Department of National Parks, Recreation, Sport and Racing

Planned Burn Guidelines

Desert Uplands Bioregion of Queensland

Queensland Government

Prepared by: Queensland Parks and Wildlife Service (QPWS) Enhanced Fire Management Team, Queensland Department of National Parks, Recreation, Sport and Racing (NPRSR).

First published May 2013
Published by the Department of National Parks, Recreation, Sport and Racing

National Library of Australia Cataloguing-in-Publication

Planned Burn Guidelines – Desert Uplands Bioregion of Queensland
First edition.
Bibliography
ISBN 978-1-7423-0931
1. Planned Burn – Guideline 2. Fire Management 3. Bioregion – Queensland

Disclaimer

Acknowledgements

The following people made substantial contributions to the intellectual content of these planned burn guidelines based on experience and/or expert knowledge with regard to fire management in the Desert Uplands bioregion. QPWS staff include: Grant Anchen, Bronwyn Terry, Tony Salisbury, David Delahoy, Col Adams, Geoff Smith, Eleanor Collins, Peter Stanton (Peter Stanton Environment Consultant Pty Ltd), Dr Paul Williams (Vegetation Management Science Pty Ltd), and Gary Pigeon (Department of Employment, Economic Development and Innovation).

This guideline has been developed and produced by the QPWS Enhanced Fire Management Team: Kerensa McCallie, David Shevill, Wayne Kington, Jenise Blaik, Troy Spinks, Mark Cant and Justine Douglas; supported by David Clark, Caroline Grayson, Ellen Thyer and Tim Killen. Following a successful pilot project (QPWS South East Region Planned Burn Guidelines) initiated and developed by QPWS staff: Wayne Kington, David Kington and Mark Burnham.

Front cover photograph: Cudmore National Park, QPWS.

Bp2011

Foreword

The Desert Uplands bioregion covers approximately 75 000 square kilometres (562 500 hectares). The uplands consist of sandstone tablelands and the remnants of these weathered plateaus. The lower country is predominately sandy plains with soils of poor or low nutrients. Vegetation types within the QPWS estate range from tall spotted-gum forests, ironbark and box woodlands to thick heath-type vegetation consisting of grevilleas and small shrubby acacias with tussock grasslands in the lowlands, dominated by Mitchell and blue grass. Spinifex grasslands and the reduced rainfall contribute to the semi-arid nature of this region.

The use of fire in this landscape has changed over time with the development of the pastoral industry. Some introduced grass species such as buffel grass, while an exceptional fodder species, is having a significant impact on fire behaviour where it exists within the QPWS estate. The challenge here is to develop fire regimes that will not only protect and maintain biodiversity but will compliment fire management across the landscape.

These guidelines should be used as starting point and are designed to be added to as our knowledge improves. It is important to undertake monitoring to gauge the effectiveness of different fire regimes and also to gauge the capacity of the Desert Uplands to recover from wildfires.

Caleb Bailey
Ranger-in-Charge
Central Region
Queensland Parks and Wildlife Service.

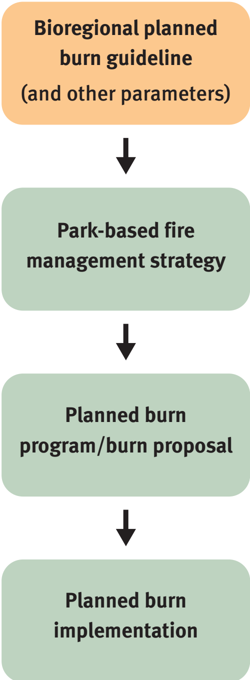
Table of contents

Purpose of this guideline

This guideline was developed as part of the Department of National Parks, Recreation, Sport and Racing's (NPRSR) Queensland Parks and Wildlife Service (QPWS) Fire Management System to support the formation of fire strategies, burn proposals and on-ground planned burn implementation (supported by the Planned Burn Guidelines: How to Assess if Your Burn is Ready to Go). They assist rangers and other land managers to:

- protect life and property
- maintain healthy ecosystems
- promote awareness of fire management issues in the field
- identify clear fire management objectives to address those issues; and how to assess objectives to assist in adaptive management
- identify suitable fire behaviour, burn tactics and weather conditions to achieve objectives
- provide information and tools to assist in implementing planned burns.

Please note that this planned burn guideline uses 'fire vegetation groups' provided in ParkInfo that assist their integration into maps and fire strategies. A fire vegetation group is a group of related ecosystems that share common fire management requirements.



How the planned burn guideline fits into the QPWS Fire Management System.

Scope

- This guideline applies to the Desert Uplands bioregion (refer to Figure 1) and covers the following fire vegetation groups: eucalypt communities, grasslands, melaleuca communities, shrublands, casuarina communities, acacia communities and riparian/spring/swamp communities (refer to Appendix 1 for regional ecosystems contained in each fire vegetation group).
- It covers the most common fire management issues arising in the Desert Uplands. In some cases, there will be a need to include issues in fire strategies or burn proposals beyond the scope of this guideline (e.g. highly specific species management issues).
- This guideline recognises and respects Traditional Owner traditional ecological knowledge and the importance of collaborative fire management. Consultation and involvement should be sought from local Traditional Owners in the preparation and implementation of planned burns and specific guidelines incorporated into fire strategies where relevant.
- Development of the guideline has been by literature review and a knowledge-capturing exercise, using both scientific and practical sources. It will be reviewed as new information becomes available.

QPWS, Bells Prairie Track, Moorrinya National Park (2008).

Figure 1: Map of the Desert Uplands bioregion of Queensland.

Fire and climate in the Desert Uplands bioregion of Queensland

The hot semi-arid climate of the Desert Uplands bioregion receives a relatively high average rainfall (400–600 mm), most of which falls in the summer (Fensham and Fairfax 2007). However, years which experience average rainfalls are interspersed with long periods of drought (e.g. nine consecutive years of below average rainfall in the late 1800s). In many communities this results in fires that will only carry after years of high rainfall, sometimes a succession of good seasons are required (Anchen et al. 2006). Therefore planned burning in many fire vegetation groups of the desert uplands is highly dependant on rainfall and subsequent growth of the ground stratum resulting in sufficient fuel load to carry a fire.

The unpredictable summer rains are followed by cold, dry winters when severe frosts can result in the curing or death of vegetation and increase the flammability of fuels and wildfire risk.

Planned burning in the Desert Uplands generally commences in the early dry season (around April) to take advantage of the remaining soil moisture from the previous wet season and partially cured grasses to create patchy burns (Anchen et al. 2006). The wildfire season extends from September through to March (seasonally dependant), with most wildfires occurring within two years of average or above average rainfall.

Further information can be found in the QPWS Planned Burn Guidelines: How to Assess if Your Burn is Ready to Go and on the Bureau of Meteorology website at <www.bom.gov.au>.

How to use this guideline

Step 1: Know your local fire strategy. This planned burn guideline works with and supports your local fire strategy. While the guideline should address the majority of issues in your area, it is essential you also review your fire strategy before completing your planned burn proposal to ensure all ecological issues are considered (e.g. zoning plan, threatened species, fire histories, *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* and other legislative requirements).

Step 2: Observe the country. It is essential to regularly observe the country that you manage (and the surrounding landscape). Familiarise yourself with this guideline so it becomes part of your observation of the environment as you go about your work. To assist you in observing the environment, undertake this simple exercise:

1. If a **canopy** is present (e.g. for open forests and woodlands) observe the following:
   a) Is tree branch foliage dying? Is there epicormic regrowth on branches? Are there any dead trees?
   b) Are there habitat trees (e.g. trees with hollows)?
   c) Are there rainforest, scrub or riparian ecosystems nearby?
2. For fire vegetation groups with a **mid-layer** (trees above the height of shrubs and grasses but not yet in the canopy) observe the following:
   a) What are the mid-layer trees (young canopy trees, wattles, casuarinas or rainforest species)? How open or dense is the mid-layer?
   b) Is there evidence of fire? What is the prevalence and height of blackened bark?
3. For fire vegetation groups with a **ground-layer** of grasses, sedges or shrubs, observe where relevant:
   a) The presence of grasses and grass clumps. Do the grasses look healthy and vigorous? Are there well-formed grass clumps?
   b) Is there a build-up of dead and decaying matter associated with grasses, shrubs, ferns or sedges?
   c) Are shrubs looking healthy and vigorous? Are there dying crowns on the shrubs?
   d) Does the ground-layer have a diversity of species or is it dominated by one or a few juvenile tree species? Are weeds dominating the understorey?

