apply to a large number of species. |
| **C – species show a long-term decline following fire with or without a short- term increase** | This response occurs when:<br>• the shrub layer is reduced by fire, providing short-term habitat for species that feed in the open<br>• regeneration of the shrub layer then makes this habitat unsuitable for these fauna species<br>• shrubs thin out over time and these fauna species recover. |
| **D – species decline immediately post-fire and do not recover for very long periods** | Repeated burning could produce this response if the fire frequency did not allow the EVD to persist, or the fire intensity was sufficient to remove certain habitat elements that take a long time to be replaced (eg hollow-bearing trees). |

Adapted from MacHunter et al (2009)

This table shows that most fauna populations can be expected to recover from fire given sufficient time for their habitat to recover.

MacHunter et al (2009) also list attributes of key fire response species selected for several ecological vegetation divisions, including habitat types and food preferences. These can be used to determine appropriate treatments to minimise harm (see Step 5) or an appropriate fire regime (frequency, intensity, season, extent and type) to promote biodiversity (see Step 6).

Tree hollows and logs are habitat elements that are particularly vulnerable to high fire intensity and frequency because of the long recovery time.

The season of burning or fire management may have an impact on reproduction and dispersal of young, which will be vulnerable to predators. Collett and Neumann (2003) found that burning in spring resulted in no long-term effects on invertebrates found in litter. Although autumn burning resulted in changes, these may have been caused by other factors.

The extent of fire or activities such as clearance of firebreaks, burning or slashing may remove habitat and important habitat links. Small untouched patches provide important refuges for wildlife to recolonise burnt areas.

Fire is a key tool in biodiversity management. Ideally, a diverse fire regime (of varying intensities, scales, seasons and fire intervals) is needed. This makes the vegetation and the habitat it provides more diverse and more resilient to major disturbances, such as large fires or pest outbreaks. Fire can be provided by bushfire or planned fire.

## Effects on land and water

Fire may affect soil temperatures and chemistry. However, Humphreys and Craig (1981) note that papers they reviewed indicated that “quite severe fires both in terms of the energy released and its duration are required to significantly heat the column to a depth greater than 2.5cm”.

Fire and vegetation removal can change water yield in catchments significantly. Following fire, water runoff from bare and water-repellent soil increases. As plants regenerate they use more water in their active growing stages.

Fire, removal of vegetation and clearance of control lines can result in erosion and reduce the success of regeneration on the eroded site.

Soil that is erodible (eg sandy soil) or affected by salt or high acidity, or is located on steep slopes (eg greater than 10-15 degrees) is particularly vulnerable to erosion.

Water falling on burnt soil or compacted surfaces can carry soil, nutrients, ash and other debris into waterways. This can change the depth, flow rate, lighting and temperature of the habitat, which may affect its suitability for some species. It can also cause flooding in severe cases.

Hall (1994) flagged the possibility of a long-term loss of productivity in forest soils after noting a 30-fold increase in phosphorus loss after burning. An increase in phosphorus and nitrogen can also be expected in waterways after fire. This may lead to algal blooms and fish kills (Government of Victoria 2003; Pearl and Scott 2010).

Water runoff, erosion and water pollution can be expected to be less for planned fires compared with bushfire where filtering streamside vegetation is retained.

Fire suppression foam and other chemicals such as herbicides used in fire prevention can also pollute waterways (Pearl and Scott 2010).

## Effects on air quality

Small particles in smoke that lodge in the lungs may lead to a range of health effects in sensitive groups (eg people with existing heart and lung disease or asthmatics).

A major factor affecting the amount of smoke production from prescribed fires is the area alight at any one time (Tolhurst and Cheney 1999). Overall, the contribution from planned burning to particle levels is small compared with other sources. However, in some rural areas of Victoria, smoke can be quite widespread and visible, resulting in significant community concern (EPA, DNRE and CFA 2001).

In Victoria the amount of smoke from bushfires and planned burning during the peak planned burning periods is monitored by the Victorian Government and the impacts of smoke for a given area are considered when the burns are being scheduled by the fire agencies.

Fire and fire management can contribute to carbon pollution and climate change. Fire and planned burning release carbon and other greenhouse pollution to the environment and vegetation removal reduces the absorption of carbon from the atmosphere. This pollution may be wholly or partially offset by absorption of carbon by regrowing vegetation.

Australia’s carbon accounting does not include carbon pollution resulting from forest management, cropland management, grazing land management, or revegetation (Department of Climate Change and Energy Efficiency 2010). These activities include fire and fire management.

In large remote areas of the Northern Territory (NT), planned fire has been use to reduce the size and intensity of bushfires and therefore the carbon released by bushfires (DENR undated). On this basis, land managers have been able to successfully claim carbon pollution credits. However, Victorian landscapes are highly fragmented in comparison. Climate, weather patterns and fuel types are also very diverse and differ significantly from NT conditions. Carbon pollution will therefore not be considered further in this Guide.

## Fire management effects – myth or fact?

Fire management in the rural landscape is often guided by perceptions of risk including judgements on what constitutes a hazard, the level of risk that hazard poses, and how to manage that risk. This can lead to unnecessary pressure on the environment.

Common myths include:

- vegetation management alone will solve the problem
- burning is always the best way to solve the problem
- trees are the main problem
- vegetation on roadsides, waterways and rail corridors creates unacceptable risks.

There is also the perception that biodiversity conservation efforts hamper appropriate fire management. Common myths include:

- fire reduces conservation values in every instance
- biodiversity and fire risk management objectives are not reconcilable
- small blocks of bush and single trees have no conservation value.

Some points to consider are as follows.

### Vegetation management is only one of a number of treatments that may reduce fire risk

Good fire management should use a range of treatments to manage the risk to human life. These include avoiding the risk by not building in dangerous environments, leaving early when properties cannot be defended, increasing the fire resistance of buildings to improve their ability to provide shelter from a fire, as well as reducing fuel hazards.

A multi-pronged approach is more likely to succeed, particularly if one treatment fails. Undertaking alternatives (for example, building improvement) may also enable less vegetation management to be carried out, which will lessen pressure on the environment.

### Burning may not be the most appropriate treatment to reduce fire risk

The time required for fuel to return to pre-burn levels in a study conducted in the Wombat Forest (Tolhurst 1994) was:

| | |
|---|---|
| Surface fuel | 2-4 years |
| Elevated fuel | 10+ years |
| Bark fuel | 15-25 years |

This study indicates that burning will be of use in medium- term reduction of elevated and, in particular, bark fuel.

However, burning only gives short-term reduction of surface fuel. To reduce surface fuel hazard levels may mean burning more frequently than is desirable for some species, including woody shrubs and some animals. Frequent burning may be difficult because of resource constraints and the narrow window of appropriate weather conditions. Burning may also increase the germination of weed seeds or bracken, which may increase the fuel load.

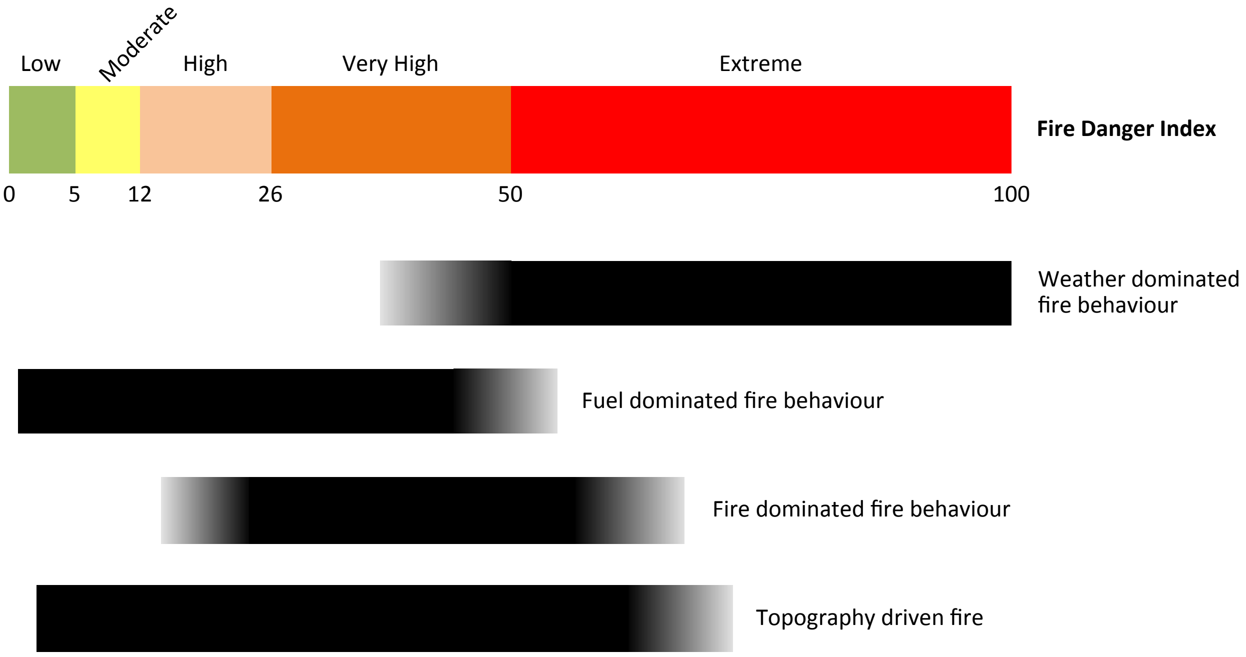
Consideration should be given to alternate vegetation treatments, including slashing of understorey, weed removal, and burning bark (using a technique known as ‘candling’). See the case studies in Step 7 for more information about bark reduction.

### Threats from trees can be managed

Continuous crown fires have been observed in conifer plantations, but will not be maintained in eucalypt forests unless there is a strong surface fire (Tolhurst and Cheney 1999).

The risk of crown fire and spotting can be significantly reduced where the overall fuel hazard including surface, near-surface, elevated and bark fuels are reduced. In addition, trees may help to reduce the impact of fire by reducing wind speed and by screening embers.

**Relationship between Forest Fire Danger Index and fire behaviour factor potential dominance**




Source: Tolhurst (2010)

## Roadside vegetation may not significantly affect fire behaviour under severe weather conditions

Roadside vegetation may be significant in affecting the safety of the community and firefighters using roads in the event of fire. CFA's *Roadside Fire Management Guidelines* (CFA 2001) provide guidance on how this risk can be managed sensitively.

However, in conditions where weather is the dominant factor in determining fire behaviour, roadside or other linear vegetation may have little impact on fire behaviour. Counsel assisting the 2009 Victorian Bushfires Royal Commission concluded from expert evidence about roadside vegetation and fire behaviour that "... in the overwhelming majority of instances, the severe weather conditions on 7 February 2009... had the effect that roadside vegetation had no significant impact on the overall spread or shape of the fires".

Counsel also concluded that the presence of fallen logs and tree debris on the sides of roads had little impact on fire behaviour.

The relationship between the Forest Fire Danger Index and the dominance of fuel and weather in determining fire behaviour is illustrated in the diagram above.

## Appropriate fire regimes can improve the condition of vegetation and the habitat it provides

Fire has been a natural part of the Australian environment for thousands of years. Plants and animals have evolved and adapted to fire. Different species have different approaches.

For example:

- Fire-adapted plants germinate and re-sprout after fire from below ground seed and bud-and-tuber banks. Fire can also increase flowering and seed availability.
- Reptiles survive in burrows, rock shelters, under bark and in unburnt hollows. Mammals flee fire initially, but quickly return to burnt areas to graze on fresh growth. Some birds use fires for hunting, by feeding on small animals fleeing the fire front. Smoke from fires can also cue reproductive behaviour in some insects (including native bees), frogs and bat species. Birds and mammals may flee the fire or survive in unburnt patches.
- Wildlife species return to burnt areas at different rates and times, depending on the availability of their habitat requirements (eg food and shelter).

Fire regimes (frequency, intensity, extent, season and type) influence what vegetation and wildlife can live in Victoria. Too much or too little fire can harm native plants and animals and over time can alter the species mix at a site (DSE 2010c).

## Even small blocks of bush have conservation value

More than one-third (38 per cent) of the total area of native vegetation in Victoria is in patches smaller than 1,000 hectares (VEAC 2010).

Suckling (1982) concluded that small blocks not only provide habitat but important links between habitat. In a study carried out in Gippsland, Suckling noted that forest remnants of 50 to 100 hectares supported half the mammal species found in the region.

# STEP 5: Identify what is needed to minimise environmental harm

**This step will help you to identify approaches that will minimise harm to environmental assets from fire management.**

Fire management activities such as burning, slashing or other treatments have the potential to harm the environment through pollution of air, water and land, damage to biodiversity, and use of water and other scarce resources.

Environmental assets may also be threatened by inappropriate fire regimes (including absence of fire). Information about this issue is included in Step 6.

## 5.1 Identify environmental assets that need to be protected

Identify the priority environmental assets to be protected from threats using the information collected in Steps 3 and 4.

## 5.2 Select the most appropriate fire management treatments

### Appropriate treatments and decision-making

The most appropriate or sustainable treatments will be those that achieve community safety objectives, while avoiding or minimising harm and maximising benefits to the environment and meeting legal and policy obligations for environmental care.

It may not always be possible or practical to meet some objectives. It is the land manager's responsibility to make fire management decisions based on the best information available, as they will be accountable.

Fire safety and conservation need not conflict. Look for 'win-win' outcomes. Both fire and other forms of vegetation management, such as clearing of over-represented shrub layers, can help achieve biodiversity as well as community safety objectives.

### Scale and location of treatments

The fire management works that you plan or implement may have effects on the environment beyond the boundaries of the land you are working on. In working through Step 5, it is important to identify any work needed to manage offsite effects.

It is also important to identify work that could be carried out elsewhere to address risks to either the community or the environment. For example, locating fire management works on land that is already cleared, or effective community engagement programs that encourage residents to manage safety risks on their own land and leave on days of higher fire risk, may reduce the need to rely so much on vegetation management on public land.

### Treatment selection and staging

Fire has several environmental advantages over other forms of fire management such as slashing or grazing. These include:

- reduced competition for light, moisture and space
- heat (plant, soil, seed, chemical and physical changes, organic matter, nitrogen, phosphorus, sulphur, pH)
- smoke and heat that may increase productive output by stimulating germination, flowering and seeding
- soil sterilisation (fungi, bacteria, invertebrates)
- soil albedo (dark ash/char), which helps to provide warmth for seed germination (Tolhurst 2010).

While fire has environmental advantages, burning may not help achieve fire safety objectives. For example, burning of long unburnt bushland may increase the surface and elevated fuel hazard, particularly in vegetation with shrubby understorey, as the native vegetation regenerates.

Conversely, intense fire may kill trees, particularly those stressed by drought. Burning may also encourage weed growth that, if left untreated, can restore pre-burn fuel hazard levels within a season.

Burning may not always be practical as many bushland areas have extreme fuel loads. If burnt, the result may be a fire that is too intense and cannot be managed safely.

Burning is only possible in short periods of the year and not all brigades have the appropriate resources, skills or confidence to burn. In these cases, a staged approach (below) may make burning safer and help achieve community safety and environmental objectives.

| | |
|---|---|
| **1** | Manual reduction of elevated fuel (shrub layer) either as a boundary break or over the whole burn site. |
| **2** | Reduce bark hazard by burning ('candling') in winter. |
| **3** | Burn in a sequence of multiple smaller burn units. |

## 5.3 Identify prescriptions to minimise environmental harm

The following strategies can be used to develop prescriptions for fire management operations and monitoring. Further sources of information are listed in Appendix 5-1.

| Assets at risk | From | Possible effects | Strategies for minimising risks to the environment | Advice |
|---|---|---|---|---|
| Air quality | Smoke | Nuisance<br>Health risk to vulnerable groups<br>Visual amenity<br>Road safety<br>Community concern | Plan burn to direct smoke away from community and roads<br>Notifications to community to enable them to avoid smoke<br>Traffic management<br>Mop up promptly | DEECA |
| Land condition | Fire breaks<br>Control lines<br>Burning<br>Other vegetation management | Soil loss<br>Water pollution<br>Regeneration impeded<br>Visual amenity | Use existing tracks, low grades<br>Make control lines and other areas of bare soil only as big as you need them<br>Align areas of bare soil along the contour<br>Stabilise control lines to prevent erosion<br>Avoid ploughing and grading of fire breaks<br>Consider alternatives to machines for control lines, eg rakehoe, candling, hoselines<br>Rehabilitate control lines when no longer required | DEECA |
| Water quality and availability | Control lines<br>Burning | Water pollution<br>Loss of environmental flows<br>Loss of habitat<br>Town water supplies | Seek advice, modify plans to avoid impact on waterways, and obtain permits<br>Avoid wetlands, waterways, water supply areas<br>Do not disturb buffer areas<br>Minimise runoff through siting/design of control lines<br>Take care to prevent entry of foam to waterways<br>Minimise water use | CMA<br>Water authority |
| Biodiversity assets<br>Significant trees/species/ communities<br>Hollow trees<br>Habitat corridors | Control lines<br>Burning<br>Other vegetation management | Loss/damage to habitat<br>Weed invasion<br>Soil erosion<br>Water pollution<br>Community concern<br>Improve habitat/biodiversity | Seek advice, modify plans as appropriate to avoid impact on significant species and habitats, and obtain permits<br>Protect significant assets/exclude from burn or other fire management<br>Carry out burning/other fire management in ecologically appropriate regime where possible | Council/ DEECA |
| Environmental and agricultural assets | Machines<br>Vehicles<br>Foot traffic<br>smoke | Regeneration of weeds<br>Spread of weeds and disease via soil water<br>Invasion of predators<br>Increase on overall fuel hazard<br>Community concern<br>Crop taint (eg grapes) | Seek advice, modify areas to avoid spread of weeds, predators and disease<br>Arrange for control of pest plants and animals before the burn or other treatment<br>Protect trees or other values by excluding them from the burn or other treatment<br>Undertake treatments in ecologically appropriate regime where possible | Landowner<br>Land manager<br>DEECA<br>AV |

# STEP 6: Identify what is needed to maintain or enhance ecosystem resilience

**This step will assist you to identify what can be done to improve biodiversity using fire and fire management.**

This step refers to tools and processes developed by the Fire Ecology Working Group. These tools are evolving and continued application helps to refine them.

It is important to test assumptions, outputs from decision-making tools, and the objectives and prescriptions that are applied, by monitoring the treatment results (see Step 8). This will not only help improve the management of the site being monitored, but also improve the tools for others.

Biodiversity risks can be reduced through, among other things, creating "a mosaic of growth stages of vegetation, across the landscape, in a suitable spatial arrangement, that meets species' needs. This appropriate mix of growth stages needs to be maintained over time. In addition, specific measures need to be in place to protect some 'at risk' species and ecosystems" (DSE 2010c).