Step 3: Read the relevant chapters of this guideline and decide which issues apply to the area you are observing. It is common for burn proposals to address more than one issue—do not necessarily limit yourself to one issue per burn proposal.

Step 4: Consider your fire management priorities. Each chapter offers guidance for determining fire management priorities. The statements about priorities are based on a standard QPWS planned burn proposal prioritisation framework intended to guide both land managers and approval bodies.

Step 5: Choose measurable objectives. Each chapter of this guideline provides measurable objectives to include in your burn proposals (be guided also by the objectives in your fire strategy). Choose one or more objectives whilst observing the land. Do you need to adjust the objectives so they apply to your situation? Do you need to develop objectives not already included in these guidelines? If you find it difficult to identify your objectives, contact your natural resource management ranger or equivalent.

Step 6: Write a burn proposal. The **measurable objectives, fire behaviour, tactics** and **weather conditions** sections of each chapter can be copied directly into your burn proposals. Copy (ctrl+c) statements from a PDF version of this guideline and paste them (ctrl+v) into the burn proposal. Note that you may have to adjust the wording.

Step 7: Is your burn ready to go? Refer to the QPWS Planned Burn Guidelines: How to Assess if Your Burn is Ready to Go. Becoming familiar with the tools in this guideline will enable you to predict fire behaviour and achieve your burn proposal objectives.

Step 8: Review the measurable objectives in your burn proposal. After a fire, undertake the post-fire assessment recommended by this guideline (as defined in your burn proposal). This will indicate if you have achieved your planned burn objectives. This guideline provides information on how to report the results in your fire report.

Step 9: Review your fire management issue (re-apply this guideline to the burn area starting from Step 1). Return to the burn area after one year and then a few years after the original burn—once again applying this guideline. Many issues (such as weed control) are not resolved with a single burn and it is important to keep observing the land. If the results of fire management are unexpected or difficult to understand please seek further advice. If this process identifies shortfalls in your fire strategy, consider reviewing it. Step 9 can be implemented as part of a structured photo-monitoring process at various locations within the estate. Instructions can be obtained from the QPWS Fire Management System.

Chapter 1: Eucalypt communities

This fire vegetation group occurs throughout the Desert Uplands bioregion and contains a variety of communities that vary with annual rainfall, landform and soil type. The canopy is generally between 12–25 m, and occasionally up to 30 m and is dominated by one or a few eucalypt, bloodwood or box species. Sand plains and sandstone ranges tend to support yellow jacket *Eucalyptus similis,* rustyjacket *Corymbia leichhardtii*, silver-leaved ironbark *Eucalyptus melanophloia*, White's ironbark *Eucalyptus whitei* and *Corymbia setosa*. Boxes are present (generally on better soils) and may include grey box *Eucalyptus persistens* and Reid River box *Eucalyptus brownii*. A shrub layer is sometimes present and may be sparse to scattered. Some areas have a dense heath understorey.

There are two main types of eucalypt communities distinguished by their ground layer:

Spinifex and heath dominated eucalypt communities consist of open woodlands to shrublands of mixed eucalypt and corymbia species with a ground layer dominated by spinifex species such as buck spinifex *Triodia mitchellii* or soft spinifex *Triodia pungens* with sedges, other grasses and forbs also present (often as scattered individuals). Some areas can have a dense heath layer that burns with a higher severity.

Tussock grass dominated eucalypt communities have a ground layer dominated by grasses with species such as *Eriachne, Aristida, Heteropogon, Paspalidium, Cymbopogon* and/or occasional *Triodia*. Forbs and sedges are also occasionally present. The ground layer is often sparse and will generally not burn due to low fuel loads. The canopy of mixed bloodwood and eucalyptus species is also often sparse. This fire regime group includes areas of fringing eucalypt woodland.

Fire management issues

The main fire management issue in eucalypt communities is maintaining a variation in time-since-fire across the landscape. Such an approach to fire management ensures diversity of habitats and species including recently burnt areas as well as habitat for long-lived and obligate-seed regenerating species requiring longer fire intervals. This mosaic burning also assists in reducing the extent of wildfires and impacts on adjacent fire-sensitive communities (e.g. lancewood *Acacia shirleyi*). The overabundance of some species such as acacia, eucalypt, false sandalwood *Eremophila mitchellii* and currant bush *Carissa lanceolata* can be an issue in some areas and may lead to woody thickening. Being aware of the presence of high-biomass grasses such as buffel *Pennisetum ciliare* and woody weeds such as parkinsonia *Parkinsonia aculeata* and rubber vine *Cryptostegia grandiflora* is important, as these may require an altered approach to fire management.

Issues:

1. Maintain healthy spinifex dominated eucalypt communities.
2. Maintain healthy tussock grass dominated eucalypt communities.
3. Reduce overabundant saplings.
4. Reduce woody weeds.
5. Manage invasive grasses.

Extent within bioregion: 4 409 473 hectares (ha), 63 per cent; **Regional ecosystems:** Refer to Appendix 1 for complete list.

Examples of this FVG: White Mountains National Park, 57 243 ha; Moorrinya National Park, 16 045 ha; Cudmore (Limited Depth) National Park, 9 705 ha; White Mountains Resources Reserve, 7 382 ha; Cudmore Resources Reserve, 4 277 ha; Forest Den National Park, 137 ha.

Issue 1: Maintain healthy spinifex dominated eucalypt communities

Awareness of the environment

Key indicators of healthy eucalypt communities with a spinifex understory:

- Eucalypt communities have a canopy of eucalypt or corymbia trees. Some young canopy species are recruiting in the understorey (enough to eventually replace the canopy) but are not extensive enough to produce shading impacts.
- There is a variation in time-since-fire for spinifex across the landscape. Some more recently-burnt areas have spinifex interspersed with occasional grasses. These should be broken up by longer unburnt areas that retain large clumps of mature spinifex.
- In shrubby/heath areas such as in the Burra Range there is a diversity of shrub species including acacia, hop bush *Dodonaea* spp., *Jacksonia ramosissima*, Townsville wattle *Acacia leptostachya*, *Comesperma pallidum* and toothbrush grevillea *Grevillea pteridifolia*.

The presence of mature, healthy trees and saplings of White's ironbark may be an indicator of healthy open woodlands.

E.J. Thompson, Queensland Herbarium, Llorac Station, Muttaburra (2006).

Mature spinifex ground cover would ideally be interspersed with areas of more recently-burnt spinifex. A diversity of short-lived grasses and forbs between hummocks may be present especially after rain.

E.J. Thompson, Queensland Herbarium.

Flowering *Jacksonia ramosissima*. Shrubby eucalypt communities often contain obligate-seed regenerating species and require a longer period after fire to mature and set seed (at least two years of seeding is preferred).

Paul Williams, Vegetation Management Science Pty Ltd, Burra Range, White Mountains (2007).

Dense shrubby woodland often contains fire-killed shrubs and requires fire less frequently than more open spinifex woodlands.

Paul Williams, Vegetation Management Science Pty Ltd, White Mountains (2008).

The following may indicate that fire is required to maintain eucalypt communities with a spinifex understory:

- Spinifex hummocks have accumulated dead matter within the clumps.
- Spinifex clumps have joined to become more continuous in such a way that fire will carry.
- The diversity of the ground layer has decreased. Herbs and forbs are absent between spinifex hummocks.
- Fire-germinated seedlings (such as some acacias and grevilleas) have matured and borne seed (allow to set seed at least twice).
- Wattles and *Jacksonia ramosissima* or *Comesperma pallidum* that germinated after a previous fire are beginning to die or are dead.
- In shrubby eucalypt communities with a spinifex ground layer, dodder laurel *Cassytha filiformis* may have begun to smother shrubs and ground layer plants.

After eight years without fire, spinifex can become so dense that herbs and forbs growing between hummocks are rare.

Paul Williams, Vegetation Management Science Pty Ltd, White Mountains (2008).

Dead shrubs may indicate long unburnt areas and the need to introduce fire.
Paul Williams, Vegetation Management Science Pty Ltd, White Mountains (2009).

Acacia galioides matures relatively quickly following fire (two to three years). Other obligate-seed regenerating species may require six or more years.
Paul Williams, Vegetation Management Science Pty Ltd, White Mountains (2005).