Sources of information are listed in Appendix 6.

## 6.1 Classify the vegetation

- Identify the ecological vegetation classes (EVCs) present on site using DEECA online mapping tools eg NatureKit.
- Verify the EVCs present by checking the EVC description on the DEECA website against the species list for the site, by inspecting the site or by obtaining specialist advice.
- Ecological vegetation divisions (EVD) and ecological fire groups (EFG) are groupings of EVCs with common requirements and tolerances for fire. Identify the EVD and EFG that each EVC belongs to through DSE (2009i).

## 6.2 Determine if fire regime is appropriate to the vegetation community

- Identify the EVDs that are either fire dependent or fire influenced using the descriptions of expected fire behaviour for each EVD in Cheal 2010 (Table 2.3).
- Exclude areas where it may be inappropriate to burn (eg the vegetation is under stress from prolonged drought or insect attack or is sensitive to fire (such as rainforest) or is unsafe or impractical to burn).
- Check if you are likely to achieve your objectives through use of fire.

## 6.3 Identify indicator species

Fire response indicator species give an indication if the fire regime is appropriate to the ecological needs of flora and fauna.

Floral key fire response species include species likely to die or be significantly reduced from either very frequent or infrequent fires. Floral key fire response species are used to develop the maximum and minimum tolerable fire intervals (section 6.4) for each EVC as well as any specific habitat features that may need to be created or maintained. They are also used in monitoring to determine if ecological objectives have been met.

Floral key fire response species are derived from DEECA's Vital Attributes Database. Appendix 6 contains an explanation of the attributes described in the following paragraphs.

To identify plant species that are most sensitive to fire or disturbance that is too frequent, select plants known to be or thought to be on site that have:

- seed availability attributes G and C (reproduce only by seed, and their seed pool is exhausted with a single germination pulse after fire)
- vegetative characteristics V and Y (where sprouting vegetation is non-reproductive)
- the longest juvenile period for the EVC.

To identify plant species that are most sensitive to infrequent fire or disturbance, select plants that:

- have the shortest extinction period
- show establishment response I (unable to regenerate beneath a mature canopy) or R (require conditions to establish under mature canopy).

Faunal key fire response species occupy key habitat features that are required to cater for the wider range of species expected on site.

To identify key fire response species and their attributes, see Appendix 4 in MacHunter et al (2009).

It is unlikely that the fire response of species in a community will differ greatly from that of the key fire response species. Selection of at least five each of floral and faunal key fire response species should give a good indication of the fire response of a community.

## 6.4 Identify the interval over which fire may be needed in the vegetation community

The minimum tolerable fire interval (TFI) refers to the minimum period between fires required to allow all species within the EVD to reach reproductive maturity. This is set by the key fire response species, which take the longest time to reach maturity. These species are adversely affected when fires are too frequent.

The maximum tolerable fire interval (TFI) refers to the maximum period between fires for the EVD beyond which some species may become extinct in the area. This is set by the key fire response species with the shortest time to local extinction.

To identify the maximum and minimum tolerable fire intervals (years) for each EVD/EFG, refer to Cheal (2010). These intervals are based on the fire responses of floral key fire response species (see 6.5 below).

## 6.5 Adjust this interval for needs of indicator and significant species

Identify the vital attributes of key fire response species and significant flora and fauna (eg threatened species), including time to reproductive maturity, time to extinction and tolerance to canopy cover as set out in step 6.3.

Identify significant species that may have requirements outside the tolerable fire interval for the community.

Adjust the tolerable fire intervals if needed to accommodate key fire response species and significant species.

Alternatively, differing fire frequency needs could be met through techniques such as patchy burning.

## 6.6 Identify the 'ideal' fire frequency for the vegetation community

Identify the history of fire and other disturbance such as grazing or mechanical clearance plus the area affected, patchiness, frequency and intensity.

Identify the area occupied by different growth stages on site for each EVD/EFG using sections 3 and 4 of Cheal (2010).

Determine the area that is theoretically 'available' for burning in the longer term (from an ecological viewpoint) by identifying growth stages that have a greater proportion of the area than expected or optimum for the species being protected. At present there is no target identified for each growth stage in each EVD. This is a management decision and should be confirmed using expert advice.

Determine the area likely to be burnt within the tolerable fire interval by bushfire.

It is difficult to predict the likely occurrence of bushfire. The incidence of bushfire and landscape scale bushfire is expected to increase due to climate change (Hennessy et al 2006).

Determine the area likely to need planned fire within the tolerable fire interval by subtracting the area likely to be burnt by bushfire.

Determine the 'ideal' fire frequency for vegetation communities.

The fire cycle is the period of time within which an area equal to the total area of a vegetation type will be burnt and is defined as approximately the mid-point between the upper and lower tolerable fire interval – equal to min TFI + max TFI)/2.

A broad estimate of 'ideal' fire frequency (expressed as average area or percentage of the total area each year) at a community level can be estimated by dividing the area or percentage of the area available for burning by the fire cycle (in years).

## 6.7 Identify other issues to be considered for developing an ecological fire regime

A fire regime is described by its frequency, season, extent, intensity and type.

The ideal fire regime should consider the ideal community-level fire frequency (as set out in the preceding section), and the frequency needs of key fire response species and significant species.

The regime should also consider the needs of species that may influence the season, intensity, extent and type of fire or disturbance.

It should also consider the effect of fire management on issues identified in Step 4, including:

- drought-stressed vegetation
- weeds and predators
- changes to fuel levels from burning
- alternatives to fire for improving ecological condition and reducing fuel
- grazing and loss of regeneration
- habitat linkages for key fauna species to each growth stage of the vegetation and the important structures within it (eg hollows)
- soil, water and air quality.

## Case study: 'Ideal' fire regime

The biodiversity officer for Nillumbik Shire Council worked with contractors to develop an ecologically sustainable fire management plan for a four-hectare reserve, Professors Hill Reserve, in Warrandyte North.

### Vegetation classification and appropriateness of fire

The site supports three EVCs that are grouped into two EVDs. One EVD is shown in this example. Based on the information provided in Cheal (2010), fire has been and should be a part of these communities (subject to any species-specific requirements or site constraints such as drought).

| EVD | EVC | Fire behaviour | Fire needs |
|---|---|---|---|
| Grassy/<br>Heathy dry forest | Grassy dry Forest<br>Transitional valley<br>Grassy forest/herb-rich foothill forest | Regime of high frequency and very high intensity fires, flammable for most of the year (possibly not winter), rapid recovery post- fire, much regeneration fire-cued | The patchiness of low intensity fires is critical in maintaining sensitive species in the community, as it means that some vegetation, within the fire perimeter, escapes being burnt at such frequent intervals. |

### Interval over which fire may be needed

The minimum and maximum tolerable fire intervals predicted for grassy/heathy Dry Forest is shown in the table below. As the reserve has not been burnt for approximately 60 years, grassy/heathy dry forest is well outside the tolerable fire interval. This means that this EVD may have lost some species due to lack of fire.

| EVD name | Max. TFI (years) | Minimum TFI –high-intensity fires (years) | Minimum TFI – low-intensity patchy burns (years) |
|---|---|---|---|
| Grassy/ heathy dry forest | 45 | 15 | 10 |

### Indicator species

The key fire response species that take the longest time to reach maturity are adversely affected when fires are too frequent. Examples include Swamp Gum Eucalyptus *ovata var. ovata* (20 years to reach maturity), Blackwood Acacia melanoxylon and Prickly Currant bush *Coprosma quadrifida* (10 years to reach maturity).

Key fire response species with the shortest time to local extinction and at most risk from infrequent fires include Narrow-leaf Bitter-pea *Daviesia leptophylla* (20 years to reach possible extinction) and Common *Cassinia Cassinia aculeata* (50 years to reach possible extinction).

### Ideal fire frequency

The proportion of the grassy/heathy dry forest EVD in the different growth stages was identified using the descriptors in Cheal (2010) and is shown below. To promote vegetation diversity, it is proposed in this case that the long-term target for each age class should be evenly divided.

| Growth stage | Distinguishing features | Current age class (%) | Suggested age class target (%) |
|---|---|---|---|
| Young = Renewal + Juvenility + Adolescence | | 0 | 33 |
| Mature | | 0 | 33 |
| Waning | Long-lived ground plants maximised | 100 | 33 |
| Old = Senescence | Canopy open<br>Mature shrubs dying and shrub layer opening out | | |

This assessment shows that:

- the 'young' and 'mature' stages are under-represented in this EVD and the waning/old stages are over-represented
- in theory, 66 per cent of the current waning/old vegetation can be considered available for burning in the longer term.

In this example, it was assumed that there will be no bushfire in this reserve during the planning period, but if there is, then plans to apply fire will be adjusted.

A broad estimate of 'ideal' fire frequency (expressed as average area/year) at a community level can be estimated by dividing the area available for burning by the fire cycle.

Fire cycle = (Max + Min TFI)/2

= 55/2 = 30 years (rounded to the nearest 5) for low intensity fire

Fire frequency for this EVD (approximately)

= available area/ fire cycle

= 66%/30 years

= 2%/year or 11% every 5 years

### 'Ideal' fire regime summary

The following 'ideal' fire regime for Professors Hill Reserve was based on consideration of fire frequency needs of individual flora species, and intensity, extent, seasonal and type preferences for all environmental assets.

| Asset | Frequency | Extent | Intensity | Season | Type | Other |
|---|---|---|---|---|---|---|
| EVD – Grassy/ Heathy dry forest | Initial trial to determine response of drought-affected vegetation following survey of key fire response species (refer to C2)<br>Burn to achieve long-term aim of three growth stages (33% young, 33% mature, 33% waning/old)<br>Burn 11% of area greater than minimum TFI every five years if initial trial successful | Burn small patches (10x10m max) with long boundary along contour, in a random pattern, excluding areas to be protected | Minimise high intensity fire, which may damage drought-affected tree crowns | | | |
| Orchid species | Trial burning of small patches at a range of intervals from 3-10 years (based on Coates et al) to ascertain a frequency that will benefit orchid diversity | Burn small patches (10x10m max) in a random pattern, excluding areas to be protected | Low intensity fire considered unlikely to damage tubers (Coates et al 2006) | Minimise fire after late April (affect Greenhoods)<br>Avoid spring burns (Corybas and Pterostylis spp) | | |
| Hollow-reliant fauna | | Protect trees with hollows<br>Include larger trees in burns to encourage hollow formation | Minimise high intensity fire, which may damage hollows | Minimal disturbance required during winter/spring (nesting and dispersal) | | |
| Shrub-dependent fauna | Retain 20% of old vegetation and introduce fire or disturbance to encourage age class diversity (e.g. three growth stages) | Provide shrub links between hilltop and riparian habitat | Minimal disturbance required during winter/spring (nesting and dispersal) | | | |
| Ground cover-dependent fauna | | Protect logs<br>Ensure patchy burns to maintain areas of ground cover for recolonisation | Minimise high intensity fire, which may damage logs/ reduce patchiness | Minimal disturbance required during winter/spring (nesting and dispersal) | | |
| Aquatic fauna | | Exclude waterways and buffer from burn areas | | | | Protect waterways from runoff |
| Soil/ water quality | | Burn small patches (10x10m max) with long boundary along contour to minimise runoff/ erosion | | | Use hand removal of shrubs to minimise erosion on steep slopes | Design of control lines; manage blacking out. See 'Environmental care') |
| Air quality | | Burn small areas at a time | | | | Use wind direction and notifications to minimise impact on community |

## Plant indicator species for monitoring at Professors Hill Reserve

As shown in the following table, species that are most sensitive to fire or disturbance that is too frequent (those indicated by blue colouring) have:

- seed availability attributes G and C (reproduce only by seed, and their seed pool is exhausted with a single germination pulse after fire)
- vegetative characteristics V and Y (where sprouting vegetation is non-reproductive)
- the longest juvenile period for the EVC.

Examples include Prickly Currant bush *Coprosma quadrifida* and Common *Cassinia Cassinia* aculeata.

Species that are most sensitive to infrequent fire or disturbance (those indicated by yellow colouring):

- have the shortest extinction period
- show establishment response I (unable to regenerate beneath a mature canopy) or R (require conditions to establish under mature canopy).

Examples include Narrow-leaf Bitter-pea *Daviesia leptophylla* and Grey Parrot-pea *Dillwynia cinerascens*.

The most suitable key fire response species for monitoring are those labelled 1 (highly suitable) or 2 (suitable).

Refer to Appendix 6-2 for the legend for floral vital attributes

| Species | Seed response (PERSEED) | Vegetative response (PERVEG) | Establishment conditions (TIRMK) | Time to reproduction (JUVEN) | Extinction time (SPP LIFE) | Plant life span (INDIV LIFE) | GEOPHYTE | KFRS |
|---|---|---|---|---|---|---|---|---|
| Acacia aculeatissima | S | X | I | 5 | 100 | MP | N | 3 |
| Acacia mearnsii | S | X | I | 5 | 100 | SP | N | 1 |
| Acacia melanoxylon | S | Y | T | 10 | 100 | LP | N | 2 |
| Acacia ulicifolia | S | | I | 3 | | | | |
| Acrotriche serrulata | | Y | T | 5 | 50 | LP | N | 2 |
| Cassinia aculeata | C | X | T | 5 | 50 | MP | N | 2 |
| Cassinia longifolia | S | X | T | 5 | 50 | MP | N | 2 |
| Coprosma quadrifida | C | V | T | 10 | 100 | MP | N | 3 |
| Correa reflexa var. reflexa | | Y | F | 5 | 50 | 3 | | |
| Daviesia leptophylla | | | I | 5 | 20 | MP | | 2 |
| Dillwynia cinerascens | S | X | I | 5 | 50 | MP | N | 2 |
| Hovea heterophylla | | Y | I | 5 | 100 | | | 3 |

# STEP 7: Use this information to guide sustainable fire management

**This step provides examples of how to use the information outlined in previous steps to improve the sustainability of fire management plans, operations and advice.**

The case studies in this section all use variations of the following basic 'adaptive management' steps.


## 7.1 Develop a sustainable fire management plan for a large area

This section provides guidance about how to identify and address environmental issues when developing a fire management plan for a large area in a rural or rural-urban landscape.

Examples of plans to which this guidance could be applied include municipal fire management plans, local area fire management plans, road or rail management plans and township protection plans.

This process is built upon Steps 1 to 6.

This section contains a summary of each case study. Full case studies are in Appendix 7.

### Case Study: Municipal fire management plan in protected grasslands

Fire management in western Victoria focuses on management of fire fuels located on strategic roadsides to supplement work carried out on private property. CFA staff and brigades are working with state government and local government biodiversity staff to integrate grassland conservation management with fire safety objectives. Brigades have burnt thousands of kilometres of strategic roadsides for road authorities for many years. This work is carried out to help prevent fires from starting and spreading, to assist their control and to make roadsides safer for road users in the event of fire. It is also carried out to improve the environmental values of the grasslands.

The case study demonstrates how multiple objectives for roadside management can be achieved using a collaborative approach, and that planned burning can be used successfully to achieve fire and conservation management objectives.

### Case study: Roadside fire management plan – Hamilton Highway

The Hamilton Highway Strategic Fire Management Plan was developed to provide an integrated approach to reducing fuel and maintaining biodiversity values along this roadside. It recognises the contribution that native grasslands can make to reducing fuel loads. The plan, which was co-developed by CFA, local government and DSE, has two main objectives of maintaining the highway as a strategic fuel break and protecting the rare and threatened native grassland habitat.

The planning process used is an excellent example of the benefits of a multi-agency, multi-discipline approach to sustainable fire management.

### Case study: Roadside fire management plan – Corangamite Shire

A 30-year plan for roadside vegetation management developed by Ballarat University is used to implement the Corangamite Shire Council Municipal Fire Management Plan. The plan maps ecological vegetation classes (EVC) and uses information about EVC fire response to inform planned burning for fuel reduction. The plan also integrates targeted weed management.

The case study is an example of how information about fire needs of native vegetation type can be applied in a municipal roadside context, and reaffirms that twin objectives of weed control for fire prevention and biodiversity conservation can be achieved using a planned approach.

### Case study: NCCMA Box Ironbark Fire Management Strategy

The North Central Catchment Management Authority (NCCNA) commissioned a study to support the implementation of appropriate fire management regimes to sustain key ecological process on private land.

The case study highlights knowledge gaps in relation to ecological effect of planned fire on some vegetation types. However, sustainable interventions can be developed provided scientifically informed decision frameworks support them.

## 7.2 Develop a sustainable fire management plan for a small reserve

In 2010 Nillumbik Shire Council commissioned a plan for fire management in a municipal conservation reserve.

The planning process assessed biodiversity values, community risks, treatment options and risk to biodiversity assets from each of the treatment options. Preferred options were then mapped to management zones in a similar process used on public land by state government. Monitoring actions are included in the plan.

The case study is an example of a stepped approach to planning and monitoring as a mechanism to test outcomes against objectives.

### Case study: South Gippsland Shire Council

South Gippsland Shire Council has adopted an approach to developing environmentally sensitive fire management plans where prescription for fuel reduction work can be tailored to better address community concerns about hazards in municipal bushland reserves.

The case study provides an example of the use of management zones and staged approach to implementation. It highlights the importance of community engagement skills for understanding community values.

### Case study: Wannon Reserve

A Community Based Bushfire Management program identified high risk associated with fuels in bushland reserves embedded in the hamlet of Wannon. Residents and agencies found that the major contributor to the risk was hedge wattle, a native species that was also threatening flora and fauna values in the reserve. After initial hand removal of the threatening species (funded by agencies) community members now undertake ongoing hand weeding of new seedlings.

The case study highlights the important role of community in the planning and implementation process for fire management plans. It is also an example of the importance of mechanical treatments for fuel management in native vegetation of high conservation and social significance.

## 7.3 Develop a sustainable fire management plan for a farm or lifestyle property

### Case study: Trust for Nature covenanted property

A private landowner commissioned a fire management plan for his conservation covenanted property in the Gippsland lakes area. The plan uses small patch burns, and monitoring of key fire response species before and after the burns will inform ongoing planned burning.

The case study highlights the importance of planning for fire management on private property and how some of the tools applied to public land can also work on private land.

## 7.4 Planning and implementing burning operations for environmental outcomes

### Case study: Applying CFA standard procedures to achieve environmentally sustainable outcomes for burning operations

Many land managers, including agencies, request CFA to plan and conduct burns for them. CFA provides guidance to CFA members on planning and implementing burns in the *Chief Officer's Standard Operating Procedure SOP 9.39: Planning and Conducting a Planned Burn (CFA, 2021a).*

This case study sets out a process for implementation of a planned burn building on steps 1 to 6 of this guide.

### Case study: South Gippsland burn targets stringybarks first

This case study highlights how the brigades have reduced bark hazard on stringybarks trees to make subsequent fuel reduction burns safer in bushland reserves in residential areas.

### Case study: Fire as a management tool requires careful consideration

Senior environmental works officer Brad Tadday from Nillumbik Shire Council recounts the preparation and follow-up work required to ensure best management practices in the implementation of a prescribed burn.

### Case study: Kilsyth South spider-orchid – using fire to increase the abundance of a rare native plant in an urban reserve

A small reserve in a highly-urbanised area has very high biodiversity values with several Flora and Fauna Guarantee Act-listed species as well as an Environment Protection and Biodiversity Conservation Act-listed species: the Kilsyth South spider-orchid, *Caladenia sp. aff. venusta* Kilsyth South.

The case study shows how a long-term fire management plan was developed and implemented. Fuel reduction and biodiversity outcomes were achieved, and new orchids appeared post burn.

## 7.5 Helping others to practise sustainable fire management

CFA personnel involved in vegetation management can all help others improve their fire management practices. An important component of this is helping others carry out fire management in an environmentally sustainable way.

Changing any behaviour involves addressing and overcoming some significant barriers such as knowledge, attitude, cost, resources and time.

These case studies provide examples of the way different organisations have tackled this.

### Case study: Learning about ecologically responsible fire management

The Ecologically Responsible Roadside Management Project is a joint project between CFA, Moyne Shire Council, Department of Energy, Environment and Climate Action, Southern Grampians Shire, VicRoads and the community.

The case study shows how an approach of recognition, encouragement and support to CFA brigades and landowners can grow awareness of ecologically sustainable fire management practices.


### Case study: Hotspots fire program (NSW Nature Conservation Council)

The case study demonstrates how a community engagement approach backed by practical workshops and supported by fire safety and biodiversity conservation expertise can lead to the implementation of science-based fire management practices on private land.

The 'Hotspots' program is delivered by Nature Conservation Council of NSW in partnership with NSW Rural Fire Service, NSW Department of Environment, Climate Change and Water, the catchment management authorities, and the NSW Farmers Association.

### Case study: Fire regimes on private conservation lands

This case study summarises research that looks into the barriers to landholders taking up sustainable fire management on private conservation lands in NSW and Queensland. It also identifies key characteristics of a successful community engagement program to foster sustainable fire management practice

### Case study: Fire ecology engagement in fire-adapted landscapes (FEEFAL)

The reality of more frequent fires near human settlements, associated with the impacts of climate change, means there is an increasing need to help connect people with the natural landscapes and ecological processes that surround them.

This case study summarises how the Victorian FEEFAL program can support community engagement with sustainable fire management.

## 7.6 Assessing the level of risk to environmental assets

Risk can be defined as a combination of likelihood and consequences. Environmental risks can be grouped into two categories: risk to the environment and risk to an organisation from environment-related activities (Standards Australia/Standards New Zealand, 2006).

Risk assessment can be used to quantify:

- the priority for action to reduce the risk
- whether specific treatments will be effective in reducing risk.

### Risk from bushfire or planned fire to environmental assets

The *Victorian Fire Risk Register (VFRR) Reference Guide* (CFA 2010) outlines a process for assessing the risk to environmental assets from bushfire or planned fire that is outside the asset's preferred fire regime (or tolerable fire interval as described in Step 6 of this Guide). It is summarised below.

### Likelihood of fire affecting environmental assets

The VFRR Reference Guide (CFA 2010) bases the likelihood of fire on two factors:

- Do fires occur frequently?
- If a fire occurs, is it expected to spread and reach environmental assets?

Likelihood is categorised as unlikely, possible, likely or almost certain as shown in the following table.

| | Fires are expected to spread and reach assets | Fires are not expected to spread and reach assets |
|---|---|---|
| Fires occur frequently | Almost certain | Possible |
| Fires occur infrequently | Likely | Unlikely |

### Consequences of fire affecting environmental assets

Consequence ratings for an environmental asset can be determined by considering the vulnerability of the asset and the potential impact of the effects of a bushfire or planned fire.

### Vulnerability of an environmental asset

The vulnerability of an environmental asset to fire is based on its conservation status and the geographic extent or range of the asset.

Conservation status (endangered, vulnerable or locally important) is used to provide an indication of the relative importance of an environmental asset.

Geographic extent, or distribution, is used to provide an indication of the uniqueness or rarity of a particular environmental asset.

The *VFRR Reference Guide* (CFA 2010) proposes that the geographic extent of environmental assets be determined using the following table.

| Category | Description |
|---|---|
| Highly restricted | The species or community is found in one municipal area. |
| Restricted | The species or community is found in two to four municipal areas. |
| Widespread | The species or community is found in five or more municipal areas. |

The following table provides a means to determine the vulnerability of an environmental asset to bushfire or planned fire.

| | Conservation status | | |
|---|---|---|---|
| **Geographic extent** | **Locally important** | **Vulnerable** | **Endangered** |
| Highly restricted | Moderate | High | Very high |
| Restricted | Low | Moderate | High |
| Widespread | Low | Low | Moderate |

### Potential impact of fire

The potential impact of fire can be divided into three categories:

- Exclude fire – Fire should be excluded or conditions applied to significantly restrict the use of fire in the area such as "no burning within 100m of stream" or "no burning in spring or summer". Fire outside the tolerable fire interval (Step 6 of this Guide) for species or communities would also fall into this category.
- Restrict fire – Standard restrictions for fire may be required, such as "no fire more than once every five years".
- No conditions – It is likely that this outcome will only be applied in severely degraded native vegetation.

## Determining consequence

There are four categories for consequence: minor, moderate, major and catastrophic. The following table can be used to determine consequence ratings for environmental assets.

| | Vulnerability | | | |
|---|---|---|---|---|
| **Potential impact of fire** | **Low** | **Moderate** | **High** | **Very high** |
| Exclude fire | **Moderate** | **Major** | **Major** | **Catastrophic** |
| Restrict fire | **Minor** | **Moderate** | **Moderate** | **Major** |
| No conditions | **Minor** | **Minor** | **Minor** | **Moderate** |

## Determining risk to environmental assets

The VFRR tool calculates risk from likelihood and consequences using the following table

| | Consequences | | | |
|---|---|---|---|---|
| **Likelihood of fire** | **Minor** | **Moderate** | **Major** | **Catastrophic** |
| Almost certain | **High** | **Very High** | **Extreme** | **Extreme** |
| Likely | **Medium** | **High** | **Very high** | **Extreme** |
| Possible | **Low** | **Medium** | **High** | **Very high** |
| Unlikely | **Low** | **Low** | **Medium** | **High** |

## Risk from other fire management works to environmental assets

The approach taken in the *VFRR Reference Guide* (CFA 2010) for assessing the risk to environmental assets from bushfire or planned fire can also be used to assess the environmental consequences of other fire management works, such as the construction of firebreaks.

## Consequences of other fire management works affecting environmental assets

Consequence ratings for each environmental asset can be determined by considering the vulnerability of the asset (refer above) and the likely impact of those works.

## Likely impact of fire management works

The likely impact of fire management works (such as firebreak construction) can be divided into three categories:

- exclude works
- resite or restrict works
- standard/no conditions.

| Likely impact of fire management works | Standard/no conditions | Resite or restrict works | Exclude works |
|---|---|---|---|
| Obligations/compliance | Minor non-compliance with Flora and Fauna Guarantee, Catchment and Land Protection, or Environment Protection Acts. | Moderate non-compliance with Flora and Fauna Guarantee, Catchment and Land Protection, or Environment Protection Acts. | Significant impact to matters protected under the Environment Protection and Biodiversity Conservation and Flora and Fauna Guarantee Acts.<br>Major non-compliance with Catchment and Land Protection Act (eg significant soil erosion).<br>Major non-compliance with Environment Protection Act (significant water quality and/or air quality breach). |
| Relationships/reputation | Minor deterioration of stakeholder relationships | Moderate deterioration of stakeholder relationships. | Substantial deterioration of stakeholder relationships. |

Adapted from DSE 2010d)

The above table can be used to help determine the appropriate category

## Determining consequence

There are four categories for consequence: minor, moderate, major and catastrophic. The following table can be used to determine consequence ratings for environmental assets.

| | Vulnerability | | | |
|---|---|---|---|---|
| **Likely impact of fire mgmnt works** | **Low** | **Moderate** | **High** | **Very high** |
| Exclude works | **Moderate** | **Major** | **Major** | **Catastrophic** |
| Resite or restrict works | **Minor** | **Moderate** | **Moderate** | **Major** |
| Standard/ no conditions | **Minor** | **Minor** | **Minor** | **Moderate** |

Adapted from CFA (2010)

### Case study: Risk of inappropriate fire regime on the Eltham Copper Butterfly

This case study demonstrates a method used to asses the risk from fire regimes to the endangered Eltham Copper Butterfly found at a series of small bushland reserves in an urban area.

### Case study: Risk of inappropriate fire management on soil stability

This case study looks at the assessment of threats to soil stability from fire management regimes.

# STEP 8: Monitoring, learning and improving

Fire management activities should be monitored to determine:

- if management objectives (including environmental objectives) have been achieved
- if remedial work is needed to achieve objectives
- to learn from the experience and to adjust approaches (adaptive management).

Monitoring should:

- aim to collect only the data that is relevant to the objective and desired outcome of the work
- be simple and quick to carry out
- be carried out before and after operations
- be carried out in a consistent way to ensure that results from different operations can be compared
- contribute data to statewide databases to improve their scope and accuracy.

The following plan highlights key issues to monitor fire management plans and individual operations.

## Monitoring and remediation plan

Cawson and Muir 2008 and Treloar 2010 provide comprehensive guidance for monitoring fire intensity, flora and fauna.

It is suggested that when monitoring for ecological outcomes that simple visual inspections for key fire response species and fauna habitat be carried out.

Because of the specialist skills needed, it is suggested that detailed monitoring plots only be used where needed (for example, to calibrate KFRS surveys).

In addition, while photographic records are useful for reports and as memory aids, they should only be considered if there is an appropriate record-keeping system that will enable others to use them.

All monitoring records for burns and other fire management operations should be filed in accordance with SOP 9.39.

| Issue to be monitored | Location | Priority | Monitoring | | Remediation or follow-up | |
|---|---|---|---|---|---|---|
| | | | Component | Timing | Specifications | Timing |
| Community safety | Asset protection and strategic fire moderation zones | H | Survey for overall fuel hazard, using *Overall Fuel Hazard Guide* (DSE 2010) | Annually, preferably spring | Identify the need for changes to vegetation management to meet objectives | Following each survey |
| Biodiversity | All treatment sites | H | Survey for presence of significant environmental assets | Prior to operations<br>Post operation (2 years)<br>Post operation (5 years)<br>Post operation (10 years) | Identify the need for changes to vegetation management operations to avoid unacceptable effects on assets<br>Identify the need for changes to proposed fire regimes to meet objectives | Following each survey |
| | | H | Survey for key fire response species using:<br>*Flora monitoring protocols for planned burning: a user's guide* (Cawson and Muir 2008, pp 71-74)<br>*Protocols for monitoring fauna habitat structure Version 0.12* (Treloar 2010) | At the commencement of this plan to establish baseline<br>Prior to operations<br>Post operation (2 years)<br>Post operation (5 years)<br>Post operation (10 years) | Confirm the need for fire or appropriate ecological disturbance<br>Identify the need for changes to proposed fire regimes to meet objectives | Following each survey |
| | | H | Survey for fire severity using<br>Flora monitoring *protocols for planned burning: a user's guide* (Cawson and Muir 2008, pp 71-74) | Post operation (2-6 weeks)<br>Post operation (2 years)<br>Post operation (5 years)<br>Post operation (10 years) | Determine the response of vegetation to fire intensity<br>Identify the need for changes to Propose fire regimes (e.g. intensity and season) to meet objectives | Following each survey |
| Erosion | All treatment sites | H | Visual inspection | Immediately after operation, then quarterly | Rehabilitate temporary control lines<br>Implement sediment control to minimise risk of sedimentation of waterways | Before significant rain |
| Weeds | | H | Visual inspection | Prior to operation | Washdown all machinery before entering site and when moving between grassed and native areas | Before operation |
| | | H | Visual inspection | Immediately after operation, then quarterly | Control weeds | Before significant rain/spring growth |
| Pests/ disease | | H | Visual inspection for onset of disease | Annually | Washdown all machinery (using registered disease control product) | Before entering site |
| Ongoing relevance of plan | | H | Review for completeness and relevance, based on monitoring data collected | Annually/following any changes to statewide policy or if a new development in proximity to site | Identify the need for changes to change the plan to meet the overall objective | Annually or following changes |

## Case study: Grassy woodland monitoring project in Longwood

In early December 2021, four planned burns were conducted in the township of Longwood, Victoria. These were a continuation of the township's long history of annual burning in spring/early-summer to reduce fire risk following the tragic deaths of seven people in the 1965 grassfire.

Two of the sites burnt in December 2021 have been burnt annually and are highly diverse grassy woodlands. The other sites are degraded grassy woodlands that had not been burnt for more than 30 years.

Monitoring was conducted pre and post-burn to:

- understand the effect of frequent spring/early summer burning on species richness compared with long unburnt sites
- investigate the effect of spring/early summer burning on resprouting and seedling survival of the critically endangered Dianella tarda.

### Results and discussion

The key results were:

- sites burnt frequently in spring/early summer have a higher species richness (particularly native forb richness) compared to long unburnt sites
- all individuals of the critically endangered Dianella tarda survived the burn, either above-ground or by resprouting post-burn
- although a germination event was observed, spring to early-summer burning reduced seedling survival of the critically endangered Dianella tarda.

Sites burnt frequently in spring/early summer appear to have a higher species richness (particularly native forb richness) compared to long unburnt sites. This is compelling evidence that spring-summer burning results in higher native plant diversity compared to no burning. Frequent burning benefits native plants by reducing competition for resources and promoting germination via smoke and heat cues.

Reduced seedling survival following early summer burning of Dianella tarda suggests that spring/early summer burning may reduce recruitment and seedling establishment in the long term. For this species, burning in late-summer to autumn may be better because autumn burning will likely result in increased seedling survival – seedlings that germinate in autumn have adequate growth time before being exposed to hot and dry summer conditions which kill smaller seedlings.

The linked report details the results of pre- and post-burn ecological monitoring of the sites. Add link to report

The photo, below, shows an individual Dianella tarda not burning even when directly impacted by low intensity flame. This suggests that this species may possess some form of thermal insulation (a fire-adapted trait that prevents ignition and damage to above-ground foliage) which allows the individual to survive the fire above-ground and seed into the favourable post-fire environment.

J.Hodges

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# APPENDICES

Appendices are numbered to refer to the step in which they are first identified. For example, Appendix 3-1 is the first appendix relevant to Step 3 in the Guide.

# Appendix 1

## 1-1

### Legal and policy framework

This appendix provides a brief overview of the legal and policy framework for environmental sustainability. CFA personnel can obtain further information from the obligations register, which forms part of CFA's environmental management system. Copies of legislation can be viewed at www.austlii.edu.au

### Environment Protection and Biodiversity Conservation Act 1999

It is an offence under Part 3 to undertake actions that cause a "significant impact" on matters of national environmental significance without the prior permission of the Federal Minister for the Environment. Listed matters include threatened species or communities (s18, 18A) and migratory species (ss20, 20A). "Significant impact" is not defined in the EPBC Act, but in separate guidelines prior approval of the Minister is required before undertaking activities that may have an impact on matters of significance (Part 9).

### Flora and Fauna Guarantee Act 1988

Section 4(2) of the Flora and Fauna Guarantee Act 1988 provides that a public authority (including councils) "must be administered so as to have regard to the flora and fauna conservation and management objectives".

These are to:

(a) guarantee that all taxa of Victoria's flora and fauna other than the taxa listed in the Excluded List can survive, flourish and retain their potential for evolutionary development in the wild

(b) conserve Victoria's communities of flora and fauna

(c) manage potentially threatening processes

(d) ensure that any use of flora or fauna by humans is sustainable

(e) ensure that the genetic diversity of flora and fauna is maintained

(f) provide programs of community education, co-operative management of flora and fauna and conservation incentives

(g) encourage the conserving of flora and fauna through cooperative community endeavours.

Permits may be required (under Part 6) for removal (killing, removal or destroying) of protected flora.

## Environment Protection Act 1970

It is an offence to discharge waste into water (s38, 39), air (s40, 41), or onto land (s44) unless in accordance with declared state environment protection policy or other policy.

## Planning and Environment Act 1987

The objectives of planning in Victoria include the "protection of natural and man-made resources and the maintenance of ecological processes and genetic diversity".

The Planning and Environment Act regulates native vegetation clearance through the requirement to obtain a permit (clause 52.17 of the Victoria Planning Provisions (VPPs)).

The VPPs specify a number of circumstances in which native vegetation may be removed, destroyed or lopped for fire protection.

Changes to the VPPs made in response to recommendations of the 2009 Victorian Bushfires Royal Commission include the establishment of the primacy of life over other planning objectives.

## Land and biodiversity policy

The Land and Biodiversity White Paper (Government of Victoria 2009b) outlines new policy and legislation to achieve the following vision over the next 50 years:

"Victorians acting together to ensure that our land, water and biodiversity are healthy, resilient and productive". A key goal is to "safeguard Victoria's land, water and biodiversity by building ecosystem resilience, maintaining ecosystem services and improving connectivity".

Protecting Victoria's Environment – Biodiversity 2037 (DELWP 2017) states that:

"Climate change will increase the pressure on Victoria's biodiversity, by exacerbating existing threats and introducing new ones, such as:

- increased frequency and severity of extreme weather events
- increased frequency and intensity of bushfires and drought.

The policy commits land managers to consider the impact of climate and the uncertainty it brings. Native vegetation retention and enhancement remains a key biodiversity strategy. "At a broader level, the Victorian Government is committed to achieving an overall 'net gain', expressed as an improvement in the overall extent and condition of native habitats across terrestrial, waterway and marine environments. Not all habitats or vegetation types will need to be improved or increased in order to achieve this goal, but overall gains will need to outweigh losses."