Discussion

- Spinifex usually continues to increase in size and fuel load with time-since-fire. As time-since-fire increases, the distance between hummocks decreases, allowing the fire to travel more readily across the landscape. A very wet year (depending on when the rain falls, e.g. summer rain is better for spinifex growth than winter rain) or a succession of wet years can provide a boost to the growth of spinifex (and consequently an increase in fuel load). This increased fuel load can result in severe, extensive wildfires usually within the following two seasons.
- To achieve a mosaic in spinifex, burns need to occur in the wet season (or very soon after the wet season) to take advantage of moisture retained in the fuel. Be aware that spinifex can appear green throughout the year, and yet still burn intensely (depending on moisture retention).
- Recently-burnt spinifex communities tend to have a greater diversity of species. These include resprouting perennials, annuals and ephemeral forbs that occur amongst the spinifex. The number of species present tends to decline with time-since-fire.
- Shortly after a fire in an area where spinifex is interspersed with tussock grasses (such as blady or black spear grass) spinifex can appear as though it has not re-sprouted. This is because tussock grasses have a faster-growing habit. Over time the spinifex hummocks will regain their pre-fire height, giving a mixed hummock/tussock grassland appearance.
- Some shrubs such as *Acacia leptostachya* and *Jacksonia ramosissima* tend to decline with the absence of fire. Results of a field survey in White Mountains National Park in 2009 showed that after eight years without fire these shrubs were senescing. However, a number of years are required between fires to allow them to mature and set seed, in order that they persist in the ecosystem. For example, *Jacksonia ramosissima* requires four years and *Acacia leptostachya* requires six years (Williams et al. 2007). Mosaic burning helps to maintain various areas at different time-since-fire.
- Fires which are too-severe and occur without sufficient soil moisture result in the death of sub-soil grass bases/roots and slow post-fire recovery time. Soil moisture promotes rapid spinifex seedling establishment post-fire. Burning without soil moisture will often kill the spinifex hummock or slow seedling establishment giving a competitive advantage to weeds and woody species.
- Mosaic burning is the best way to maintain areas at various stages of post fire recovery to meet the varying habitat requirements of a diversity of species. For examples, in shrubby yellow jacket woodland with a spinifex understorey, small mammals are regularly recorded in monitoring surveys on the Burra Range. Numbers of the delicate mouse *Pseudomys delicatulus* and desert mouse *Pseudomys desertor* were shown to vary in abundance depending on time-since-fire. The results suggest that fire frequencies of greater than six years are required to allow shrubs to mature and ground cover to return, maintaining vegetation health and benefiting the small mammals of the community.

The numbers of delicate and desert mice fluctuate in response to vegetation growth following fire. **Above:** *Pseudomys delicatulus*
DERM photo library.

Unlike tussock grasses, spinifex hummocks continue to accumulate fuel (albeit more slowly in very dry years).
Kerensa McCallie, QPWS, White Mountains National Park (2011).

What is the priority for this issue?

Priority	Priority assessment
Very high	Planned burn required to maintain areas of **special conservation significance**.
High	Planned burns to **maintain ecosystems** in areas where **ecosystem health** is **good**.

Assessing outcomes

Formulating objectives for burn proposals

Every proposed burn area contains natural variations in topography, understorey or vegetation type. It is recommended that you select at least three locations that will be good indicators for the whole burn area. At these locations walk around and if visibility is good look about and average the results. Estimations can be improved by returning to the same locations before and after fire, and by using counts where relevant.

Select at least two of the following as most appropriate for the site:

Measurable objectives	How to be assessed	How to be reported (in fire report)
Over several hectares, a mosaic of 50–80 % of blackened ground within the boundary of the burn area.	Chose one of these options: a. Visual estimation of percentage of vegetation burnt - from one or more vantage points, or from the air. b. Map the boundaries of burn area with GPS, plot on GIS and thereby determine the percentage of area burnt. c. In three locations (that take account of the variability of landform and ecosystems within burn area), walk 300 m or more through planned burn area estimating percentage of ground burnt within visual field.	**Achieved:** 50–80 % reduced. **Partially Achieved:** 25–50 %, or 80–90 %. **Not Achieved:** < 25 % or > 90 %.

> 75 % of grass bases remain after fire.	Before and after fire, select three or more sites (taking into account the variability of landform and likely fire intensity) and estimate cover of grasses that recover one to three months after fire.	**Achieved:** > 75 % basses remain. **Partially Achieved:** 50–75 % basses remain. **Not Achieved:** < 50 % basses remain.
Obligate seeders (e.g. *Jacksonia, Acacia* spp.) promoted.	Six to 12 months after the burn: Obligate seeders such as acacias, *Jacksonia* or grevilleas can be seen to be recovering from fire— from one or more vantage points, or from the air.	**Achieved:** Obligate seeders recovering. **Not Achieved:** Few obligate seeders recovering.
Minimise canopy scorch across the planned burn area.	Before and after fire, select three or more sites (taking into account the variability of landform and likely fire intensity) and estimate number of mature trees. Determine the percentage of canopy scorched.	**Achieved:** > 50 % of trees have not had extensive canopy scorch. **Partially Achieved:** 50–70 % have not had extensive canopy scorch. **Not Achieved:** > 70 % have had extensive canopy scorch.

If the above objectives are not suitable refer to the compendium of planned burn objectives found in the monitoring section of the QPWS Fire Management System or consider formulating your own.

Monitoring the issue over time

Many issues are not resolved with a single planned burn and it is important to keep observing the land. To support this, it is recommended that observation points be established. Observation points are usually supported by photographs and by recording observations. Instructions for establishing observation points can be obtained from the monitoring section of the QPWS Fire Management System.

Monitoring obligate seed regenerating species can assist in ensuring fires are sufficiently patchy over time to allow these species to persist in the landscape. Monitoring obligate seeders such as acacias, *Jacksonia* or grevilleas, to ensure they can be seen to be at various heights and stages of recovery from fire is useful. Fire reports and fire history mapping, where available, can provide guidance.

Fire parameters

What fire characteristics will help address this issue?

Fire severity

- **Low** and occasionally **moderate**.
- Due to the dense structure of the mid stratum in some spinifex-dominated eucalypt communities, they may burn with a **high** severity.

Fire severity class	Fire intensity (during the fire)		Fire severity (post-fire)	
	Fire intensity (kWm^{-1})	Average flame height (m)	Average scorch height (m)	Description (loss of biomass)
Low (L)	50–100	0.3–0.5	≤ 2.5	Some patchiness. Most of the surface and near surface fuels have burnt. Stubble still evident.
Moderate (M)	100–1500	0.5–1.5	Complete standing biomass removed (ground layer).	All surface and near surface fuels burnt. Stubble burnt to blackened remnants.

Note: This table assumes good soil moisture and optimal planned burn conditions.

Obligate seeders require many years to mature and set seed prior to fire. *Comesperma pallidum* can be a useful indicator of appropriate fire management—once they are beginning to die, consider applying fire to the area.

Paul Williams, Vegetation Management Science Pty Ltd, White Mountains National Park (2006).

This area is not yet ready for reintroduction of fire. Three years after fire, these shrubs are yet to mature and set seed, also the density of spinifex ground cover remains too sparse to carry fire.

Paul Williams, Vegetation Management Science Pty Ltd, White Mountains (2004).

Fire frequency / interval (refer to Appendix 2 for a discussion)

- Fire frequency should primarily be determined through **on-ground assessment of vegetation health, fuel accumulation and previous fire patchiness** and adjusted for wildfire risk and drought cycles.
- Apply mosaic planned burns across the landscape at a range of frequencies to create varying stages of post-fire response (recently burnt through to the maximum time frame). For eucalypt woodlands with a spinifex understorey consider a broad fire interval range of between five to ten years. And for heath dominated understoreys consider a fire interval of greater than six years.

Mosaic (area burnt within an individual planned burn)

- A mosaic is achieved with generally 50–80 per cent burnt within the target communities.

What weather conditions should I consider?

It is important to be aware of conditions prior to and following burns so that undesirable conditions and weather changes can be avoided, or to help with burn planning.

Season:

- Burn during the wet season to mid-dry season, while the soil retains moisture.
- Do not burn in the late dry season to avoid high-severity fires. (August to September have characteristic strong, south-easterly winds).

GFDI: < 11

DI (KBDI): 80–120 (ideally < 100)

Wind speed: Beaufort scale 1–5, < 20 km/hr

Soil moisture: Use good soil moisture where possible as it protects the underground portion of vegetation and promotes seedling germination post-fire. Burning under conditions of good soil moisture will help restore ground cover and prevent erosion.

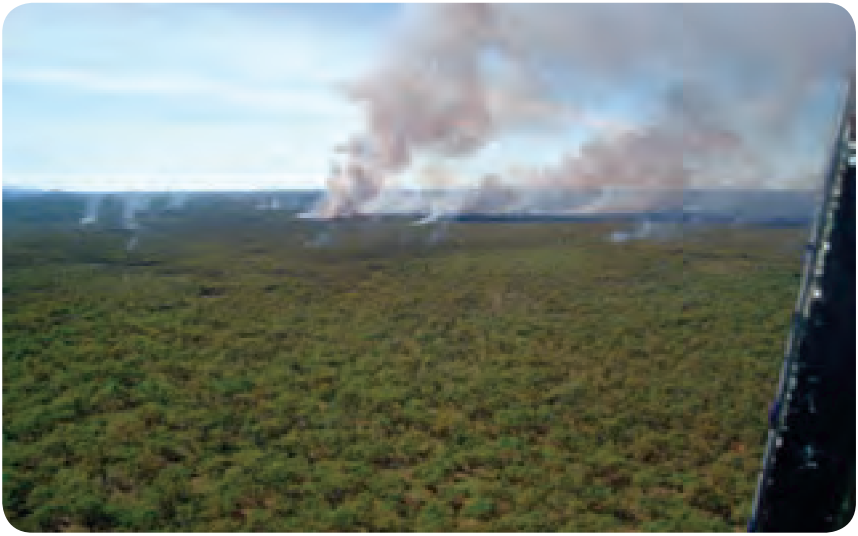
A dense ground cover of spinifex can indicate the need to apply fire. However these areas may burn with high severity in the wrong conditions.
Bronwyn Terry, QPWS, Moorrinya National Park (2012)

The same location as above with fire applied in February. It is clear that grass bases have been retained and some patches of unburnt vegetation remain. This is desirable.
Bronwyn Terry, QPWS, Moorrinya National Park (2012).

What burn tactics should I consider?

Tactics will be site-specific and different burn tactics may need to be employed at the same location (e.g. due to topographical variation). Also, during the burn tactics should be reviewed and adjusted as required to achieve the burn objectives. What is offered below is not prescriptive, rather a toolkit of suggested tactics.

- **Spot ignition** is the primary ignition tool used in this fire vegetation group. This tactic is used to alter the intensity of a fire and create the desired mosaic of burnt and unburnt areas. This can be achieved using a range of methods including drip torches, matches and incendiaries. Spots closer together will result in a line of a greater intensity (as spots merge they create hot junction zones). Spots further apart (or alternatively a single spot ignition) will result in a lower-intensity fire and greatly-varied mosaic of unburnt and burnt patches. The spacing of the spots may vary throughout the burn due to changes in weather conditions, topography and fuel loads. If the spinifex community has been broken up by previously-burnt areas, target the unburnt patches during the following years to create a richer landscape-level mosaic.
- **Commence lighting on the leeward (smoky) edge** to contain the fire and promote a low-intensity backing fire. Depending on available fuels and the prevailing wind on the day this may require either spot or strip lighting or a combination of both. Do not burn repeatedly from the same fireline.
- **Limit fire encroachment into non-target communities.** In some cases, acacia and spring communities can occur adjacent to eucalypt communities. Use appropriate lighting patterns along the margin to promote a **backing fire** that burns away from the non-target community. Refer to Chapter 5 (Issue 6), for fire management guidelines.



Aerial ignition using widely-spaced spots to create a high level of patchiness.
Grant Anchen, QPWS, White Mountains National Park (2010).

Issue 2: Maintain healthy tussock grass dominated eucalypt communities

Awareness of the environment

Tussock grass dominated eucalypt communities have a ground layer composed of grasses with shrubs generally absent or rare. Species such as *Eriachne, Aristida, Heteropogon, Paspalidium, Cymbopogon*, blue grasses *Dicanthium* or *Bothriochloa* spp. or occasional *Triodia* may be present. Forbs and sedges are also occasionally present. Often the ground layer is sparse to very sparse and will not burn due to low fuel loads. Fire mostly occurs only after good growth years.

Key indicators of health:

- Eucalypt communities have a canopy of eucalypt or corymbia trees. Some young canopy species are recruiting in the understorey (enough to eventually replace the canopy) but are not extensive enough to produce shading impacts.
- Grasses appear upright and vigorous.
- After the wet season a diversity of herbs and forbs are found between the grass tussocks in the ground layer.
- False sandalwood *Eremophila mitchellii* and currant bush *Carissa lanceolata* where present, are scattered and are not so frequent that they are beginning to shade out the ground layer.

Grasses may be naturally sparse, limiting fire spread and severity.

E. J. Thompson, Queensland Herbarium, Ventcher Station, 82 km south-west of Torrens Creek (2005).

Eucalyptus coolabah woodland. Grasses are upright and vigorous. This area would carry fire.

E. J. Thompson, Queensland Herbarium, Moorrinya National Park (2006).

Shrubs are scattered throughout the mid stratum but are not so abundant that they shade-out the understory.

E. J. Thompson, Queensland Herbarium, on stock route through Timaru Station, 50 km south south-east of Torrens Creek (2005).

Dense grasses may dominate the ground layer.

Eleanor Collins, QPWS, Moorrinya National Park (2008).

The following may indicate that fire is required to maintain eucalypt communities with a tussock grass understory:

- There is an accumulation of thatch (dead material), collapsing grass and the grass clumps are poorly formed.
- There is a build-up of dead branches, leaves, bark and other fuels.
- False sandalwood or currant bush are becoming more than scattered and are beginning to have shading impacts on the ground layer.

When grasses begin to collapse or accumulate thatch it may indicate that fire needs to be applied.

Bronwyn Terry, QPWS, Moorrinya National Park (2012).

In long-unburnt areas currant bush (Bottom) and false sandalwood (left and middle) can have shading impacts on the ground layer.

Paul Williams, Vegetation Management Science Pty Ltd, White Mountains National Park (2003).

Eleanor Collins, QPWS, Moorrinya National Park.

Paul Williams, Vegetation Management Science Pty Ltd, White Mountains National Park.

Discussion

- Fires that are too-severe and occur without sufficient soil moisture result in the death of sub-soil grass bases/roots and can slow post-fire recovery time. Soil moisture also promotes rapid post-fire seedling establishment. Burning without soil moisture can slow seedling establishment, reduce the ability of plants to reshoot from their bases and give weeds and woody species a competitive advantage.
- Fires from adjacent communities should be allowed to trickle into riparian woodlands but only for specific management purposes such as hazard reduction burning. If these areas must be burnt aim not to burn the same area more frequently than every eight years. Please refer to Chapter 4 for further management guidelines.
- Seed germination and recruitment of some species in the Desert Uplands may be linked to rainfall events (which possibly only occur every decade or so) and may occur in the absence of fire. These species include ghost gum *Eucalyptus dallachiana* and coolabah *Eucalyptus coolabah*. It is not necessary to apply fire to thin these trees as some of the trees which establish are then thought to dieback in years of drought. However it can be an advantage to burn in the year following good rains to manage currant bush and false sandalwood seedlings where rainfall has promoted their germination.
- Ironbarks are highly susceptible to drought stress. In years of consistently lower rainfall where these trees may be stressed, avoid burning until conditions improve.
- Off protected area estate, grasslands of the Desert Uplands are often heavily impacted by grazing. Combined with years of low rainfall this can result in very low fuel loads which over many years will inhibit fire.
- In some areas the canopy may become more closed if overabundant saplings have been left unmanaged. Provided grasses are still continuous enough in the understory to carry fire, the implementation of the guidelines for managing healthy grassy eucalypt forest or woodland should be sufficient to control the issue.
- The invasion of buffel grass is a key issue within some tussock grass eucalypt communities. Buffel grass can increase fuel hazard and contribute to tree death (particularly within ironbark communities). If this is an issue, refer to Chapter 5 (Issue 5), for fire management guidelines.

What is the priority for this issue?

Priority	Priority assessment
High	Planned burns to **maintain ecosystems** in areas where **ecosystem health** is **good**.
Medium	Planned burn in areas where **ecosystem health** is **poor** but recoverable.

Healthy woodlands should have trees ranging in age from saplings/seedlings through to mature canopy trees.