# 1-2

## Sources of information – fire history

The following table lists additional information and sources that may help you to complete Step 1.

| Issue | Information | Source |
|---|---|---|
| Fire history | Fire ignition points and reported data, eg area burnt, type of fire | CFA Fire and Incident Reporting System (FIRS)<br>Fire history data at:<br>https://discover.data.vic.gov.au |
| | Fire ignition density spatial layer* | CFA GIS |
| | Bushfire management strategies | |
| | Story map | Bushfire Planning Storymap (ffm.vic.gov.au) |
| | eMap | Tarnook<br>ffm.vic.gov.au |
| | Fire ecology assessments for public land | Parks Victoria fire ecology planning officers |
| | Local knowledge | Land manager, newspapers, CFA brigade, historical society |
| | Field assessment | Charcoal |

*data starts at year 2000 and may be up to two years between fire events and digitisation

# Appendix 2

## 2-1

### Sources of information – community risk and treatment options

The following table lists additional information and sources that may help you to complete Step 2.

| Issue | Information | Source |
|---|---|---|
| Risk assessment and treatment | Houses and properties | Fire Ready Kit (CFA 2021b)<br>Landscaping for bushfire (CFA 2021c)<br>On the land (CFA 2019)<br>Guide to retrofit your home for better protection from bushfire (CFA and VBA) |
| | Linear corridors | Roadside fire management guidelines (CFA 2001) |
| | Landscape-scale planning, eg local area or municipal | Victorian fire risk register reference guide (CFA 2010), which includes a risk rating tool<br>Bushfire Management Strategies at https://bushfireplanning.ffm.vic.gov.au/? |
| | Potential for fire spread to assets | Fire behaviour and spread prediction tools include: municipal fire risk register, overall fuel hazard guide DSE 2010e),<br>Grassland curing guide (CFA 2001a), CSIRO fire danger and fire spread calculator, Catchpole et al (1998, heath), McCarthy and Chatto (1998, heath) and Marsden-Smedly (1995, Button Grass), Cruz et al (2015), weather records including fire danger ratings,<br>Potential fire suppression success: CFA plans including pre-incident plans and township protection plans, Overall fuel hazard guide (DSE 2010e) Table 9.1 |
| Fire consequences | Threat posed by fuel hazard | Bushfire Attack Level (BAL) or radiant heat exposure (AS 3959:2009)<br>House Ignition Likelihood Index (Tolhurst and Howlett 2003)<br>Phoenix Rapidfire<br>Spark |
| | Vulnerability (including preparation of properties and community to respond appropriately to fire) | Regional Bushfire Management Strategies.<br>Municipal fire risk registers<br>Site assessment |

# Appendix 3

## 3-1

### Sources of Information– environmental assets

The following table lists additional information and sources that may help you to complete Step 3.

Notes:

1 EPBC listed vegetation communities do not necessarily align to EVCs. Advice from DEECA biodiversity officers may be needed to align boundaries.

2 Database information may not always be current, or complete. Check with the biodiversity experts to conform database and data outport validity

| Environmental asset | Information | Source |
|---|---|---|
| All | Assistance with implementing Step 3 | DEECA, CMA, CFA, and municipal biodiversity officer, or other expert |
| | Significant assets | eMap ffm/vic.gov.au |
| Ecological vegetation classes | EVC descriptions<br>Spatial data: NatureKit<br>Vegetation quality (habitat hectares)<br>EVC benchmarks | DELWP, native vegetation webpages DSE (2004b)<br>DEECA, native vegetation web pages |
| Bioregional Conservation<br>Status of each EVC | EVC Bioregional Conservation Status | DEECA, native vegetation web pages<br>NatureKit |
| Ecological Vegetation Divisions | EVCs assigned to EVDs<br>EVD list and descriptions<br>Spatial data: ecological vegetation divisions (EVDs) | DSE 2009i<br>Cheal 2010 DSE |
| Listed communities | EPBC Act listed communities (1) | DSEWPC and DEECA |
| | FFG Act listed communities<br>Flora Information System | DEECA<br>DSEWPC and DEECA<br>DEECA |
| | Action statements and recovery plans | DEECA |
| | Research and survey papers | |
| | Expert local knowledge (including DEECA, PV, CMA, CFA and council biodiversity officers) | |

| Environmental asset | Information | Source |
|---|---|---|
| Listed species | EPBC Act listed species | DAWE and DEECA |
| | FFG Act listed species | DEECA |
| | ABC database | DEECA |
| | Flora Information System | DEECA |
| | Victorian Biodiversity Atlas | DEECA |
| | Action statements and recovery plans | DEECA |
| | Research and survey papers | |
| | Expert local knowledge (including DEECA, PV, CMA, CFA advisors and munciapl biodiversity officers) | |
| | Spatial data: threatened species, EVC BCS | NatureKit |
| Biological significance (biosites) | | DEECA |
| Wetlands | RAMSAR100 (1:100 000)<br>WETLAND_1994 (Current wetlands)<br>Wetlands DIR100 (Victorian Wetlands listed in A Directory of Important Wetlands in Australia) | DEECA |
| Reference areas | | DEECA |
| Forest management | Special protection zones (SPZs) and old growth forest locations | DEECA |
| Long-term research projects | | DEECA<br>ARI |
| Land for Wildlife properties | | DEECA |
| Trust For Nature properties | | Trust for Nature |
| Native vegetation offset sites | Ecotender, Bush Tender sites | DEECA |
| Biolinks | | DEECA |

## 3-2

## Environmental assets – conservation status assigned in the Native Vegetation Framework

Source: DSE (2002a) Native Vegetation Framework

| Conservation significance | Vegetation types | | Species | Other attributes |
|---|---|---|---|---|
| | Conservation status | Habitat score | | |
| VERY HIGH | Endangered | 0.4 – 1 | Best 50% of habitat for each threatened species in a Victorian bioregion | Sites with unique National Estate values<br>Sites identified as being of national significance as a relict, endemic, edge of range or other non-species Ramsar sites<br>East Asian-Australasian Shorebird Site Network sites, other wetlands of international significance for migratory waterbirds<br>Areas identified as providing refuges (eg during drought) for threatened species |
| HIGH | Endangered<br>Vulnerable<br>Rare | < 0.4<br>0.3 – 0.5<br>0.3 – 0.6 | The remaining 50% of habitat for threatened species in a Victorian bioregion<br>Best 50% of habitat for rare species in a Victorian bioregion | Sites with rare National Estate values<br>Sites identified as being of state significance for relictual, endemic, edge of range or other non-species values<br>Wetlands listed in A Directory of Important Wetlands in Australia<br>Wetlands of national significance for migratory waterbirds<br>Areas identified as providing refuges (eg during drought) for rare species<br>Priority areas for re-establishment of habitat for a threatened species (eg as determined in Biodiversity Action Plan) |
| | Depleted | 0.6 – 1 | | |
| MEDIUM | Vulnerable<br>Rare<br>Depleted<br>Least Concern | < 0.3<br>< 0.3<br>0.3 – 0.6<br>0.6 – 1 | The remaining 50% of habitat for rare species in a Victorian bioregion<br>Best 50% of habitat for regionally significant species | Sites with uncommon National Estate values<br>Sites identified as being of regional significance for edge of range or other non-species values<br>Wetlands of bioregional significance (based on application of National Land and Water Resources Audit criteria) |
| LOW | Depleted<br>Least Concern | < 0.3<br>< 0.6 | | |

# Appendix 4

## 4-1

### Sources of information – environmental effects

The following table lists some information and sources that may help you to complete Step 4.

| Issue | Information | Source |
|---|---|---|
| All | Assistance with implementing Step 4 | DEECA, PV, CMA, CFA, or municipal biodiversity advisor, or other expert |
| Pest plants | Prohibited Weed List<br>Invasive Plants List<br>Advisory List of environmental weeds<br>Flora Information System<br>ABC database | AV<br>AV<br>DEECA<br>DEECA<br>DEECA |
| Pest animals | Integrated Pest Management System<br>Wildlife Atlas of Victoria | AV<br>DEECA |
| Pathogens | Phytophthora cinnamomi distribution Expert advice | DEECA<br>PV |
| Assessing the level of risk | | VFRR reference guide (CFA 2010) |

# Appendix 5

## 5-1

### Sources of information – treatments

The following table lists some information and sources that may help you to complete Step 5.

| Issue | Information | Source |
|---|---|---|
| All | Assistance with implementing Step 4 | DEECA, CFA, PV, CMA or municipal biodiversity officer, or other specialist advisor |
| Works | Environmental effects and treatments | (CFA 2001) Roadside fire management guidelines<br>DSE (2011) Guideline for Fire Control Lines and Management of Hazardous Trees<br>FFMVic (2016). Suppression Methods to Minimise Environmental Impacts Work Instruction<br>CFA and DSE (2017). Working with Heavy Machinery. Bushfire Fighter, reference manual, Edition 2) |
| Pest plants and animals | ABC database<br>Pest Management Information System<br>Published weed lists, including local planning scheme policy controls and local laws<br>Catchment management strategies | DEECA<br>AV |
| Pathogens | Expert advice | DEECA<br>PV |

# Appendix 6

## 6-1

### Sources of information – biodiversity values

The following table lists some additional information and sources that may help you to complete Step 6.

| Step | Information | Source |
|---|---|---|
| All steps | Ecological fire needs for vegetation on private land (where it may have similar requirements to vegetation on public land)<br>FAME<br>Rumpff, Amos and MacHunter (2019) | PV fire ecology planning officers<br><br>ARI |
| 6.1 Vegetation classification | Ecological Vegetation Classes (EVCs) EVC descriptions<br>NatureKit | DEECA, native vegetation webpage |
| | EVCs assigned to EVDs<br>Ecological vegetation divisions (EVDs) and ecological fire groups (EFGs) Lists and descriptions | DSE 2009i<br>Cheal 2010 |
| 6.2 Appropriateness of fire | Expected fire behaviour for EVDs | Cheal 2010 (Table 2.3) |
| 6.3 Indicator species | Flora: Vital attributes database | DSE 2009f<br>(Held by ARI) |
| | Fauna: MacHunter et al (2009) | |
| 6.4 Fire intervals | Tolerable fire interval table | Cheal 2010 (Table 2.5) |
| 6.5 Needs of indicator and significant species | | Refer to Step 6.3 |
| 6.6 'Ideal' fire frequency | History of fire | Refer to Appendix 1-2 |
| | History of other disturbance, eg grazing/logging | Land manager, other local knowledge |
| | Growth stages | Cheal 2010 (sections 3 and 4) |
| | Area likely to be burnt by bushfire | Refer to Appendix 2-1 |

## 6-2

### Description of tools –biodiversity values

The following table provides additional information and sources that may help you to complete Step 6.

| Tools | About these tools | Step | Source |
|---|---|---|---|
| Ecological vegetation class (EVC) maps and descriptions | Used to classify native vegetation based on common ecological characteristics | 6.1 Vegetation classification | DEECA website, native vegetation page<br>NatureKit |
| EVC to Ecological Vegetation Division (EVD) tables | Used to group EVCs that share similar responses to fire | | DSE 2009i |
| Ecological Fire Groups (EFGs) tables | Used to subdivide EVDs to distinguish different fire response characteristics such as minimum tolerable fire intervals within the EVD | | Cheal 2010 (Table 2.5) |
| Expected fire behaviour for EVD tables | Used to describe the fire behaviour expected in each EVD | 6.2 Appropriate ness of fire | Cheal 2010 (Table 2.3) |
| Floral vital attributes database | The floral vital attributes database summarises life history characteristics of each plant species including time to reproduction and extinction. Using these attributes, those species most susceptible to variation in fire regime (key fire response species) can be used to identify fire needs and to monitor the impact of fire. This tool is under continuing development | 6.3 Indicator species | DSE 2009f |
| Faunal key fire response species (KFRS) table | The faunal key fire response species table lists species most susceptible to variation in fire regime (key fire response species) for 16 of the current 32 EVDs. This tool is under continuing development | | MacHunter et al 2009 (Appendix 4) |
| Tolerable Fire Interval Table | This table lists the minimum and maximum recommended time intervals between fire for each EVD. The time interval is derived from the vital attributes of the plan and animal species that occupy the vegetation community. The TFIs guide shows how frequent fires should be in the future to allow the persistence of all species for the defined area | 6.4 Fire Intervals | Cheal 2010 (table 2.5) |

## 6-3

### Legend for floral vital attributes table

| Major category | Category state |
|---|---|
| Seed response (PERSEED) | D – widely dispersed, seed available at all times after fire |
| | S – long-lived seed bank, seed stored, partial germination after fire |
| | G – long-lived seed bank, complete germination after fire |
| | C – short-lived seed bank, exhausted after single disturbance |
| | Z – does not re-establish from seed immediately (or soon) after fire |
| Vegetative response (PERVEG) | V – sprouters, all ages survive, but all become juvenile |
| | U – sprouters, mature remain mature, juvenile remain juvenile |
| | W – sprouters, mature remain mature, juveniles die |
| | N – sprouters, mature become juvenile, juveniles die, or there are no juveniles before the fire |
| | X – does not resprout post-fire |
| | Y – sprouters, mature become juvenile (i.e. non-reproductive), juveniles die, or there are no juveniles before the fire |
| Establishment conditions (TIRMK) | T – tolerant, can establish immediately after fire and in later years as vegetation ages, right through to mature and over-mature vegetation (assuming suitable seasonal conditions) |
| | I – intolerant, able to establish immediately after a fire (within the first two seasons and usually within the first season), but cannot continue recruitment as the vegetation ages further, unable to establish in mature vegetation |
| | R – unable to establish immediately after fire (within the first season or two), but can establish in older vegetation (including mature to over-mature vegetation), requires some environmental characteristics not found in vegetation straight after fires |
| | M – can only establish at an intermediate stage, i.e. cannot establish straight after fire or in mature to over-mature vegetation |
| | K – establish immediately after fire and also in mature to over-mature vegetation, cannot establish in intermediate-aged vegetation |

| Major category | Category state |
|---|---|
| Time to reproduction (JUVEN) | < 1 year |
| | 1-2 years |
| | 3-5 years |
| | 5-10 years |
| | 10-20 years |
| | 20-40 years |
| | > 40 years |
| Extinction time (SPP LIFE) | ≤ 3 years |
| | 3-10 years |
| | 10-20 years |
| | 20-50 years |
| | > 50 years (score as 100) |
| Plant life span (INDIV LIFE) | A = Annual |
| | ASP = annual or short-lived perennial |
| | B = Biennial |
| | SP = short-lived perennial |
| | MP = medium-lived perennial |
| | LP = long-lived perennial |
| Geophyte | Yes |
| | No |
| KFRS | 1 (Highly suitable) |
| | 2 (Suitable) |
| | 3 (Somewhat suitable) |
| | NS (Not suitable) |
| All | F – inadequate data |
| Data Source | [in parentheses – data source noted but inconsistent with other data and overruled] |
| Remarks | (in parentheses – refers to data source) |

Source DSE (2009h)

# Appendix 7

## Case Studies 7-1

**Develop a sustainable fire management plan for a large area**

### Case study: Municipal fire management plan in protected grasslands

Western Victoria contains some of the most important native grasslands in the state and approximately one-third are located on roadsides. The Natural Temperate Grassland of the Victorian Volcanic Plain is listed under the EPBC Act.

These grasslands are home to numerous endangered species, including the Striped Legless Lizard (*Delma impar*).

Fire management in western Victoria focuses on management of fire fuels located on strategic roadsides to supplement work carried out on private property. Brigades have burnt thousands of kilometres of strategic roadsides for road authorities for many years. This work is carried out to help prevent fires from starting and spreading, to assist their control and to make roadsides safer for road users in the event of fire. It is also carried out to help to improve the environmental values of the grasslands.

| | | |
|---|---|---|
| Plan | Identify the risks (fire safety and environment) | Consult with stakeholders |
| | Identify the objectives | |
| | Identify the treatments | |
| | Incorporate agreed risks, objectives and treatments in the (then) Municipal Fire Prevention Plan | |
| Do | Implement the treatments | |
| Review | Check that treatments meet objectives | |

CFA staff and brigades in south-west Victoria have been working with DEECA biodiversity staff and other partners over the past decade to integrate grasslands management for fire safety and environmental outcomes using the following process.

Their work confirmed what brigades have known for a long time.

- Fire safety and the health of grasslands are both threatened by weed invasion and lack of fire.
- Good environmental management means good fire safety (and vice versa).
- Burning can help achieve both fire safety and environmental outcomes.

Volcanic Plains Grassland showing legless lizard habitat tile

**Risks – weed invasion**

Weed invasion suppresses native vegetation species and changes the habitat for the wildlife it supports.

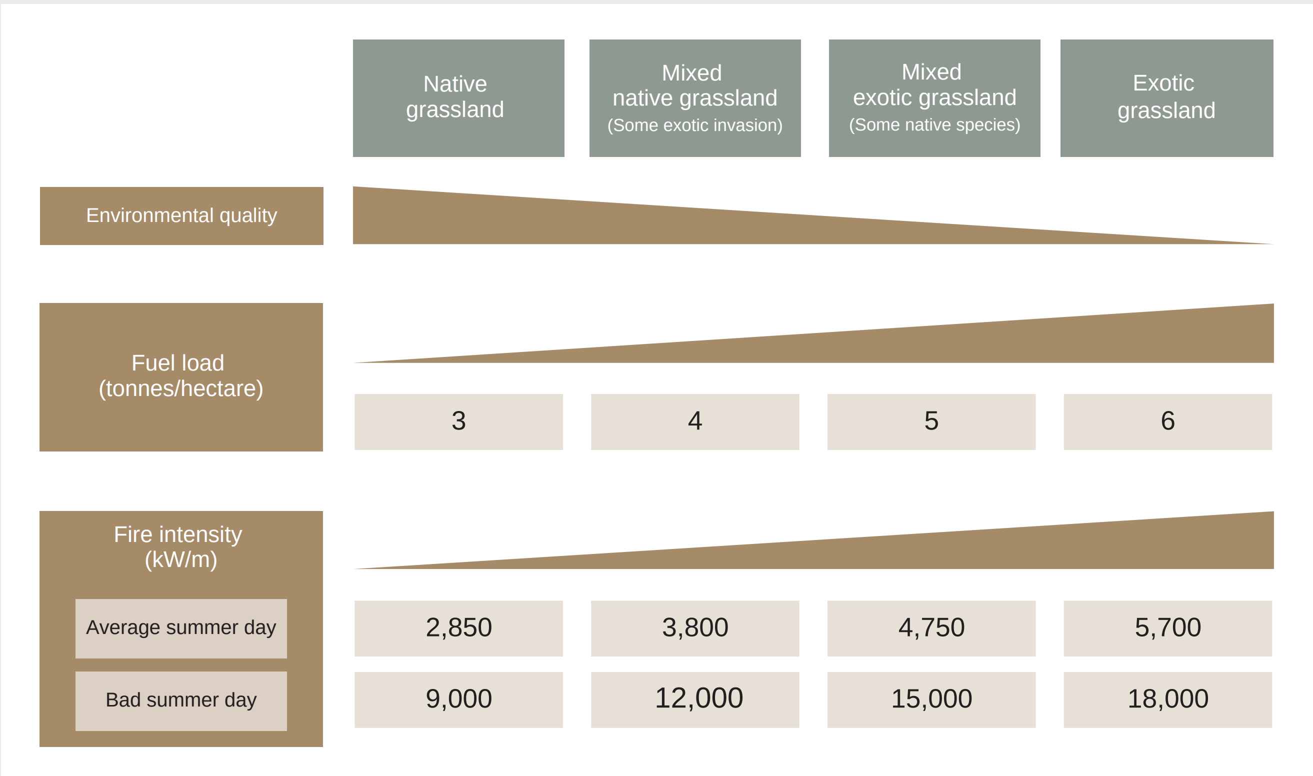
Weeds can also raise fuel levels substantially. For example, Phalaris can grow to two metres tall, with fuel levels of 29 tonnes/hectare (CFA 2004c). This contrasts with fuel levels of 6 tonnes/hectare measured for native Themeda grasslands during January in an average year.