Paul Williams, Vegetation Management Science Pty Ltd, Moorrinya National Park (2009).

Assessing outcomes

Formulating objectives for burn proposals

Every proposed burn area contains natural variations in topography, understorey or vegetation type. It is recommended that you select at least three locations that will be good indicators for the whole burn area. At these locations walk around and if visibility is good look about and average the results. Estimations can be improved by returning to the same locations before and after fire, and by using counts where relevant.

Select at least two of the following as most appropriate for the site:

Measurable objectives	How to be assessed	How to be reported (in fire report)
A mosaic of 50–80 % of blackened ground within the boundary of the burn area.	Choose one of these options: a. Visual estimation of percentage of vegetation burnt – from one or more vantage points, or from the air. b. Map the boundaries of burnt areas with GPS, plot on GIS and thereby determine the percentage of area burnt. c. In three locations (that take account of the variability of landform and ecosystems within burn area), walk 300 m or more through planned burn area estimating the percentage of ground burnt within visual field.	**Achieved:** 50–80 % reduced. **Partially Achieved:** 25–50 %, or 80–90 %. **Not Achieved:** < 25 % or > 90 %.
> 75 % of false sandalwood and current bush reduced to the ground layer.	Before and after fire, select three or more sites (taking into account the variability of landform and likely fire intensity), and estimate the percentage of overabundant shrubs (above ground components) reduced by fire.	**Achieved:** > 75 % reduced. **Partially Achieved:** 25–75 % reduced. **Not Achieved:** < 25 % reduced.

If the above objectives are not suitable refer to the compendium of planned burn objectives found in the monitoring section of the QPWS Fire Management System or consider formulating your own.

Monitoring the issue over time

Many issues are not resolved with a single planned burn and it is important to keep observing the land. To support this, it is recommended that observation points be established. Observation points are usually supported by photographs and by recording observations. Instructions for establishing observation points can be obtained from the monitoring section of the QPWS Fire Management System.

Fixed monitoring plots are useful to monitor the combined loss of stags and logs over time (e.g. an ‘acceptable’ loss of five per cent of standing dead trees becomes ‘unacceptable’ when a consecutive fire also results in the loss of five per cent).

Monitor the composition of native grasses to ensure fire regimes (predominantly the season and frequency of burns) have not favoured one species over another across large areas.

Fire parameters

What fire characteristics will help address this issue?

Fire severity

- **Patchy** to **low** and occasionally **moderate** where overabundant shrubs or young trees are an issue.

Fire severity class	Fire intensity (during the fire)		Fire severity (post-fire)	
	Fire intensity (kWm^{-1})	Average flame height (m)	Average scorch height (m)	Description (loss of biomass)
Patchy (P)	< 50	< 0.3	≤ 1.5	High percentage of patchiness. Does not remove all the surface fuels (litter) and near surface fuels.
Low (L)	50–100	0.3–0.5	≤ 2.5	Some patchiness. Most of the surface and near surface fuels have burnt. Stubble still evident.
Moderate (M)	100–1500	0.5–1.5	Complete standing biomass removed (ground layer).	All surface and near surface fuels burnt. Stubble burnt to blackened remnants.

Note: This table assumes good soil moisture and optimal planned burn conditions.

Fire frequency / interval (refer to Appendix 2 for discussion)

- Fire frequency should primarily be determined through **on-ground assessment of vegetation health, fuel accumulation and previous fire patchiness** and adjusted for wildfire risk and drought cycles.
- Apply mosaic planned burns across the landscape at a range of frequencies to create varying stages of post-fire response (recently burnt through to the maximum time frame). Consider a broad fire interval range of between four to ten years for eucalypt woodlands with a grassy understorey.
- Concentrate the greater proportion of burning during wet years. Do not burn during drought years—this is particularly important for ironbark communities. If overabundant saplings/seedlings are an issue, fires at the lower end of the fire frequency are recommended until the issue is under control.

Mosaic (area burnt within an individual planned burn)

- A mosaic is achieved with generally 50–80 per cent burnt within the target communities.

Other considerations

- Frosts can occur in the Desert Uplands from late April until September, which can dramatically change fire behaviour overnight. Be aware that after the first big frost of the season, fuels will be significantly more cured and planned burns are much harder to contain.

Fire should be allowed to occasionally trickle into fringing eucalypt woodlands. Fire lit in adjacent ironbark woodland was allowed to trickle in to this adjacent river red gum riparian community. This will help prevent a late dry-season wildfire.

Paul Williams, Vegetation Management Science Pty Ltd, Bullock Ck, Moorrinya National Park (2011).

What weather conditions should I consider?

It is important to be aware of conditions prior to and following burns so that undesirable conditions and weather changes can be avoided, or to help with burn planning.

Season: Late wet season through to early dry season when the soil is moist. Timing burns to coincide with follow-up rain will further assist in promoting grasses.

- Be aware that periodic wildfires will occur and are not necessarily detrimental to this fire vegetation group (providing they do not occur too frequently or too extensively).
- **DO NOT** burn in very dry years. Wet seasons do not occur every year.
- Do not burn in the mid-late dry season as high-severity fires are likely (August to September have characteristically strong, south-easterly winds).

GFDI: < 11

DI (KBDI): 80–120 (ideally < 100)

Wind speed: Beaufort scale 1–5, or < 20 km/hr

Relative humidity: During the dry season be aware that sudden drops in humidity (even if not accompanied by increased wind speed) can occur and significantly increase the fire severity. A westerly wind change may precede this occurrence.

Soil moisture: Burn with good soil moisture where possible to protect the underground portion of vegetation. This will promote seedling germination post-fire and prevent erosion.

Late wet season burns can create patchy, low-severity fires in tussock grass-dominated eucalypt woodlands.

Paul Williams, Vegetation Management Science Pty Ltd, Moorrinya National Park (2008).

What burn tactics should I consider?

Tactics will be site-specific and different burn tactics may need to be employed at the same location (e.g. due to topographical variation). Also, during the burn tactics should be reviewed and adjusted as required to achieve the burn objectives. What is offered below is not prescriptive, rather a toolkit of suggested tactics.

- **Spot ignition** is often used to alter the intensity of a fire and create the desired mosaic of burnt and unburnt areas. This can be achieved using a range of methods including drip torches, matches and incendiaries. Spots close together will result in a line of a greater intensity (as spots merge they create hot junction zones). Spots further apart (or alternatively a single spot ignition) will result in a lower-intensity fire and a greatly varied mosaic of unburnt and burnt patches. The spacing of the spots may vary throughout the burn due to changes in weather conditions, topography and fuel loads. In the late wet season, patches of limited extent can be created by spot ignition late in the afternoon, using overnight dew to self-extinguish the fire.
- **Progressive burning** is an approach to planned burning where ignition is carried out throughout as much of the year as conditions safely allow. In the Desert Uplands, ignition can begin soon after the wet season providing fuel has cured sufficiently enough to carry fire. Numerous small ignitions create a fine-scale mosaic. Continue lighting until fires are beginning to carry well into the night but not overnight. These burnt areas can provide opportunistic or targeted barriers to fire. These support burning later in the year as well as provide fauna refuge areas. Progressive burning helps create a rich mosaic of severities, burnt/unburnt areas and seasonal variability.
- **Commence lighting on the leeward (smoky) edge** to contain the fire and promote a low-intensity backing fire. Depending on available fuels and the prevailing wind on the day this may require either spot or strip lighting or a combination of both. Do not burn repeatedly from the same fireline.
- **Limit fire encroachment into non-target communities.** In some cases, riparian, lancewood and springs communities can occur adjacent to eucalypt communities. Use appropriate lighting patterns along the margin to promote a **backing fire** that burns away from the non-target community (refer to Chapter 5 (Issue 6), for fire management guidelines).
- Creating a **running fire** (through closely-spaced spot ignition or line ignition with the wind) may help in addressing the issue of woody species over-dominance.
- **Dual line spot ignition.** Ignite parallel lines of fire along a fireline to draw fires together. This creates greater fire intensity. This technique is particularly useful in areas of less-cured or sparse fuels. Be aware that in heavier or more cured fuels this technique may produce a greater severity fire than intended.

Issue 3: Reduce overabundant saplings

Overabundance of acacias, eucalypts or other shrubs and trees may lead to woody thickening. Woody thickening reduces the health of the ground layer through competition and shading.

Refer to Chapter 5 (Issue 3), for fire management guidelines.

Issue 4: Reduce woody weeds

Rubber vine *Cryptostegia grandiflora* is found predominantly in the north of the bioregion in moderate to low density infestations. Much of the northern half of the Desert Uplands is considered a priority management area because the infestations lie beyond the rubber vine containment line. Rubber vine is fire-sensitive and in some areas its eradication has been achieved using fire alone. Parkinsonia *Parkinsonia aculeata* is also found within the bioregion and is abundant and widespread in some areas.

Refer to Chapter 5 (Issue 4), for fire management guidelines.

Issue 5: Manage invasive grasses

Be aware that fire often promotes invasive grasses through disturbance. Some species of invasive grasses can be reduced or eliminated using fire as part of control.

Refer to Chapter 5 (Issue 5), for fire management guidelines.

Chapter 2: Grassland communities

Grasslands in the Desert Uplands bioregion consist of areas of mixed grasses or are dominated by one or two species with occasional forbs. Trees and shrubs are absent or very rare. The most common species include Mitchell grass *Astrebla* spp., curly bluegrass *Dichanthium fecundum*, desert bluegrass *Bothriochloa ewartiana* and *Chloris* spp.

Grasslands are found predominantly in the west of the bioregion with scattered patches in the north-east.

Fire management issues

The main fire management issue in grasslands is maintaining their open structure by preventing an overabundance of seedlings and young trees. Overabundant native seedlings/saplings (leading to woody thickening) occur where fire has been long-absent, infrequent or repeatedly applied too early in the season (creating fires of insufficient severity to scorch seedlings/saplings). The presence of woody weeds and invasive grasses may also require and altered approach to fire management.

Issues:

1. Maintain tussock grasslands.
2. Reduce overabundant saplings/seedlings.
3. Manage woody weeds.
4. Manage invasive grasses.

Extent within bioregion: 141 524 ha, 2 per cent; **Regional ecosystems:** Refer to Appendix 1 for complete list.

Examples of this FVG: Moorrinya National Park, 3 496 ha; Forest Den National Park, 36 ha.

Issue 1: Maintain tussock grasslands

The structure of these grasslands can be very sparse, making fire difficult to introduce. These areas are prone to woody thickening so opportunities such as high rainfall events that promote a more continuous layer of grass fuels are important to manage this issue.

Awareness of the environment

Key indicators of healthy fire-adapted grassland:

- A diversity of grasses (including annuals and perennials) and forbs are present but perennials should dominate.
- Grasslands are treeless and shrubless or contain only scattered trees or shrubs.

Mitchell grasslands are open and easy to walk through due to a lack of shrubs and trees.
E.J. Thompson, Queensland Herbarium, Moorrinya National Park (2005).

A few scattered trees are present but not enough to create a shading impact.
E.J. Thompson, Queensland Herbarium, Ashton Station (2005).

Perennial grasses should dominate grasslands.
Eleanor Collins, QPWS, Moorrinya National Park (2009).

The following may indicate that fire is required to maintain fire-adapted grasslands:

- An accumulation of thatch (dead material), collapsing grass and poorly formed grass clumps are present.
- There is a lack of herbs and forbs between the grass tussocks.
- There is a dominance of annuals (especially the very distinctive, orange coloured flinders grass *Iseilema* spp.).
- Gidgee *Acacia cambagei*, blackwood *Acacia argyrodendron*, boree *Acacia tephrina*, *Eremophila* spp., or whitewood *Atalaya hemiglauca* may be common and seedlings are becoming visible above the grasses.
- Seedlings of weeds such as prickly mimosa *Acacia farnesiana* and prickly acacia *Acacia nilotica* are abundant and beginning to emerge above the grasses, especially after high rainfall events.
- Grass tussocks are more or less continuous across the ground layer, allowing the passage of fire.

Perennial grass cover can decline and be replaced by annuals in the absence of fire and/or due to grazing.

Paul Williams, Vegetation Management Science Pty Ltd, Moorrinya National Park (2004).

Accumulated thatch at the base of grass clumps is a good indicator of the need to apply fire.

Bronwyn Terry, QPWS, Moorrinya National Park (2012).

Discussion

- Native species such as *Acacia* spp., *Eremophila* spp., or weeds such as prickly acacia or prickly mimosa can produce a flush of seedlings following good seasonal rain or high rainfall events which can shade-out or out-compete ground layer diversity. Fires applied when these trees are young will have more success in reducing their density. For guidance on addressing overabundant saplings/seedlings refer to Chapter 5 (Issue 3).
- Fires that are too severe and occur without sufficient soil moisture result in the death of sub-soil grass bases/roots and slow the post-fire recovery time. Burning without soil moisture will often kill the grasses, slow the seedling establishment and give a competitive advantage to weeds and woody species.
- Fire is useful in the control of some woody weeds but is less effective (or may have no impact) on other species. If woody weeds are an issue, refer to Chapter 5 (Issue 4), for fire management guidelines.
- Grassland composition can decline with time-since-fire. Annuals begin to dominate the ground stratum.
- Dunnarts such as the endangered Julia Creek Dunnart *Sminthopsis douglasiar* are known to inhabit Mitchell grasslands, sheltering in crevices within the cracking clay soils or vegetation when rain prohibits the use of crevices. Woody weeds such as prickly acacia, mesquite *Prosopis* spp., parkinsonia and overabundant native shrubs are a major threat to the Julia Creek Dunnart as they shade out the grasses required for shelter and inhibit the cracking of the soils. In addition, increased tree density provides refuge for feral animals and additional roosting and perching sites from which predators (e.g. barn owls) can observe prey (DERM 2009). Maintaining regular, patchy fire in areas impacted by woody weeds and native shrubs can help control the issue (refer to Chapter 5 (Issue 4), for fire management guidelines).
- Mitchell grasslands may be subject to periodic invasion by coolabah *Eucalyptus coolabah*. A flush of coolibah may germinate and quickly grow to sapling size in years of floods and high water tables. The saplings then suffer major dieback when the country dries out (Addicott 1994). This is a natural, self-regulating process.
- Woody thickening becomes much more severe where stock grazing is combined with repeated early season burns. Stock grazing reduces fuel loads and prevents fires of sufficient severity to manage overabundant seedlings/saplings. This is further compounded by cattle concentrating their feeding on regrowth grasses in the recently burnt areas which allows woody species the competitive advantage.

What is the priority for this issue?

Priority	Priority assessment
Very high	Planned burn required to maintain areas of **special conservation significance**.
High	Planned burns to **maintain ecosystems** in areas where **ecosystem health** is **good**.
Medium	Planned burn in areas where **ecosystem health** is **poor** but recoverable.

Retaining the grass bases through implementing low-severity burns is important for the recovery of grasses after fire.

Paul Williams, Vegetation Management Science Pty Ltd, Moorrinya National Park (2011).

Continuous grasses will ensure even early dry season burns carry and also assist in soil moisture retention.

QPWS, Moorrinya National Park (2008).

Assessing outcomes

Formulating objectives for burn proposals

Every proposed burn area contains natural variations in topography, understorey or vegetation type. It is recommended that you select at least three locations that will be good indicators for the whole burn area. At these locations walk around and if visibility is good look about and average the results. Estimations can be improved by returning to the same locations before and after fire, and by using counts where relevant.

Select at least one of the following as most appropriate for the site:

Measurable objectives	How to be assessed	How to be reported (in fire report)
Over several hectares, a mosaic of 50–80 % of blackened ground within the boundary of the burn area.	Choose one of these options: a. Visual estimation of percentage of vegetation burnt - from one or more vantage points, or from the air. b. Map the boundaries of burn area with GPS, plot on GIS and thereby determine the percentage of area burnt. c. In three locations (that take account of the variability of landform and ecosystems within burn area), walk 300 m or more through planned burn area estimating the percentage of ground burnt within visual field.	**Achieved:** 50–80 % reduced. **Partially Achieved:** 25–50 %, **Or** 80–90 %. **Not Achieved:** < 25 % or > 90 %.
> 75 % of shrubs or saplings reduced.	Before and after fire, select three or more sites (taking into account the variability of landform and likely fire intensity), and count the number of shrubs or saplings (above ground components) reduced by fire.	**Achieved:** > 75 % reduced. **Partially Achieved:** 50–75 % reduced. **Not Achieved:** < 50 % reduced.

> 90 % of the bases of grass clumps remain in burnt areas.	Select one or more sites or walk one or more transects (taking into account the variability of landform and likely fire intensity) and estimate grass basses remaining after fire.	**Achieved:** > 90 % bases remain. **Partially Achieved:** 75–90 % bases remain. **Not Achieved:** < 75 % bases remain.