The probability that a bushfire can be controlled decreases as fuel levels and the corresponding fire intensity increase. The probability decreases significantly at fire intensities greater than 3500 kW/metre (McCarthy and Tolhurst 1998).

As shown in the table on page 55, under average summer conditions, fires that start in exotic grasslands are unlikely to be controlled unless response is rapid. Under these conditions, there is a much higher probability that fires in native grasslands can be controlled.

**Grassland environmental quality and fire safety**

Predictions are based on average summer day (high fire danger) and bad summer day (very high to extreme fire danger) scenarios for south-west Victoria. Weather parameters are based on local knowledge. Calculations are based on CSIRO 1997a and 1997b. Pasture is 80 per cent cured (CFA 2001). Fuel loads were determined from visual assessment of 'natural pasture'.




## Fire regime

Lack of fire is one of the main factors that has contributed to the loss of native vegetation species in grasslands in the south-west and elsewhere (DSE 2003).

Without fire or other disturbance for five to 10 years, tussock grasses dominate the grassland and suppress other species, including lilies and herbs. As tussocks die off, weeds can invade the gaps.

Too-frequent fire may also cause loss of some species. For example, five-year intervals between fires may be most beneficial for Striped Legless Lizard habitat (DNRE 1993).

However, annual burning is reported to have favoured native grasslands on roadsides (DNRE 1999). Morgan and Lunt (1999) note that most species-rich grasslands in south-eastern Australia have a history of frequent burning, with intervals of one to three years between burns.

## Damage to habitat by fire management activities

Key risks include:

- damage by traffic to soil crusts
- damage by traffic to vegetation and other habitat (such as rocky Striped Legless Lizard habitat)
- preparation of breaks needed to control the burns and to protect fences.

## Objectives and treatments

Fire management is carried out in a way that minimises the impact on the environment, and where practical, improves it.

CFA vegetation management staff refer CFA burn proposals annually to CFA biodiversity advisors and to DEECA specialists for feedback on any biodiversity concerns.

DEECA also advises CFA vegetation management staff annually about road reserves where DEECA is seeking burns for ecological outcomes.

Fire management is guided by the following objectives and treatments. These are formalised as a 'Fuel break guiding principles' document (DSE 2009g).

| Objectives | Treatments (examples) |
|---|---|
| Community safety is improved | Fuels are reduced by burning grasslands located on strategic roadsides on an annual basis, unless advised otherwise by the department |
| Impact of fire management on the environment is minimised | Ploughing is restricted to control lines three metres wide (unless otherwise approved by roads authority) |
| | Broad acre ploughing is no longer used to reduce fuels |
| | Herbicide use is restricted to control lines three metres wide unless otherwise approved by roads authority, or when applied by 'wick wiper' as part of a weed control program (CFA 2004a and 2004b) |
| | Traffic through native grasslands is restricted to minimise damage to vegetation, rocky areas and soil crusts |
| | Burns are conducted in summer, rather than spring. This can help lizards to take refuge in soil cracks |
| | Foam is not used to black out burns |
| Grasslands are protected and, where practical, improved and extended | Sensitive areas are excluded from burning or other treatments |
| | High-quality native grasslands are burnt at intervals no longer than five years, or otherwise as advised by the department |
| | Exotic grasslands are replaced with native species |

**Documentation of plans**

All risks, objectives and treatments, the person (or agency) responsible, and timelines are documented in a database and mapped (CFA 2004e) and, once agreed, are included in the Municipal Fire Prevention Plan and its successor, the Municipal Fire Management Plan.

**Benefits of a cooperative and integrated approach**

This cooperative and integrated approach to fire management has led to a number of benefits for both fire safety and the environment.

- Subject to weather and resourcing, brigades burn more than 2600km of roadsides each year for land managers in accordance with approved plans.
- Working relationships between biodiversity experts including DEECA and CFA are positive and productive.
- Formal monitoring of burns by brigades has been limited. This presents an opportunity for improvement. However, a comparison of maps has identified a strong correlation between high value native grasslands and annual burning programs. This view is supported by research reported in DNRE 1999 and DSE 2003.
- The value of having an agreed approach to grassland fire management has also been demonstrated during bushfire response. The incident management team used the Southern Grampians Municipal Fire Prevention Plan to plan control lines during the 2006 Mt Lubra fires.
- The planning process for installation of 73km of containment lines was assisted by this document as key stakeholders had already agreed to relevant issues, including management of significant grasslands on roadsides. The incident action plan also included guidelines to minimise damage to the grasslands.

Native grasslands require fire treatment to maintain biodiversity

## Case study: Roadside fire management plan – Hamilton Highway

CFA, councils, VicRoads and DSE worked together to develop a roadside fire management plan for the Hamilton Highway.

The processes used to develop these roadside fire management plans broadly follow the process outlined in the case study 'Municipal fire management in protected grasslands'.

### Assets and risks

The Hamilton Highway provides a fuel break of strategic importance on the Victorian Volcanic Plains. It runs in an east-west direction and is primarily grassland, with isolated exotic plantations.

Over the past 20 years, introduced grasses including Phalaris have invaded native grasslands on the roadside and intensive cropping has replaced grazing on private property, resulting in a much higher fuel load and spotting potential. With higher fuel loads, increased traffic volumes and reduced volunteer availability, the roadsides are now more challenging to burn.

VicRoads and DSE carried out a vegetation assessment on the Hamilton Highway roadside, identifying several significant native grasslands. These have been classified and mapped as high, medium and low conservation value.

| Value | Criteria |
|---|---|
| High | Relatively intact native vegetation<br>Minimal weed invasion<br>May contain good wildlife habitat |
| Medium | Modified native vegetation<br>Some weed invasion and loss of some understorey |
| Low | Roadsides with little or no native vegetation remaining |

### Objectives

The Hamilton Highway Strategic Fire Management Plan was developed to provide an integrated approach to reducing fuel and maintaining biodiversity values along this roadside. It recognises the contribution that native grasslands can make to reducing fuel loads.

The objectives of the plan are to:

- maintain the Hamilton Highway between Cressy and Darlington as a strategic fire break
- protect the remnant native grasslands and if possible re-establish native grassland areas along this section of the highway
- maintain support and funding through partners
- maintain and support the integrated approach by all agencies for roadside fire management
- use fire as a tool to manage native vegetation and biodiversity conservation values as far as practicable.

**Strategies**

The plan identifies several strategies to deal with the identified risks. These include:

- burning native grasslands (high and medium conservation value) in late summer/early autumn (after seed fall) every three to fivve years to maintain species diversity. Where these areas are threatened by exotic grasses, they are to be burnt before seed fall from exotic grass
- slashing native grasslands (high and medium conservation value) in late summer/early autumn (after seed fall). Where exotic grass has invaded, these areas are to be slashed in early spring at a height above the native grass
- targeted spraying of Phalaris and other weeds in accordance with CFA guidelines to achieve fire protection and environmental benefits
- trialling the control of introduced grasses and revegetation with native grasses
- spraying weed-infested areas around waterways only with 'frog-friendly' chemicals
- reducing weed spread through equipment washdowns and grading or slashing well before or after seed fall
- preparation of fuel breaks in accordance with guidelines, 'Management of fuel breaks on medium and high conservation roadsides' (DSE 2009g)
- stakeholder education in partnership with groups such as LandCare.

**Brigade work plans**

The plan proposes that individual works plans be developed for each brigade area and incorporated in the Municipal Fire Prevention Plan. The works plans will enable brigades to carry out appropriate works in the defined areas with minimal requirement for further consultation.

Works plans are to include:

- an A3 laminated aerial photograph of the brigade area, with all native grassland communities identified by colour coding
- preferred treatment options for high/medium and low sites of conservation value
- traffic management plans.

**Monitoring and review**

The success of the plan will be monitored to ensure that it:

- is being implemented by the responsible land managers and associated agencies
- is effective in reducing the identified risks
- remains relevant over time.

The plan states that "success will be assessed through reports to the coordinating committee at regular identified intervals.

## Case study: Roadside fire management plan – Corangamite Shire

This 30-year plan (University of Ballarat et al 2009) was developed following interest from Cobden and Timboon brigades to reduce fuel loads on strategic fire management roads. It implements an action in the Corangamite Municipal Fire Prevention Plan.

The aim of the plan is to provide on selected strategic fire management roads:

- relatively safe corridors for passage of traffic
- protection and enhancement of native vegetation.

Recommendations were developed using the following process.

- Databases were searched for significant species likely to found on the roadsides.
- Conservation value, fuel hazard and location of assets was assessed by detailed field survey and mapped. All field data is stored in the council's roadside management database.
- Fire effects were considered by reviewing the effects of a burn carried out in 2006.
- Fire regimes (fire frequency, intensity, extent, season and type) were developed based on ecological vegetation classes (EVCs), conservation value, weed status and overall fuel hazard of the roadside.

EVCs within the roadsides were categorised according to their dependence on fire based on guidelines provided by Kennedy and Jamieson (2007) and unpublished data provided by Parks Victoria for the nearby Otways region.

Three kilometres of roadsides supporting lowland forest were categorised as 'fire dependent'. The plan considered that this EVC required fire for regeneration and to maintain biodiversity approximately every 30 years.

Most of the roadside vegetation was categorised as 'fire influenced' or 'fire sensitive'. The plan recommends avoiding burning in fire-sensitive EVCs, as these contain species that are not adapted to frequent fire.

The plan recommends burning 'with caution' in fire-influenced EVCs at a frequency of no less than every 20 years. The plan gives priority to burning segments of low and medium conservation value in fire-influenced EVCs that have high fuel loads and abundant weeds. Priority is not given to burning in these EVCs where conservation value is 'high' as "no specific species requirements have been identified that require burning in the foreseeable future", and because of the risk of fire stimulating regeneration of weeds.

Much of the fuel load along the roadsides considered in this plan is created by weeds such as blackberry, Phalaris and Austral bracken. The plan notes that planned burning may temporarily reduce fuel load, but fuel loads will rapidly increase following fire due to rapid regeneration of these species.

To deal with this issue, this plan integrates weed management in the fire management program.

The burning prescriptions aim to reduce the fire risk across the entire road. While some sections of the roadsides may remain unburnt for long periods of time, targeted weed control will be carried out on all segments.

The plan recommends regular monitoring of conservation condition using habitat hectare scores (DSE 2004b), species abundance (rather than key fire response species) and overall fuel hazard to assess the impact of prescribed burns on the fuel load and biodiversity and to determine the need for further burning.

Exotic grass can provide a greater fire threat than native species

## Case study: NCCMA Box Ironbark Fire Management Strategy

Box ironbark ecosystems cover a large proportion of Victoria. They comprise approximately 250,000 hectares of predominantly dry sclerophyll eucalypt forest inland of the Great Dividing Range in northern Victoria.

The North Central CMA (NCCMA), as part of its regional catchment strategy and native vegetation plan, identified the need to "Develop and implement appropriate fire management regimes to sustain ecological processes in key private land vegetation remnants". NCCMA commissioned the Arthur Rylah Institute to implement this project.

Phase 1 of the project collated knowledge of fire responses (based on floral vital attributes) and practices through a literature review and a science-based workshop (Tolsma, Cheal and Brown 2007a).

Phase 2 (management strategy) provided a decision framework to enable the requirement for ecological burning to be determined on a site-by-site basis (Tolsma, Cheal and Brown 2007b).

**Fire needs**

The authors noted that Box ironbark forests had not been shaped by regular fire to the extent that many other vegetation types had been, and that many plant species did not need fire to persist.

They concluded that most species should persist provided the inter-fire period allows all species to reach reproductive maturity (10-20 years), and will continue to be present even when the interval between fires exceeds 50 years.

Some flora and fauna species are particularly sensitive to fire, such as the ground-foraging Brown treecreeper. It would be affected in the short-medium term after a fire by the reduction of litter. Daphne Heath may face local extinction if burnt twice within five to 10 years. However, occasional fire may benefit some shrub species and maintain vegetation complexity.

Despite fragmentation of the forest since European settlement, which may create a barrier to recolonisation after fire, the authors concluded that "fire remains a normal habitat process that in some instances may be necessary for the maintenance of species".

**Fire management strategy**

A decision framework was developed using the steps outlined in the Guidelines for Ecological Burning (DSE 2004a) as a basis. Key questions in the decision framework include:

- is the time since fire outside the tolerable fire intervals?
- will fauna species be negatively affected by fire?
- can impact be acceptably reduced?
- will habitat become unsuitable if not burnt?

The authors identify several barriers to effectively implementing the fire management strategy in the longer term. These are:

- a lack of fire-age data hinders the planning of broad-scale (mosaic) ecological burning on private land across the CMA
- the relationships between fauna diversity and fire regimes are largely unknown in this area. To deal with this issue until more is known, this strategy uses vegetation composition and fire history to identify possible burns, with key fauna species playing a 'veto' role where necessary
- the relatively infrequent need for fire (at around 50-year intervals) and discontinuity in private land ownership are likely to impose practical limits on what can be achieved.
- the lack of knowledge on the responses of specific Box ironbark flora and fauna species and communities to fire and patterns of burning that might maximise total biodiversity.

However, the authors note that "appropriate use of fire in Box- ironbark remnants, based on robust scientific data, should ensure that plant structural and floristic diversity can be maintained without disadvantaging fauna species in the long term"

## Case Studies 7.2

**Develop a sustainable fire management plan for a small reserve**

### Case study: Nillumbik Shire Council

Nillumbik Shire Council's Fire Management Plan for Professors Hill Reserve (obliqua pty ltd and Oates Environmental Consulting Pty Ltd 2010) is built on Steps 1 to 6 outlined in this Guide.

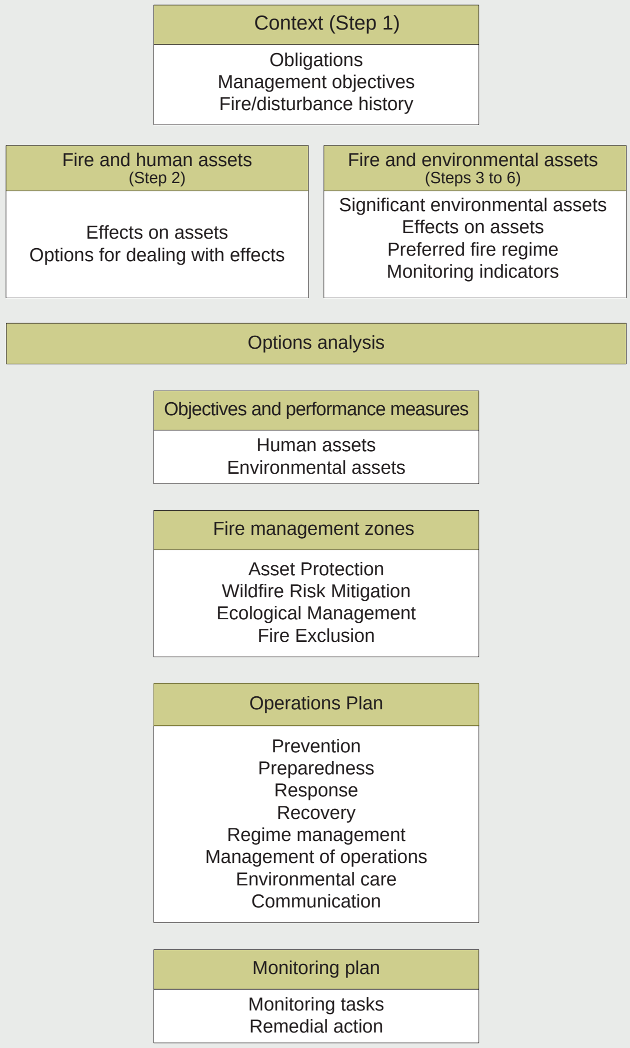
Council biodiversity officer Brad TaddAy explains. "This reserve is regionally important for conservation, particularly for its orchid flora, which is representative of what was once found over the whole region but is now confined to small remnant areas like this reserve. Two orchids found in the reserve are important at a state level. We want to make sure that we meet not only our obligations for community safety but also those for conservation."

Council's plan was developed using the steps shown opposite.

The plan identifies two options for protecting adjacent houses from the potential effects of a bushfire burning in the reserve, which has 'extreme' overall fuel hazard over much of its area.

Option 1 involves managing an asset protection zone for a depth of 60 metres along the northern boundary to an overall fuel hazard of 'moderate'. Option 2 reduces the depth of this asset protection zone to 25 metres, providing the remainder of the reserve can be managed to an overall fuel hazard of 'high'.

Over mature vegetation with high fuel hazard




**Fire management planning process**

To help Council to decide which option to select, the plan contains an options analysis. This assesses the environmental benefits and harm and community safety benefits associated with each option by comparing the proposed treatments with the preferred fire regime table developed in Step 6.

In summary, both options are considered to have potential to improve the environmental condition of the reserve as well as community safety by reducing dense stringybark saplings to environmentally preferred levels and reduction of over- mature shrubs.

Option 2 has the potential for lower environmental harm as there will be less need for soil disturbance on the steep slopes to create control lines for burning, although this impact can be managed through good design.

It is unclear if burning, which may be needed to manage surface fuel levels in the asset protection zone, will be beneficial or harmful to drought-affected orchids and other perennial plants. Therefore, the smaller asset protection zone is preferred until trials can establish the frequency of burning preferred by the orchids.

The plan uses the information developed in Steps 1 to 6 to set objectives and performance measures that are 'MAD' – measurable, achievable and desirable. It is proposed that progress towards and/or achievement of the objectives is audited every two years by an appropriately qualified external auditor.

The reserve has been divided into zones based on the zoning system described in *Code of bushfire management for public land* (DSE 2012).

The operations plan sets out all activities proposed to be carried out by Council to achieve the objectives in each zone.