If the above objectives are not suitable refer to the compendium of planned burn objectives found in the monitoring section of the QPWS Fire Management System or consider formulating your own.

Monitoring the issue over time

Many issues are not resolved with a single planned burn and it is important to keep observing the land. To support this, it is recommended that observation points be established. Observation points are usually supported by photographs and by recording observations. Instructions for establishing observation points can be obtained from the monitoring section of the QPWS Fire Management System.

Monitoring the diversity of species within grasslands to ensure a mix of older, less diverse grassy areas are interspersed within a mosaic of more recently burnt areas with a mix of grasses and forbs.

It is important to regularly monitor Mitchell grasslands to ensure the encroachment and establishment of introduced and native trees and shrubs is minimised. Be prepared to implement fire to address this issue when possible. Monitor the cover of Blue grass and Mitchell grass clumps versus annual grass clumps. Fire has been absent too long when annuals begin to dominate.

Species diversity tends to decrease with time-since-fire in Mitchell grasslands.

Paul Williams, Vegetation Management Science Pty Ltd, Moorrinya National Park (2007).

Fires should be applied only when good soil moisture can be assured. Burning in the late wet season to mid dry season in years following good rainfall is ideal.

E. J. Thompson, Queensland Herbarium, Red Hill Station (2006).

Fire parameters

What fire characteristics will help address this issue?

Fire severity

- **Low** and occasionally **moderate**.

Fire severity class	Fire intensity (during the fire)		Fire severity (post-fire)	
	Fire intensity (kWm^{-1})	Average flame height (m)	Average scorch height (m)	Description (loss of biomass)
Low (L)	50–100	0.3–0.5	≤ 2.5	Some patchiness. Most of the surface and near surface fuels have burnt. Stubble still evident.
Moderate (M)	100–1 500	0.5–1.5	Complete standing biomass removed.	All surface and near surface fuels burnt. Stubble burnt to blackened remnants.

Note: This table assumes good soil moisture and optimal planned burn conditions.

A patchy burn in the early dry season.
Paul Williams, Vegetation Management Science Pty Ltd, Moorrinya National Park (2004).

Burns later in the season will have a greater flame height and be less patchy.
Eleanor Collins, QPWS, Moorrinya National Park (2009).

Fire frequency / interval (refer to Appendix 2 for discussion)

- Fire frequency should primarily be determined through **on-ground assessment of vegetation health, fuel accumulation and previous fire patchiness** and adjusted for wildfire risk and drought cycles.
- Apply mosaic planned burns across the landscape at a range of frequencies to create varying stages of post-fire response (recently burnt through to the maximum time frame). Consider a broad fire interval range of between four to ten years.
- Concentrate the greater proportion of burning during wet years. Do not burn during drought years. If overabundant saplings/seedlings are an issue, fires at the lower end of the fire frequency are recommended until the issue is under control.

Mosaic (area burnt within an individual planned burn)

- Use appropriate tactics and burning with good soil moisture to assist in creating a mosaic. Ensuring patchy fires in Mitchell grasslands is particularly important for the Julia Creek dunnart to ensure refugia from predators and maintain grassland diversity.
- A mosaic is achieved with generally 50–80 per cent burnt within the target communities.

Blue grasses are contiguous and it can be difficult to create patchy fires.

Eleanor Collins, QPWS, Kennedys Bore, Moorrinya National Park (2008).

What weather conditions should I consider?

It is important to be aware of conditions prior to and following burns so that undesirable conditions and weather changes can be avoided, or to help with burn planning.

Season:

- Burn during the late wet season to mid dry season and concentrate efforts after years of good rainfall.
- Frosts can occur in the Desert Uplands from late April until September. These frosts can dramatically change fire behaviour overnight. Be aware that after the first big frost of the season, fuels will be significantly more cured and planned burns may jump breaks and unexpectedly cross areas where earlier burns have been applied.

GFDI: < 11

DI (KBDI): 80–120 (ideally < 100)

Wind speed: Beaufort scale 1–5, or < 20 km/hr

Relative humidity: During the dry season, be aware that sudden drops in humidity, even if not accompanied by increased wind speed can occur and significantly increase fire severity. A westerly wind change may precede this occurrence.

Soil moisture: Good soil moisture is essential for assisting the protection of the underground portions of vegetation and to promote seedling germination post-fire. This will assist in restoring ground cover and preventing erosion issues.

Early season, low-severity burns will assist in the recovery of grasses.
Bronwyn Terry, QPWS, Moorrinya National Park (2012).

Curing occurs rapidly following frosts. Be aware that this can change fire behaviour.
Grant Anchen, QPWS, Blackbraes National Park (2007).

What burn tactics should I consider?

Tactics will be site-specific and different burn tactics may need to be employed at the same location (e.g. due to topographical variation). Also, during the burn tactics should be reviewed and adjusted as required to achieve the burn objectives. What is offered below is not prescriptive, rather a toolkit of suggested tactics.

- **Spot ignition** is often used to alter the intensity of a fire and create the desired mosaic of burnt and unburnt areas. This can be achieved using a range of methods including drip torches, matches and incendiaries. Spots close together will result in a line of a greater intensity (as spots merge they create hot junction zones). Spots further apart (or alternatively a single spot ignition) will result in a lower-intensity fire and greatly varied mosaic of unburnt and burnt patches. The spacing of the spots may vary throughout the burn due to changes in weather conditions, topography and fuel loads.
- In the late wet season, patches of limited extent can be created by spot ignition late in the afternoon, using overnight dew to self-extinguish the fire.
- **Progressive burning** is an approach to planned burning where ignition is carried out throughout as much of the year as conditions safely allow. In the Desert Uplands, ignition can begin soon after the wet season (providing fuel has cured sufficiently to carry fire). Numerous small ignitions can create a fine-scale mosaic. Continue lighting until fires carry well into the night, but not overnight. These burnt areas can provide opportunistic or targeted barriers to fire to support burning later in the year and provide important fauna refuges. Progressive burning helps create a rich mosaic of severities, burnt/unburnt areas and seasonal variability.
- **Commence lighting on the leeward (smoky) edge** to contain the fire and promote a low-intensity backing fire. Depending on available fuels and the prevailing wind on the day this may require either spot or strip lighting (or a combination of both). Do not burn repeatedly from the same fireline.
- **Limit fire encroachment into non-target communities.** In some cases, riparian, lancewood and springs communities can occur adjacent to eucalypt communities. Use appropriate lighting patterns along the margin to promote a **backing fire** that burns away from the non-target community.
- Creating a **running fire** (through closely-spaced spot ignition or line ignition with the wind) may help in addressing the issue of encroachment of woody species.
- Dual line/spot ignition. Ignite parallel lines of fire along a fireline to draw fires together, creating a greater fire intensity. This technique is particularly useful in areas of less cured or sparse fuels.

Various techniques can be used to create a mosaic in contiguous grasses. Well-spaced spots in Mitchell grasslands lit in the mid-afternoon with low wind in the early to mid dry season should assist in creating a patchy fire with fires extinguishing overnight.
QPWS, Moorrinya National Park (2008).

Issue 2: Reduce overabundant saplings/seedlings

Shading by native trees such as false sandalwood *Eremophila mitchellii* and currant bush *Carissa lanceolata* and *Acacia* spp. have become an issue in some areas. Shading can reduce the diversity of the ground layer and change the structure of some communities. Fires applied when these trees are young will have a better chance of reducing their density an increasing the kill rate.

Refer to Chapter 5 (Issue 3), regarding fire management guidelines.

Saplings and young trees of Blackwood *Acacia argyrodendron* are beginning to impact this Mitchell grass community. Fire should be applied soon to manage this issue.
QPWS, Bells Prairie Track, Moorrinya National Park (2008).

Issue 3: Manage woody weeds

Rubber vine *Cryptostegia grandiflora* is an aggressive, vigorous climber that can rapidly spread and smother a range of vegetation communities (most notably riparian zones and waterways). Fire has been proven to be an effective control measure for rubber vine as well as being an effective follow-up to other control methods such as mechanical and herbicide control (DEEDI 2011).

Rubber vine is well-established in watercourses, particularly in the northern Desert Uplands.