**Proposed objectives and performance measures**

| Objective | Measures | Target |
|---|---|---|
| Vegetation in the reserve is managed to ensure that flames or radiant heat in excess of 'low' do not affect adjacent houses | Number of houses exposed to radiant heat in excess of 'low' from vegetation in the reserve | Nil by 2012 |
| Age classes of vegetation in the reserve outside of asset protection zones are within 25% of the ecologically preferred age class distribution for each EVC | Per cent variation between actual and target age classes | 25% by 2060 |
| No flora or fauna species found in the reserve are lost through fire management | Number of species compared with 2010 baseline. | No difference due to fire management |
| Soil loss and air and water pollution resulting from fire management meet best-practice standards as set out in this fire management plan | Number of operations compliant with best-practice standards | 100% compliance for audited operations |

**Examples of proposed operations plan**

| | Proposed operations | Timing |
|---|---|---|
| Asset protection zone<br>Target overall fuel hazard = moderate | Remove over-mature shrubs, retaining up to 5% in isolated clumps. Slash or cut regenerating shrubs so that elevated fuel does not exceed 'moderate' | Pre summer |
| | Thin and/or burn stringybarks to reduce bark hazard to 'high' in accordance with draft prescriptions | Winter |
| | Hand slash or patch burn small areas (10m by 10m) if needed to reduce surface and near-surface fuel to achieve overall fuel hazard target. Carry out burns in accordance with in draft prescriptions | Late spring preferred |
| Survey key fire response species | Survey for key fire response species that indicate lack of fire using the method outlined for KFRS (refer to monitoring plan) | Spring prior to veg treatment |
| Trial burns | Burn trial areas (4x10m by 10m) in accordance with in draft prescriptions to determine vegetation and fuel response | Autumn and spring |
| | Fence two burnt areas to exclude grazing and monitor trial as set out in monitoring plan | ASAP |
| Ecological Management zone (option 1 only) | Grassy dry forest: burn 3% every year in small patches (10m by 10m) following successful trials | Autumn and spring |
| Community development | Partner with CFA to ensure that adjacent residents have prepared and are ready to implement their own fire management plans that identify triggers for leaving early on days of risky conditions. Fuel management to similar standards to that proposed for the reserve and improvement to buildings to help protect against ember attack | ASAP |
| | Partner with CFA, DEECA, Parks Victoria and other experts to conduct activities aimed at increasing the understanding of Council, service providers and the community about ecological fire needs | 2011 |

- Prior to any works being carried out, an assessment for significant species is to be conducted and operations plans modified to protect these species where practical.
- All works will be supervised by a person or pe with skills in environmental management and assessment of overall fuel hazard.
- All burning will be supervised by a person with the appropriate CFA Complexity Rating (in this case CR2).
- All areas proposed for treatment and sensitive areas, including monitoring sites, slopes over 10 degrees and waterway buffers, will be marked and discussed on site with the appointed contractor.
- All treatment areas will be monitored to ensure compliance with prescriptions contained in this plan.

**Proposed environmental prescriptions**

| Asset | Management strategy |
|---|---|
| Significant species | Survey prior to treatment and adjust treatments if required |
| Orchid and lily species | Ensure vegetation reduction operations do not have an impact on tubers in the soil |
| Fauna habitat | Protect logs and trees with hollows from planned burns/bushfire<br>Include larger trees in burns to encourage hollow formation<br>Avoid damage to trees suffering from drought stress |
| Soil/water quality | Minimise track construction or widening. Consider use of slashing and water to supplement the minimum mineral earth breaks required. Use leafblowers and rakes to construct mineral earth breaks. Avoid cutting into soil surface. Divert runoff from tracks/slopes away from gullies<br>Rehabilitate all temporary tracks as soon as practicable after use by blocking access, diverting drainage to minimise downhill water flow and creating conditions suitable for revegetation<br>Design thinning or burning operations to minimise disturbance to soil cover and to minimise overland flows of water, especially on slopes greater than 20 degrees<br>Blacking out of burns: minimise water use. Avoid using water to disturb soil surface. Design hose lays to minimise dragging of hose and damage to soil crust and vegetation |
| Disease and weeds | Apply appropriate controls including vehicle washdowns and quarantine of infected areas |
| Air quality | Plan all burns to minimise smoke impact on adjacent community. Burn small areas at a time, plan to burn with a wind direction that minimises smoke impact, and provide notifications to enable residents to avoid smoke |
| Amenity and habitat | Maintain gates on all management roads |

The operations plan also lists measures required to minimise environmental harm including those in the table above. These are summarised from the ‘ideal’ fire regime.

The monitoring plan identifies tasks to be carried out before and after every operation to ensure that objectives are met. It also sets out action to be taken to address any issues identified through monitoring.

## Case study: South Gippsland Shire Council

South Gippsland Shire Council recently adopted an approach to develop environmentally sensitive fire management plans where prescription for fuel reduction work can be tailored to better address community concerns about hazards in municipal bushland reserves.

One reserve presented particular challenges. Baths Road Reserve, Mirboo North, is surrounded by housing on all four sides. The 13-hectare reserve is part of a complex of native vegetation in the region, but is poorly connected to larger blocks. The overall fuel hazard was assessed as 'extreme' over most of the reserve, which supports two EVCs rated as 'Vulnerable' and two rated as 'Endangered' in the Strzelecki Ranges Bioregion.

Analysis of community safety needs indicated that a large proportion of the reserve would need be treated to reduce the potential for radiant heat to 'low'.

Feedback from community consultation did not support extensive clearance of vegetation. Concern was expressed about the loss of the character of the bushland as well as environmental values that this would cause. As a result, Council has limited mechanical clearance of understorey to a depth predicted to minimise flame impact on houses.

The remainder of the asset protection zones are scheduled for burning. These areas are close to the maximum tolerable fire interval for the EVCs and so the first burns on each site are expected to improve species diversity. Further consideration will be needed as to whether it is appropriate to re-burn these areas once they exceed the overall fuel hazard target.

CFA brigades have implemented the burn plans for Baths Road Reserve commencing with candling of the messmate trees.

| Issue to be monitored | Location | Monitoring | |
|---|---|---|---|
| | | Specifications | Timing |
| Need for fire | Whole reserve | Survey for key fire response species that indicate lack of fire using the method outlined below for KFRS. | ASAP |
| Appropriateness of burning drought-affected vegetation/ significant sites | Trial plots to be selected | Monitor areas that are burnt and unburnt, fenced, and to compare the differences in vegetation structure, plant diversity using methods and assessment templates provided in the Flora monitoring protocols for planned burning: a user's guide (Cawson and Muir 2008). | Prior to burning Post burn (2 years) Post burn (5 years) Post burn (10 years) |
| Community safety outcomes | All sites | Visual inspection to determine overall fuel hazard, using the DSE Overall Fuel Hazard Guide. | Annually, preferably during spring |
| Biodiversity outcomes | All sites | Survey for threatened species. | Prior to treatments |
| | All ecological burn sites | Survey for fauna as set out in Treloar 2010. | As for plant surveys |
| | | Carry out a fire severity assessment using the method and assessment template provided in the Flora monitoring protocols for planned burning: a user's guide (Cawson and Muir 2008, pp 71-74). | Post burn (2-6 weeks) |
| | | Determine the change in presence and abundance of key fire response species and establish a permanent photo point after a burn using the methods and assessment template provided in the Flora monitoring protocols for planned burning: a user's guide (Cawson and Muir 2008, pp 52-54 and 59). | Prior to burning Post burn (2 years) Post burn (5 years) Post burn (10 years) |
| Erosion | All treatment sites | Visual inspection | Immediately after operation, then quarterly |
| Weeds | | Visual inspection | Prior to operation |
| | | Visual inspection | Immediately after operation, then quarterly |
| Pests/disease | | Visual inspection for onset of disease | Annually |
| Relevance of plan | | Review for completeness and relevance, based on monitoring data collected. | Annually/following any changes to state policy/if new house is built within 150 metres of the reserve. |

## Case Study: Wannon reserve

Increasing abundance of Hedge Wattle (Acacia paradoxa) at two bushland reserves within the hamlet of Wannon (12km west of Hamilton) was identified during a Community-Based Bushfire Management (CBBM) program as the highest significant contributor to bushfire risk.

On-site meetings with residents, conservationists and agency staff agreed that significant native flora values within the reserves (over 240 native species within the 270 hectares) were also threatened by the encroachment of Hedge Wattle. It was agreed by all parties that a vegetation management plan be prepared detailing removal of Hedge Wattle to estimated pre-European levels based on ecological vegetation class (EVC) mapping.

The agreed solution was to remove Hedge Wattle manually by cutting the large bushes up with chainsaws, then carrying the offcuts to piles in accessible clearings. The piles were then mechanically mulched, with the mulch being used by local government in community landscaping projects.

The vegetation management plan demonstrating how the removal of Hedge Wattle would protect and improve the significant woodland flora EVCs was submitted and approved by DELWP prior to works beginning.

CFA funded manual Hedge Wattle works for three years at Wannon, with supporting contributions from Southern Grampians Shire. Photo points were established to monitor before and after changes in the treated landscape. The local Wannon Residents Group now undertakes annual hand removal of Hedge Wattle seedlings growing in the treatment locations.

Before the treatment.

After the treatment

## Case Studies 7.3

**Develop a sustainable fire management plan for a farm or lifestyle property**

### Case study: Trust for Nature covenanted property

Richard McCutcheon is a part-time farmer at Meerlieu on the Gippsland Lakes. His 600-acre property 'Woodfield' has eight bush blocks, the largest being 14 hectares. Richard has covenanted his bushland with Trust for Nature and has fenced it to exclude grazing by cattle.

The largest bush block is located at the northern end of the property and has been assessed as unlikely to pose a risk to neighbouring houses in the event of fire. It supports heathy woodland (EVC 48, which is bioregionally of 'Least Concern') on the upper slopes. The lower slopes support Damp Sands Herb-rich Woodland (EVC 3, which is rated as 'Vulnerable'). There has been extensive dieback of Saw Banksia on the block, although this appears to be regenerating well. There is evidence of fire on this block in the past. Although the date of previous burning has not yet been determined, the vegetation appears to be in the 'mature' to 'old' phase.

A site assessment confirmed that there is an under-representation of younger and middle age-classes in the shrub and ground layer, although the overstorey dominated by Saw Banksia Banksia serrata seems to be regenerating adequately. Due to the long period since the last fire there has been a build-up of Saw Banksia leaf litter, resulting in a lower diversity of smaller shrubs and herbs in the ground layer. This is also accentuated by dense bracken in some areas and the ground layer often being dominated by Spiny Mat-rush Lomandra longifolia.

The fire management plan (obliqua pty ltd and Oates Environmental Consulting Pty Ltd 2009), which was prepared using Steps 1 to 6 outlined in this Guide, concluded that "patchy, low intensity burning in both the Damp Sands Herb- rich Woodland and Heathy Woodland EVCs could reduce the amount of leaf litter and promote the growth and diversity of sub-shrubs, herbs and native grasses. This could also benefit the control of weedy grasses that are in greater numbers around the edge of the block, adjacent to the pasture".

Richard is a staunch conservationist, coming from a family that has been active in conservation in Victoria for many years. However, he was reluctant to contemplate burning and as he thought it would, "interfere in the natural processes" and "blacken that beautiful bush".

However, over the past few months his attitude has changed and he is now more receptive to the idea of trialling some small burns aimed at opening up the ground layer and regenerating other species.

"I have spent a lot of time walking in an area affected by the February 2009 bushfires at St Andrews. While this is a different forest type to the vegetation on my farm, I have seen the black landscape green up and countless different wildflowers and other small plants regenerate. I guess I now appreciate how well the bush does come back after fire."

| Species | EVC | Seed availability | Vegetative reproduction | Establishment conditions | Time to reproductive maturity | Extinction time | KFRS |
|---|---|---|---|---|---|---|---|
| Acacia genistifolia | 3 | S | | I | 5 | 50 | 2 |
| Acacia longifolia s.l. | 3/48 | S | X | I | 5 | 50 | 1 |
| Acacia mearnsii | 3 | S | X | I | 5 | 100 | 1 |
| Acacia oxycedrus | 48 | S | Y | I | 5 | 50 | 2 |
| Banksia marginata | 48 | G | Y / X | T / I | 10 | 100 | 1 |
| Banksia serrata | 3/48 | | | I | 5 | 100 | 1 |
| Bossiaea cinerea | 48 | S | Y | I | 5 | 20 | 2 |
| Brachyloma daphnoides | 48 | G | W | T | 10 | 100 | 1 |
| Desmodium varians | 3 | S | W | I | 2 | 20 | 2 |

The fire management plan for Richard's property proposes that three to four small patches (10 by 10m in size) be burnt under mild conditions (mid winter for this vegetation) and monitored before and after to determine the effect on vegetation using the table reproduced in Step 8 of this document as a guide.

The fire management plan identifies floral key fire response species to be monitored before and after burning. Species marked in blue are likely to be the best indicators for fire or disturbance that is too frequent. Species marked in yellow are likely to be the best indicators for fire or disturbance that is not frequent enough. Monitoring will record the presence or absence of these species on plots spaced at approximately 20-metre intervals over the block.

## Case Studies 7.4

### Planning and implementing burning operations for environmental outcomes

Many land managers, including agencies, request CFA to plan and conduct burns for them. CFA provides guidance to CFA members on planning and implementing burns in the following Chief Officer's *Standard Operating Procedure SOP 9.39: Planning and Conducting a Planned Burn* (CFA, 2021a)

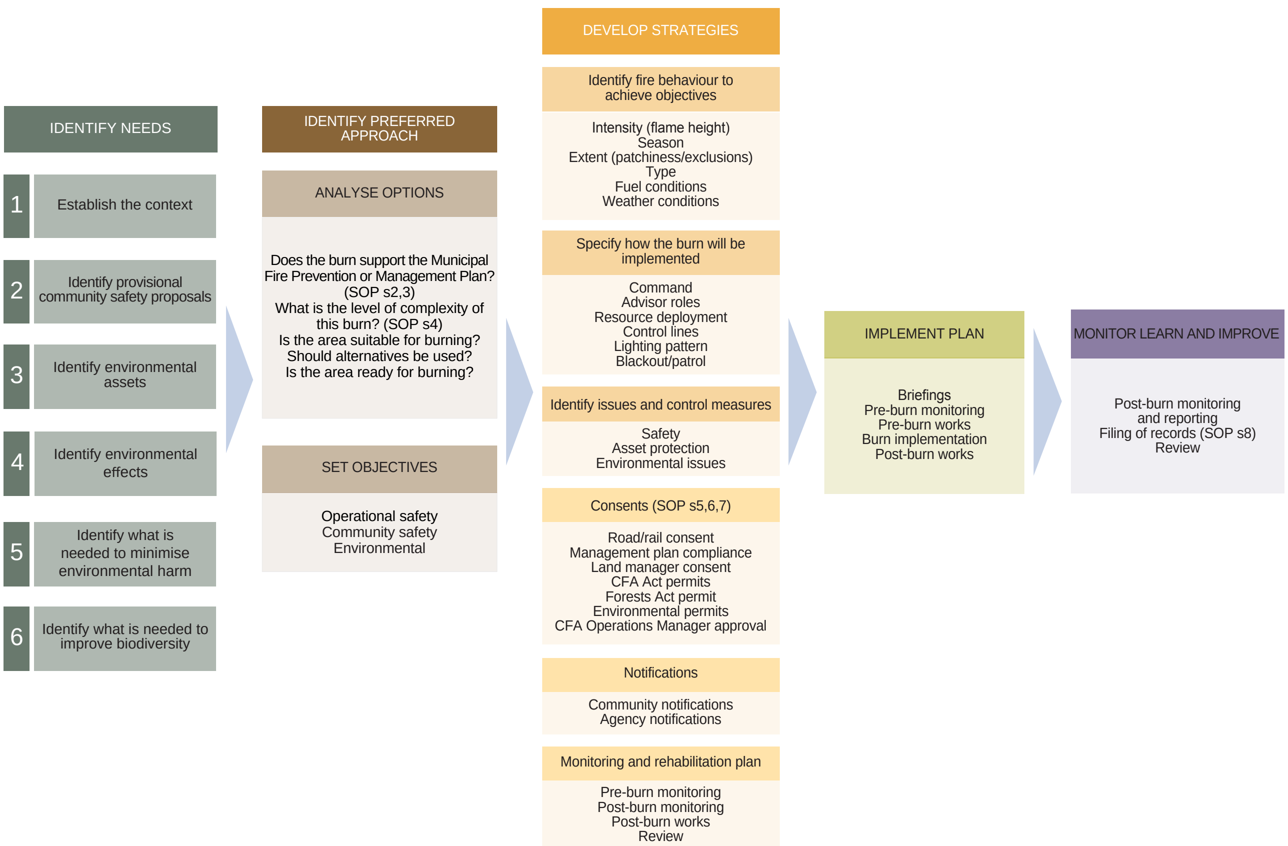
As outlined in the introduction to this Guide, these SOPs provide broad direction on environmental management requirements.

This section of the Guide provides more detailed guidance about how to identify and address environmental issues when planning and implementing a burn based on this SOP.

This process is built on Steps 1 to 6 already outlined. Steps 1 to 6 would normally be completed as part of a fire management plan, which might include proposals for several burn units.

Planning and implementing a burn is a specialist activity and should only be carried out by those competent to do so.

**Summary of prescribed burn planning process (adapted from SOP 9.39)**



### Analyse options

The options analysis step requires consideration of whether areas are generally suitable for burning and whether they are now ready to burn. Check the following steps in this Guide to assist you with analysis of options.

| Some questions to consider | Comments | For further information |
|---|---|---|
| Is fire appropriate to this site? | Fire will only be suitable for some EVCs | Step 6.2 and 6.7 |
| Should alternatives to burning be used? | Alternatives (such as hand or mechanical clearing) or a staged approach to burning should be considered if high intensity fire is likely, or if fire is likely to affect environmental assets in other ways (eg vegetation is suffering from drought and may not recover from fire) | Step 5 |
| Is the area ready for burning from an environmental viewpoint? | If the area is to be burnt for environmental outcomes, it will only be ready if it meets or exceeds the fire frequency requirements for the area or a specific environmental asset<br>If the area is to be burnt for protection outcomes and does not meet the fire frequency requirements, consider alternatives to burning or a patchy burn | Steps 6.4-6.5 |

### Set objectives for the burn

All burns should have at least one environmental objective in addition to community safety objectives.

Each objective should be 'MAD' (measurable, achievable and desirable). They should be based on consideration of Step 1 (specifically obligations and management objectives) and Steps 3 to 6 (significant assets, effects and preferred fire regime). Examples of environmental objectives are:

- to avoid impact on the environment from burning including loss of hollow trees and large logs and pollution of Wombat Creek
- to scorch no more than 30 per cent of the canopy
- smoke impact on the adjacent community is limited to a four-hour period
- to avoid loss of the vulnerable Striped Legless Lizards due to burning
- to convert 50 per cent of the 'mature' growth stage on the burn site to 'young' to create conditions suitable for regeneration of the rare orchids
- To kill 90 per cent of all woody weeds on the burn site and stimulate regeneration of weed seeds for herbicide treatment.

### Identify prescriptions to achieve objectives

- Using the ideal fire regime for the burn area (Step 5 and Step 6.6), identify requirements for fire intensity, season, extent and fire type that will achieve the environmental objectives and fit the fuel and weather conditions.
- Use this information to specify the weather and the fuel conditions needed. This is a specialist task. Further information on this step can be obtained from the latest version of DEECA's Prescribed Burning Manual (DSE 2008a).

Prescriptions for the examples given above could include the following.

| To avoid impact on the environment from burning including loss of hollow trees and large logs | Extent: exclude these areas<br>Intensity: low |
|---|---|
| Scorch no more than 30% of the canopy | Type: avoid crown fire<br>Intensity: low |
| Smoke impact on the adjacent community is limited to a four-hour period | Weather: select wind direction<br>Extent: burn size |
| To avoid loss of the vulnerable Striped Legless Lizards due to burning | Season: burn late summer (when lizards can escape into soil cracks) |
| To convert 50% of the 'mature' growth stage on the burn site to 'young' to create conditions suitable for regeneration of the rare orchids | Intensity: low, to create patchy fire<br>Season: spring (damp soil to help patchy fire, follow-up rain for regeneration) |
| To kill 90% of all woody weeds on the burn site and stimulate regeneration of weed seeds for herbicide treatment | Intensity: higher intensity (to kill woody weeds and regenerate hard-coated seed) |

**Specify how the burn will be implemented**

The following issues can have a significant impact on achievement of environmental objectives.

**Command**

Good leadership may be needed to ensure that all prescriptions, including environmental ones, are understood and carried out.

- Plan to brief the burn controller on environmental issues and how they can be managed.
- Include this information in the briefings of all personnel involved in the burn and pre and post- burn works.

**Environmental advisor role**

Environmental issues and precautions should be included in the burn plan. However, consideration should be given to having an environmental advisor on-site during the burn to:

- provide specialist input into the crew briefing
- oversee site preparation for protection of environmental assets (eg raking around habitat trees)
- provide advice on options for protecting environmental assets should it be necessary to change the plan during implementation
- carry out post-burn environmental monitoring (in addition to pre-burn monitoring).

**Resource deployment**

Allocate adequate resources to any specialist tasks, such as monitoring and protecting hollow trees that are to be excluded from the burn. Good site preparation is critical.

**Control lines**

Design and location of control lines is critical not only to containing the burn but also minimising environmental harm.

- Using information in Step 6, design control lines that will minimise environmental harm.
- Plan for rehabilitation of all control lines not required for management purposes as soon as possible after the burn has been completed.

**Lighting pattern**

Design and location of the lighting pattern for the burn is critical to fire intensity, community safety and environmental objectives. Plan for lighting to achieve the planned flame height/intensity set out in the prescriptions for the burn.

**Blackout/patrol**

Tactics used in blacking out can have a significant effect on the environment.

- Using Step 5 as a guide, plan to use tactics for blacking out/patrol that minimise water use, soil disturbance and loss of significant habitat such as logs and mature and hollow trees.

**Identify issues and control measures**

This section of the burn plan template can be used to itemise specific environmental requirements not included under ‘prescriptions’.

**Consent**

Consent may be required for environmental issues.

- Consult early in the planning process with regulators to determine possible issues and how they may be resolved.
- Obtain all necessary permits before seeking approval of the burn plan.
- Notify neighbours, police, CFA, council and DEECA before the burn.

| Issue | Regulatory instruments | Regulator |
|---|---|---|
| Biodiversity | EPBC Act<br>FFG Act | DAWE<br>DEECA |
| Waterways | CaLP Act | CMA |
| Air quality | EP Act | EPA |
| Biodiversity, air quality | Planning scheme / local Laws | Council |

**Monitoring and rehabilitation plan**

Monitoring is required to:

| | |
|---|---|
| Support decision-making | to assess if it is ‘time’ to burn<br>to find the range of conditions that meet objectives<br>to determine the appropriate prescriptions<br>to determine if further research is required. |
| Assess if further action is needed | for example, is erosion or weed control needed? |
| Asses if the burn objectives have been achieved | |

Monitoring of planned burns should be well targeted and simple to implement.

For further information on monitoring refer to Step 8 ‘Monitoring, learning and reviewing’.

## Case study: South Gippsland burn targets stringybarks first

Several brigades helped Koonwarra Fire Brigade to reduce the bark hazard on stringybark trees located around the perimeter of a block planned for burning in the Koonwarra Bushland Reserve, which adjoins the township.

Operations Officer Simon Bloink and the environmental advisors who prepared the fire management plan for the reserve provided a briefing to brigades, which included advice on minimising environmental damage by keeping flames out of the tree canopies.

“We would have liked to have burnt the whole block in one operation,” Simon Bloink said, “but by candling the stringybarks first, next time we burn the block the fire intensity should be much lower as the bark hazard will be less. This will make it easier and safer to burn this block. And there is also likely to be less damage to the tree crowns.”

## Case study: Fire as a management tool requires careful consideration

Reproduced with permission of Nillumbik Shire Council

Senior environmental works officer Brad Tadday, of Nillumbik Shire Council, recounts the preparation and follow-up work required to ensure best management practices in the implementation of a prescribed burn.

“The prescribed burn at Yirrip Reserve, Kangaroo Ground, was recommended in the reserve’s fire management plan to reduce fuel throughout the asset protection zone adjacent to private properties.

“Although fire has naturally been a significant influence on Australian ecosystems, the use of fire as a management tool needs to be carefully considered on all levels. While fulfilling Council’s responsibility towards community safety, it was also necessary to ensure that the burn did not detrimentally impact the significant values of the natural environment.

“Expert advice has informed us that the main fuel reduction benefit from a prescribed burn will be on reducing the bark fuel; all other fuels are likely to increase to the same pre-fire level within five years. While burning every five years is impractical on a resource level, it will also cause a loss of species and dramatic ecosystem change. Woody weeds may be stimulated by fire thus adding to management issues. Rabbits will be attracted to new regrowth and may destroy any ecological benefit from the fire by demolishing seedlings.

“Depending on the severity of the fire and site characteristics, erosion may become an issue if not managed closely. Habitat may also be lost if hollow trees and logs are caught alight.

“To monitor the achievement of our objectives at Yirrip Reserve, eight monitoring plots and 24 photo points were set up throughout the proposed burn site. The control line was constructed as sensitively as possible. Instead of a rake-hoe line scraped to mineral earth, the line was brush-cut and raked clear of sticks and leaves. Environmental assets such as sensitive trees and candlebark, ironbark, and habitat trees, as well as hollow logs, were also protected in a similar manner.

“The timing of a prescribed burn is crucial to the result. Only a small window of opportunity was open for our burn at Yirrip between the end of fire season and the emergence of significant orchids. The burn was delayed a week to wait for local vineyards to harvest their grapes and avoid smoke taint in their wine. The week after that was too wet to burn. Then finally there was the perfect day, just before it was too late for this season.

“The burn progressed beautifully without incident, running up the bark of the stringybarks to reduce the bark fuel. None of the habitat trees was lost to fire and only two hollow logs were reduced to ashes. A mosaic of unburnt patches throughout the site provided a refuge for small animals and insects. The site was blacked out then monitored for 48 hours before the rain finally set in.

“It doesn’t stop here though; ongoing works include after-fire photo points and control line rehabilitation. A thorough rabbit control program in also underway to ensure the regenerating plants, in particular the rare orchids, are not grazed out. Seasonal data collection of the monitoring plots will examine the ecological effects of the fire over time so we can learn as much as possible from this experience and adapt our management practices for further improvement”.

## Case study: Kilsyth South Spider-orchid

Located in CFA District 13, Kilsyth South is in the urban interface Its local government area is the City of Maroondah.  Approximately half of the Kilsyth South area is urban housing with a few larger blocks less than five hectares. There is also an industrial area, a golf course and a creek and retarding basin within a bushland reserve. The reserve has very high biodiversity values with several Flora and Fauna Guarantee Act listed species as well as an Environment Protection and Biodiversity Conservation Act listed species, the Kilsyth South Spider Orchid, Caladenia sp. aff. venusta Kilsyth South. Including a Trust for Nature property and land that Maroondah council recently purchased the bushland measures approximately 15 hectares.

**Environment**

The majority of the area was Swampy Riparian Woodland and Swampy Woodland with some Valley Heathy Forest

Only a few of the Kilsyth South Spider Orchid, Caladenia sp. aff. venusta Kilsyth South had been seen and only in this location and that was several years ago.

The aim was to reduce the speed and intensity of bushfires, protecting nearby residential assets, particularly from ember attack during bushfire events and to encourage regermination of the spider orchid with the use of fire.

There was no bushfire history of planed burn fire history recorded in the reserve. The Victorian Fire Risk Register rated the adjacent residential area as Moderate risk. Fire was expected to spread and reach assets, but ignitions did not occur frequently.

Fuel hazard was extreme and fuel loads were around 35 t/ha. Bushfires would be very intense and difficult to control. The near surface fuel was mostly Gahnia radula and Tetrarrhena juncea, and this was extreme which was not conducive to orchid germination.

**Challenges**

- Houses located adjacent to the vegetation
- Extreme fuel hazard adjacent and within the burn area
- Very narrow window to conduct the burn before the orchid emerged. Had to be completed by the 30 March.
- Authorisation was difficult as we were burning while we still had bushfires in the landscape
- The orchid was initially found on vacant private land that the council was prevented from accessing and burning had to wait until the land was purchased by the council
- Permits had to be obtained
- Post burn protection and monitoring to protect the orchid if it emerged

**Objective**

The aim was to develop fuel reduced areas of sufficient width and continuity to reduce the spread of bushfires and to increase orchid germination in an area that had been long unburnt and overgrown with a thick thatch of Gahnia radula.  To achieve this, the objective was to reduce the overall fuel hazard to moderate over 80% of the planned burn area and leave some areas unburnt. The planned area was six burn units over 18 years.

The burn window was narrow. The area needed to be burnt between December and March when the orchid would be below ground. To be able to control the fire in suitable weather conditions this would usually just leave March.

The plan was to conduct six burns in a specific order to maintain a mosaic affect over and an 18-year period. Ideally with no more than two years between each burn. Ideally the burns were to be patchy leaving at least 10% unburnt.

Control lines were to be slashed and wet rather than mineral earth so as not to disturb the orchids.

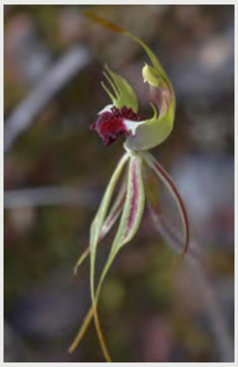
The bushfire risk and the risk to the emergence of the orchid was mostly coming from the thick near surface fuel layer of Thatch Saw-sedge (Gahnia radula) and Forest Wire-grass (Tetrarrhena juncea).

**Community Engagement**

This was a multi-agency burn involving CFA, Local Government, Melbourne Water, DELWP Biodiversity, Friends of Group, and Trust for Nature

Further meetings were held with adjacent land owners on whose land we needed access. Extensive effort was taken to explain:

- Biodiversity issues
- What to expect prior to the burn in terms of control line work
- What to expect on the day of the burn and safety issues
- What the area would look like post burn and safety issues
- Address any concerns from the land owner



Kilsyth South Spider Orchid, Caladenia sp. aff. venusta. Owen Gooding

### Stakeholder Involvement

Meetings were held with stakeholders and the key outcomes were:

- Council to put in place all the control lines
- Council to engage with surrounding residents
- Council, DELWP and consultant to do the values checks
- CFA to carry out the burn
- Night crew required from CFA
- Management of CFA volunteers including supervision, tasking and meals
- Management of members of the public who were concerned about the negative effects of burning by allocating knowledgeable agency liaison personnel to address their concerns
- DELWP and Council to organise permits including EPBC for the orchid
- Consultant, Friends of Group to conduct pre and post burn monitoring
- Funding was obtained through DELWP and council to conduct the burn to protect the orchid

### Outcomes

Four burns were conducted between 2011 and 2018. Fuel was reduced to moderate or below over 80% of the area achieveing the fuel reduction objective. Some areas were left unburnt.

Burn intesnity was low in the first area burnt but moderate in subsequnt areas. There areas that where modeate intensity have an extreme near surface fuel layer of Forest Wire-Grass and Thatch Saw-sedge.

Terracotta pots were used to successfully protect some smaller plants from burning.

A sprinkler system was used in conjunction with the control line to control the spread of fire outside the burn area in the very flammible fuels.

Several orchids emerged particularly in the area that was burnt and then had the regrowth slashed.

Control line and sprinkler

Fuel hazard

### Fuel Reduction Analysis

Fuel hazard was Low post burn but increased to moderate in the following years. Routine slashing of the Forest Wire-Grass and Thatch Saw-sedge in the following years has kept this fuel hazard to Moderate rather than it returning to extreme. This has also benefited orchids.

### Biodiversity Results

After the first burn no Kilsyth South Spider-orchids were expected to emerge in that location, however several did along the edge of the burn. Cameras were installed to protect the orchids.

Fire alone cannot provide the Kilsyth South Spider-Orchid with continuous relief from heavy competition for sunlight, moisture and nutrients by dense Forest Wire-Grass and Thatch Saw-sedge. To complement the effects of fire the near-surface fuel was slashed post fire whenever density became a threat to the orchid. There is no grazing pressure in this very urban environment.

This was very effective, and several Kilsyth South Spider-orchids emerged.

### Burn Operations

**Values Checking** Using an independent contractor to monitor the vegetation pre and post burn enabled the burn to be conducted at the right time to minimize harm to flora and fauna and also to monitor the benefits or detrimental effects of the burn.

**Hazard Tree Removal** Minimal trees were removed that were deemed hazardous. Others were protected and excluded from the burn. This was completed by the local government

**Control Lines** Control lines need to be at least three metres wide and slashed and wetted down to minimize soil disturbance. A sprinkler was used to mitigate any loss of protection.

**Crewing** The burn was conducted at 4pm which allowed maximum number of crew members to attend after work as they were all volunteers.

**Post Burn Mapping** Post burn intensity and coverage mapping was completed after each burn

## Case Studies 7.5

**Helping others to practice sustainable fire management**

### Case study: Learning about ecologically responsible fire management

The Ecologically Responsible Roadside Management Project was launched at Hawkesdale on 26 November 2009. It is a joint project between CFA), Moyne Shire Council, DEECA, Southern Grampians Shire, VicRoads and the community. The project is funded by the World Wildlife Fund, Australia from a Threatened Species Network Community Grant.

The project aims to recognise, encourage and support volunteer brigades and landholders who conduct ecologically responsible works for fire protection on roadsides. These works include burning that conserves native grassland communities, is done with an appropriate frequency and in the right season.

In south-west Victoria, local CFA brigades burn more than 2600km of roadsides each year in accordance with the Municipal Fire Management Plan.

Fuel reduction burning in roadsides can increase community safety. If it is done in an ecologically responsible manner, it can also protect important grassland remnants such as the nationally listed Natural Temperate Grassland of the Victorian Volcanic Plain and a wide range of Australian and Victorian threatened species. As highlighted in the case study 'Municipal fire management in protected grasslands' (Step 7.1), maintenance of native grasslands can result in lower fuel loads and fire intensity, making roadsides safer to work from.

## Case Study: Hotspots Program (NSW Nature Conservation Council)

The ‘Hotspots’ program aims to help communities develop and implement science-based fire management plans for the dual objectives of fire safety and biodiversity conservation, through facilitated workshops.

The program works at a range of levels from a property through to the regional level and includes facilitating prescribed burning on broad-acre private lands.

Program elements include:

- community consultation about fire management issues to determine local needs
- learning opportunities (eg field trips with experts)
- development of science-based resources to guide environmentally responsible fire management planning and implementation
- facilitated workshops with individual property owners, communities or other bodies to help them develop and implement fire management plans
- ongoing support and facilitating linkages to help participants to implement plans.

This program has been operating successfully in NSW for more than five years. Funded by the New South Wales Environmental Trust, the program is delivered by the Nature Conservation Council of NSW. Regional partners include the NSW Rural Fire Service, NSW Department of Environment and Climate Change, the catchment management authorities and the NSW Farmers Association.

A video outlining program achievements and extensive resource materials are located on the NCC website (www.nccnsw.org.au). The video is also available on the CFA intranet under Community Safety > Environment.

## Case study: Fire regimes on private conservation lands

Lucy Halliday carried out a study (Halliday 2010) that may be of benefit in designing approaches to influencing landholders to carry out ecologically appropriate fire management works, including regime management. Halliday investigated issues surrounding the management and maintenance of fire regimes on private conservation lands in north-east NSW and south-east Queensland.

These areas have benefitted from two programs aimed at introducing ecologically sustainable fire regimes on private property through the use of science and community engagement: Hotspots (NSW) and the Fire and Biodiversity program (South-east Queensland Fire and Biodiversity Consortium).

Despite the significant effects that fire can have on biodiversity as well as life and property values, fire was not a key management priority among most landholders.

Halliday found that while private conservation landholders acknowledged the risk and responsibilities of fire management on their land, and did undertake actions to reduce fuel hazards and prepare for bushfire events on their land, they directed far less effort towards fire management than other conservation management actions.

Despite the “established role and benefits of fire to many ecosystems in the region,” Halliday found that:

- landholder attitudes towards, and understanding of, the ecological role of fire was generally poor
- few private conservation landholders were aware of ecologically appropriate fire regimes for the vegetation types on their property
- few undertook fire management actions to achieve ecological outcomes, despite formally designating their lands for nature conservation
- fire is occurring at intervals outside the recommended range across all vegetation classes, which is threatening the integrity of these ecosystems.

Halliday identified barriers to implementation of fire management as:

- significant site-specific obstacles
- lack of knowledge and experience with fire management
- legal and containment concerns.

Halliday’s research highlights the need for property-specific fire management planning across all private conservation lands to:

- enable landholders to integrate ecological fire requirements into biodiversity management
- prioritise actions that aim to improve conservation outcomes while safeguarding life and property.

This report includes the following additional recommendations.

- The continuation of community fire management planning workshops, and cooperation between fire and land management agencies, to build the capacity of landholders to put their plans into practice.
- Provision of incentives to encourage collaborative fire planning and implementation projects to achieve outcomes at a larger scale.
- Implementation of an appropriate system for recording fire history.

## Case Study: Fire ecology in fire adapted landscapes (FEEFAL)

The reality of more frequent fires near human settlements, associated with the impacts of climate change, means there is an increasing need to help connect people with the natural landscapes and ecological processes that surround them.

Fire-ecology engagement in fire adapted landscapes (FEEFAL) aims to support land managers and residents on private land in high bushfire risk areas. This engagement approach also supports communities to increase their awareness and understanding of living in fire adapted landscapes by sharing knowledge and experiences of local environments, social dynamics and practical resources.

These efforts respond to a need for increasing societal awareness of the complex issues around living with bushfire risk in landscapes where fire naturally occurs. Engagement is typically structured to help increase residents' level of situational awareness across seasonal conditions and ecosystem responses.

FEEFAL approaches, like the Fire-Scape (Vic) and Hot Spots (NSW) programs, play an important role to actively bridge connections – between fire ecology, risk management, local knowledge and social and behavioural science – that are practical and locally relevant. There is evidence to show that people who can better understand their landscapes and how ecosystems function are more likely to accept that fire is a natural phenomenon. They are more likely to take action to keep themselves safer, thereby adopting risk reduction behaviours.

Cross-tenure, multi-partner approaches are well-placed to better understand local scale bushfire risks on private land through shared learning about ecological processes, associated values and possible risk reduction treatments. Successful long-term engagement relies on adequate resources, supporting relationships and sharing and acknowledging different forms of knowledge.

Further information can be found in the following Safer Together funded resources:

(links to VIDEOS, Guides and Summary report)

## Case studies 7.6

**Assessing the level of risk to environmental assets**

### Case study: Risk of inappropriate fire regime on the Eltham Copper Butterfly

The Eltham Copper butterfly is listed as threatened under the Victorian Flora and Fauna Guarantee Act (1988) and is considered endangered. It is found in three regions: north-western Victoria (Kiata/Salisbury), central Victoria (Castlemaine/Bendigo) and outer north-eastern Melbourne (Eltham and Greensborough).

In Eltham, most of the colonies occur in dry open Eucalyptus forest with an open, grassy understorey containing scattered patches of Sweet Bursaria and other shrubs.

There is an intricate relationship between the caterpillar of the butterfly, soil-nesting ants of the genus Notoncus, which tend the caterpillars, and the Sweet Bursaria, which the caterpillars feed on. All three factors are required for the species to survive.

A draft fire regime was prepared for the Eltham Copper butterfly reserves in Eltham (obliqua pty ltd, Oates Environmental Consulting Pty Ltd, INVERT-ECO, and Ecoplan Australia, 2011). It confirms that particular care is needed with the frequency, extent, season, intensity and type of fire management to reduce fuel in butterfly habitat and to improve habitat for the butterfly, which requires open flight paths and juvenile Bursaria foliage.

This plan assessed the risk of inappropriate fire management to the Eltham Copper butterfly using the principles of the VFRR Reference Guide (CFA 2010c).

The vulnerability of the Eltham Copper Butterfly to inappropriate fire regimes was assessed as follows.

- The conservation status is 'Endangered'.
- While the butterfly is found in more than one municipality, it has been assessed as 'Highly restricted' (rather than 'Restricted' as suggested in the VFRR Reference Guide) as the Eltham populations are very small and are geographically isolated to the individual reserves they are found in.

Using the following table, the vulnerability of the Eltham Copper butterfly to inappropriate fire or fire management can be rated as 'Very high'.

| | Conservation status | | |
|---|---|---|---|
| **Geographic extent** | **Locally important** | **Vulnerable** | **Endangered** |
| Highly restricted | **Moderate** | **High** | **Very high** |
| Restricted | **Low** | **Moderate** | **High** |
| Widespread | **Low** | **Low** | **Moderate** |

The likely impact of fire or fire management was assigned the highest impact category. This category (fire exclusion) was expanded from the advice provided in the VFRR Reference Guide to include situations where there are very specialised and restrictive fire regime requirements, as required by the Eltham Copper butterfly.

Based on a vulnerability of 'Very high' and the highest impact rating, the consequences of inappropriate fire or fire management (such as allowing the shrub canopy closure to continue, or over-clearing of butterfly habitat for community safety reasons) have been assessed as 'Catastrophic'.

| | Consequences | | | |
|---|---|---|---|---|
| **Likelihood of inappropriate fire/fire mgmnt.** | **Minor** | **Moderate** | **Major** | **Catastrophic** |
| Almost certain | **High** | **Very high** | **Extreme** | **Extreme** |
| Likely | **Medium** | **High** | **Very high** | **Extreme** |
| Possible | **Low** | **Medium** | **High** | **Very high** |
| Unlikely | **Low** | **Low** | **Medium** | **High** |

## Case study: Risk of inappropriate fire management on soil stability

While all potential threats to environmental assets need to be managed through appropriate practice, soil stability needs particular attention.

The Fire Management Plan prepared for South Gippsland Shire Council's Pioneer Reserve at Kongwak (obliqua pty ltd and Oates Environmental Consulting Pty Ltd 2011) notes that because of the "steep slopes and erodible soil, combined with high rainfall, there is potential for significant erosion due to baring of the soil from burning, construction of control lines or mechanical mulching".

This plan assessed the risk to soil stability from fire or fire management as follows.

- The principles of the VFRR Reference Guide (CFA 2010) were used as a guide.
- Based on the zoning (ESO5), soil in Pioneer Reserve is assessed as having 'High Vulnerability' on the steeper slopes.

The likely impact of fire management works on soil stability is assessed as:

- steepest slopes (over 15 degrees): exclude works
- moderate slopes (5 to 15 degrees): resite or restrict works
- low slopes (less than five degrees): standard conditions.

Based on the table, right, the consequences of inappropriate soil management is assessed as:

- steepest slopes (over 15 degrees): Major
- moderate slopes (5-15 degrees): Moderate
- low slopes (less than five degrees): Minor.

| | Vulnerability | | | |
|---|---|---|---|---|
| **Likely impact of fire mgmnt. works** | **Low** | **Moderate** | **High** | **Very High** |
| Exclude works | **Moderate** | **Major** | **Major** | **Catastrophic** |
| Resite or restrict works | **Minor** | **Moderate** | **Moderate** | **Major** |
| Standard/ no conditions | **Minor** | **Minor** | **Minor** | **Moderate** |

Adapted from CFA (2010)

## Case studies 7.7

**Monitoring, learning and improving**

### Case Study: Grassy woodland monitoring project in Longwood

In early December 2021, four planned burns were conducted in the township of Longwood, Victoria. These were a continuation of the township's long history of annual burning in spring or early summer to reduce fire risk following the tragic deaths of seven people in the 1965 grassfire.

Two of the sites burnt in December 2021 have been burnt annually and are highly diverse grassy woodlands. The other sites are degraded grassy woodlands that had not been burnt for more than 30 years.

Monitoring was conducted pre- and post-burn to:

- understand the effect of frequent spring/early summer burning on species richness compared with long unburnt sites
- investigate the effect of spring/early summer burning on re-sprouting and seedling survival of the critically endangered *Dianella tarda*.

**Results and discussion**

- Sites burnt frequently in spring/early summer have a higher species richness (particularly native forb richness) compared to long unburnt sites.
- All individuals of the critically endangered *Dianella tarda* survived the burn, either above-ground or by re-sprouting post-burn.
- Although a germination event was observed, spring to early-summer burning reduced seedling survival of *Dianella tarda*.

Sites burnt frequently in spring/early summer appear to have a higher species richness (particularly native forb richness) compared to long unburnt sites. This is compelling evidence that spring-summer burning results in higher native plant diversity compared to doing no burning. Frequent burning benefits native plants by reducing competition for resources and promoting germination via smoke and heat cues.

Reduced seedling survival following early summer burning of *Dianella tarda* suggests that spring/early summer burning may reduce recruitment and seedling establishment in the long term. For this species, burning in late-summer to autumn may be better, as autumn burning will likely result in increased seedling survival. This is because seedlings that germinate in autumn have adequate growth time before being exposed to hot and dry summer conditions which kill smaller seedlings.

# Appendix 8

## Abbreviations

| | |
|---|---|
| AV | Agriculture Victoria |
| BOM | Bureau of Meteorology |
| Biosite | Site of biological significance |
| BMO | Bushfire Management Overlay |
| CMA | Catchment Management Authority |
| CaLP Act | Catchment and Land Protection Act 1994 |
| CAMBA | China Australia Migratory Bird Agreement |
| DEECA | Department of Energy, Environment and Climate Action |
| DELWP | Department of Environment, Land, Water and Planning |
| DAWE | Department of Agriculture, Water and Environment (Federal) |
| DPCD | Department of Planning and Community Development |
| DPI | Department of Primary Industry (now AV) |
| DSE | Department of Sustainability and Environment (now DELWP) |
| EFG | Ecological Fire Group |
| EMO | Erosion Management Overlay |
| EP Act | Environment Protection Act 1970 |
| EPBC Act | Environment Protection and Biodiver sity Conservation Act 1999 |
| ESO | Environmental Significance Overlay |
| EVC | Ecological Vegetation Class |
| EVD | Ecological Vegetation Division |
| FFG | Flora and Fauna Guarantee Act 1975 |
| FEEFAL | Fire Ecology Engagement in Fire Adapted Landscapes |
| FIS | Flora Information System |
| IGEM | Inspector-General for Emergency Management (Victoria) |
| LSIO | Land Subject to Inundation Overlay |
| JAMBA | Japan Australia Migratory Bird Agreement |
| MAV | Municipal Association of Victoria |
| MFPC | Municipal fire prevention committee |
| MFPO | Municipal fire prevention officer |
| MFPP | Municipal fire prevention plan |
| MSS | Municipal strategic statement |
| NES | Matter of national environmental significance |
| NVPP | Native vegetation precinct plan |
| OESC | Office of Emergency Services Commissioner |
| PV | Parks Victoria |
| SLO | Significant Landscape Overlay |
| SMO | Salinity Management Overlay |
| SPPF | State Planning Policy Framework |
| SPZ | Special protection zone (forest management plans) |
| VicRoads | Government agency that manages the Victorian arterial road network |
| VicTrack | Government rail agency |
| VAGO | Victorian Auditor-Generals Office |
| VBA | Victorian Biodiversity Atlas |
| VPO | Vegetation Protection Overlay |
| VPP | Victorian planning provisions |

# Appendix 9

## Glossary

Key sources include VEAC (2010), Cheal (2010)

**Adaptive management**
A systematic process for continually improving management by learning from the outcomes of programs (based on monitoring) and incorporating new information in programs.

**Airshed**
A geographic area that is being investigated or managed for air pollution control.

**Biodiversity**
The variety of all life forms, including different plants, animals and micro-organisms, encompassing their genes, species, ecosystems and their interactions.

**Biota**
The living components (fauna and flora) of an ecosystem or habitat. (Abiotic refers to non-living components).

**Biolinks**
Broad geographic areas managed to increase ecological function and connectivity, improving the potential of plants and animals to disperse, recolonise, evolve and adapt.

**Bioregion**
Large, geographically distinct areas of land characterised by landscape-scale natural features and environmental processes that influence the function of entire ecosystems. Bioregions are defined by physical characteristics such as geology, landforms and climate.

**Canopy**
The canopy (crown) of the tallest plants, which typically comprises a layer or multiple layers of branches and leaf foliage.

**Coarse woody debris**
Dead woody material, in various stages of decomposition, located above the soil, larger than 7.5 cm in diameter which is not self-supporting (e.g. not a tree or stump).

**Connectivity/landscape connectivity**
The degree to which landscapes actually assist or restrict the movement of organisms and processes.

**Corridors**
Strips of habitat that differ from the adjacent land on both sides and connect two or more habitat areas. See also 'wildlife corridor', below.

**Country Area of Victoria**
That part of Victoria which lies outside the metropolitan fire district, but does not include any forest, national park or protected public land (CFA Act 1958 s3).

**Cultural fire use**
Fire used by first nations people for cultural purposes, including for food, protecting landscapes and for ceremonial purposes.

According to the Victorian Traditional Owner Cultural Fire Strategy (p8.) the cultural use of fire is a socially and ecologically complex practice, governed by kinship, eldership, spiritual connections to Country and environmental interactions with fire'

**Disturbance**
Any event that disrupts ecosystem, community or population structure and changes resources or the physical environment. The disruption event may be natural such as fire, snow, disease, wind, earthquake or flood or artificial in origin including timber harvesting, prescribed burning, slashing, clearing or pollution.

**Ecological processes**
The interactions and connections between living and non- living systems including movements of energy, nutrients and species.

**Ecological Fire Group (EFG)**
A subdivision of Ecological Vegetation Divisions (EVDs) (see below) to distinguish different fire response characteristics such as minimum tolerable fire intervals within the EVD. The EFG fields will be progressively updated as necessary.

**Ecological Vegetation Class (EVC)**
A native vegetation classification based upon common ecological characteristics.

**Ecological Vegetation Division (EVD)**
A classification of native vegetation based on groups of EVCs that share similar responses to fire.

**Ecosystem**
A system functioning together as a unit that includes all living organisms, the physical components of the environment and their relationships.

**Ecosystem resilience**
The ability of a system to absorb and recover from disturbance while retaining the same basic function.

**Ecosystem services**
The services provided by the environment that sustain human life, including a stable climate, clean air, water cycling and purification, nutrient cycling, soil formation, biomass production, waste disposal, crop pollination, provision of food and minerals, and the maintenance of genetic diversity.

**Edge effects**
Changes in conditions that occur at an ecosystem boundary.

**Endemic**
A species that is native to a single geographic region and is found nowhere else.

**Environmental impact**
Any change to the environment, whether adverse or beneficial.

**Environment**
For the purposes of this Guide, 'environment' is defined as air, water, land and biodiversity.

**Exotic species**
Species occurring outside their historic natural range as a result of dispersal by human activities.

**Erosion**
The wearing away of land surface by wind, water, land clearing practices or other natural or man-made processes.

**Extinction**
The end of a species, or the end of a species in a defined area ('local extinction'). The moment of extinction occurs with the death of the last individual of that species and loss of all means of reproducing (e.g. depletion of seed bank).

**Fauna**
Animal life of any particular region or time.

**Fire cycle**
Length of time for an area equal to the entire area of interest to burn.

**Fire dependent**
Refers to species or vegetation types that depend on a particular aspect of the fire regime for their establishment, growth or persistence. For example, some fire-dependent flora species may have seeds that only germinate after stimulation by heat or smoke.

**Fire ecology**
The component of fire management involving the study of fire and its interaction with the natural environment (often focusing on biodiversity).

**Fire exclusion**
The policy of suppressing bushfires or prohibiting the use of planned burning in a defined area.

**Fire frequency**
Number of fires per unit time in a specified area.

**Fire intensity**
The heat energy released in a fire expressed as kW/m of fire front.

**Fire interval**
Time (in years) between two successive fires in a designated area.

**Fire Protected Area (FPA)**
Any land that is within any state forest, national park or protected public land or unless excised, within 1.5 kilometres of these land categories (adapted from Forests Act 1958).

**Fire or fire management regime**
Seasonality, frequency, intensity, type and extent of fire or fire management over a prolonged period.

**Floodplain**
Lands adjacent to waterways that are subject to flooding.

**Flora**
The plant life occurring in a particular region.

**Flow regime**
The pattern of changes in the season, timing, frequency, volume, rates of rise and fall, and duration of flows in a waterway. The flow regime or hydrology influences the physical nature of river channels, the biological diversity, and the key processes that sustain the aquatic ecosystem and ecosystem services.

**Geophyte**
Plants that have underground food stores (e.g. bulbs, corms, rhizomes, tubers).

**Germination (in plants)**
The process by which a seed begins to sprout and grow into a seedling.

**Habitat**
The physical space within which a species lives and the organisms with which it interacts.

**Habitat degradation**
The reduction in quality or condition of an area of habitat for a given species that affects the survival of individuals or populations of the species.

**Habitat fragmentation**
Functional separation of habitat patches for a given species.

**Habitat loss**
Loss of habitat for a given species from an area, which prevents a species from persisting there.

**Habitat quality**
The ability of an area to provide conditions appropriate for survival of individuals and populations of a species. One measure of habitat quality is the 'habitat hectare', which scores the condition of the site (including modification and recruitment of vegetation and the presence of litter and coarse woody debris) and the landscape context (patch size and connection to habitat) (DSE 2004b).

**Key fire response species (KFRS)**
Those species (plant or animal) whose vital attributes (life history characteristics, see below) indicate that they are vulnerable to a fire regime of frequent fires or to long periods of fire exclusion.

**Landscape**
The visible features of an area of land.

**Native vegetation**
Vegetation that is dominated by locally indigenous species.

**Recolonisation**

The restoration of a population to an area within its range.

**Refugia**

Places that escape or are minimally affected by disturbance and provide habitat until more favourable conditions return.

**Resilience**
The capacity of a system to absorb disturbance to retain essentially the same function, structure and feedback loops.

**Riparian**
Relating to or located on the banks of a river or stream.

**Risk (see also environmental impact)**
The chance of something happening that will have an impact on objectives. Risk is measured by the consequences (outcome or impact) of an event and their likelihoods. Risk may have a positive or negative impact.

**Seed bank**
Dormant seeds that are capable of germination if the right conditions appear. The seed bank may be on the plants, in fruit or in, or on, the soil.

**Seral (or growth) stages**
The series of distinct changes in vegetation communities as they develop during succession from bare ground or immediately post-fire to mature vegetation, and beyond (see also 'Succession').

**Succession (stages)**
The process of continuous (re-)colonisation (and extinction) of populations at a particular site as vegetation ages and is replaced.

**Sustainable fire management**
For the purposes of this Guide, environmentally sustainable fire management meets community safety objectives (protecting life and property), while:

- avoiding or, if that is not possible or practical, minimising harm to the environment including the quality of air, land, water and biodiversity
- maintaining or improving biodiversity (through regime management), where practical
- using regime management to reduce the occurrence and intensity of bushfire across the landscape
- meeting legal and policy obligations for environmental care.

**Threat (see also environmental impact and risk)**
Person or thing likely to cause damage or danger.

**Threatened species**
Species or communities that are in danger of becoming extinct and whose survival is unlikely if the factors that are causing rarity continue. There are a number of different classifications of the threat level depending upon whether the species/community is listed internationally, nationally or at a state level. Classifications use terms such as rare, vulnerable, endangered, critically endangered and presumed extinct to indicate the level of threat.

**Tolerable fire interval (TFI)**
A term that expresses the minimum or maximum recommended time intervals between fire for a vegetation community. The time interval is derived from the vital attributes of plant and animal species that occupy the vegetation community. The TFIs guide how frequent fires should be in the future to allow the persistence of all species at the site or defined area.

**Vegetation remnant**
Patch of native vegetation remaining after an area has been cleared or modified.

**Vital attributes**
Vital attributes summarise life history characteristics such as growth patterns, reproduction method and life history stages. Using these attributes, those species most susceptible to variation in fire regime (key fire response species (see above)) can be used to identify fire needs and to monitor the impact of fire.

**Wetlands**
Areas featuring permanent or temporary shallow open water that does not exceed a depth of six metres at low tide. They include billabongs, marshes, swamps and lakes.

**Wildlife corridor**
Components of the landscape that facilitate the movement of species and processes between areas of substantially intact habitat.