Prickly acacia *Acacia nilotica* can be an issue in grasslands and in particular within the Mitchell grasslands. While fire is known to be an effective tool to manage prickly acacia seedlings, mature plants are highly fire resistant—after being top-killed they usually resprout.

Other woody weeds may also be an issue, please refer to Chapter 5 (Issue 4), regarding fire management guidelines.

A previously thick infestation of parkinsonia has been thinned with fire allowing easier access. Follow-up herbicide control will be required.

QPWS, Monks Dam, Moorrinya National Park (2006).

Issue 4: Manage invasive grasses

It is important to be aware of the presence of invasive grasses as they can dramatically increase the fire severity, are often promoted by fire and may result in significant damaging impacts upon the vegetation community. Buffel grass *Pennisetum ciliare* in particular poses a significant threat. It alters fuel characteristics and promotes a cycle of damaging high-severity fires which gradually results in the fragmentation and overall decline of grasslands. Grader grass *Themeda quadrivalvis* is also known to be an issue within the bioregion.

Refer to Chapter 5 (Issue 5), regarding fire management guidelines.

Chapter 3: Acacia communities

Typically these communities are dominated by a single acacia species as a pure stand or in association with eucalypts or casuarinas. Many acacia species occur in the bioregion including lancewood *Acacia shirleyi,* bendee *Acacia catenulata*, mulga *Acacia aneura*, gidgee *Acacia cambagei*, doolan *Acacia salicina*, blackwood *Acacia argyrodendron*, boree *Acacia tephrina*, false boree *Acacia microcephala* and brigalow *Acacia harpophylla* with other species present but not forming part of the canopy. The sparse lower layers vary and may include shrubs, spinifex, tussock grasses and forbs (Hodgkinson 2002). However species such as false sandalwood can sometimes form a dense shrub layer. These communities are found on a variety of landforms including sandstone ranges, alluvial plains, lakeside dunes and the margins of plateaus.

Woodlands dominated by ebony tree *Lysiphyllum carronii, Terminalia oblongata*, red lancewood *Archidendropsis basaltica* or belah *Casuarina cristata* are also included in this fire vegetation group because they have similar fire management requirements.

Acacia-dominated communities are found throughout the bioregion and can cover extensive areas. They are the second largest fire vegetation group within the Desert Uplands bioregion.

Fire management issues

These communities generally have a sparse or very sparse ground layer and in some cases will only burn following irregular high rainfall events. Acacia communities with a spinifex ground layer continue to accumulate fuel between major rainfall events and will burn once hummocks have formed a contiguous layer.

In most instances, fire is not applied directly to acacia-dominated communities (e.g. planned burns). Instead, surrounding fire-adapted communities are managed to create a landscape mosaic of burnt and unburnt areas that mitigate the frequency, intensity and extent of unplanned fires impacting upon the acacia communities. This is of particular importance where invasive grasses have become established along the margin of or have been able to penetrate into the community (as these grasses increase the severity and encroachment of fire).

In some cases it is recognised that fuel loads within more open grassy acacia communities may require infrequent patchy burns to protect them from wildfire later in the season or promote ground layer diversity.

Invasive grasses such as buffel grass *Pennisetum ciliare* are one of the major threats to acacia communities due to its ability to draw fires into areas and increase fire severity.

Issues:

1. Burn adjacent fire-adapted communities to limit fire encroachment into acacia communities.
2. Use fire to maintain open grassy acacia communities.
3. Manage invasive grasses.

Extent within bioregion: 786 416 ha, 11 per cent; **Regional ecosystems:** Refer to Appendix 1 for complete list.

Examples of this FVG: White Mountains National Park, 48 734 ha; Cudmore (Limited Depth) National Park, 10 559 ha, Moorrinya National Park, 10 340 ha, Forest Den National Park, 3 945 ha, White Mountains Resources Reserve, 1 422 ha, Cudmore Resources Reserve, 1 181 ha; Wilandspey Conservation Park, 29 ha; Dalrymple National Park, 10 ha.

Issue 1: Burn adjacent fire-adapted communities to limit fire encroachment into acacia communities

Most acacia communities are fire-sensitive. To assist in their protection, maintain a varied landscape mosaic of burnt and unburnt patches in adjacent fire-adapted communities. This will help to limit the frequency and potential impacts of damaging unplanned fires (refer to Chapter 5 (Issue 6), regarding fire management guidelines).

More mature acacia communities are often self protecting.

E.J. Thompson, Queensland Herbarium, Egera Station (2010).

Recovering brigalow takes a long time to regain its pre-fire height. This area was burnt by wildfire in 1952.

Peter Stanton, Environmental Consultant Pty Ltd, Near Nebo (1992).

Fire plays no role in the germination of gidgee.

E.J. Thompson, Queensland Herbarium, Corinda Station (2006).

Sparse ground layers may hinder or prevent fire in some acacia communities.

E.J. Thompson, Queensland Herbarium, Moorrinya National Park (2006).

Even mature lancewood is susceptible to high-severity fire.

Paul Williams, Vegetation Management Science Pty Ltd, Moorrinya National Park (2001).

Discussion

- When conducting planned burns in areas adjacent to acacia communities it is important to be aware of the dominant acacia species, their response to fire and in particular the presence of invasive species (e.g. buffel grass) (refer to Chapter 5 (Issue 5), regarding fire management guidelines).
- Acacias such as brigalow, gidgee, boree, mulga, and blackwood are soft-seeded, long-lived and may be killed by fire. Fire plays no role in their germination which is very occasional and generally follows high rainfall years. These species often resprout from root suckers and take many years to mature.
- Repeated fires within the same decade that fully scorch the crown can result in a decline in abundance and distribution of lancewood (Williams et al. 2008). Aim to ensure lancewood communities remain long-unburnt (and in some cases unburnt) or are burnt with a low flame height as per their required fire intervals. The highest proportion of burning in surrounding areas should be implemented in the grassy open forests and woodlands. This will reduce the threat of repeated fires burning extensively across the landscape into communities that require longer fire-free intervals such as acacia (Williams and Tran 2009).
- *Acacia ramiflora* is considered vulnerable under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. The species is also listed as endangered under the *Nature Conservation Act 1992* (Qld) and is found within White Mountains National Park. After fire it can resprout from the base or from seed stored in the soil seed bank. While further work is required to determine the most appropriate fire regimes for the conservation of this species, it is thought that an occasional low to moderate severity.
- Mature lancewood and gidgee are essentially self-protecting when healthy and may not need active protection in the event of a wildfire or planned burn. In some areas they are used as a barrier to fire, providing fires in adjacent fire-adapted communities are of a low to moderate severity and relatively patchy.
- Where brigalow occurs as an intact stand it is somewhat self-protecting; a fire that will penetrate into the brigalow community is generally rare due to the closed structure of the community and a lack of fuels. Brigalow becomes vulnerable to fire during severe fire weather where they adjoin fire-adapted communities, when unseasonably high levels of rainfall have resulted in significant grass growth and a continuity of fuels or where the edge of brigalow communities has been invaded by invasive grasses such as buffel grass *Pennisetum ciliare* (which can draw fire into these areas).

Issue 2: Use fire to maintain open grassy acacia communities

Use low-severity mosaic burning to maintain grassland diversity in grassy acacia communities and to reduce impacts of wildfire.

Awareness of the environment

Indicators where fire management is required in grassy acacia communities:

- A cover of native grasses is present below an open mature canopy.
- There is an accumulation of thatch (dead material), collapsing grass and the grass clumps are poorly formed.
- Herbs in the ground layer have become very sparse.
- False sandalwood or currant bush are becoming more than scattered and are having shading impacts on the ground layer.
- There is a cover of ground layer fine-fuels, such as grasses, leaf litter, sedges and forbs that is likely to carry fire.

In open, grassy brigalow communities, fire is sometimes necessary to assist in their protection and to maintain the diversity of grasses.

E.J. Thompson, Queensland Herbarium, Bowie (2010).

Blackwood communities are susceptible to high-severity fire. Low-severity, patchy fire may assist in protecting these areas.

E.J. Thompson, Queensland Herbarium, Egera Station (2010).

Due to the continuous nature of grass fuels in this open blackwood community, patchy burns may be difficult to achieve. Burn in the late wet season to ensure there is good soil moisture. Early afternoon ignition when fires are likely to extinguish overnight can also assist in creating a patchy fire.

Paul Williams, Vegetation Management Science Pty Ltd, Moorrinya National Park (2011).

Good soil moisture is essential to maintain native grasses and prevent high-biomass grasses such as buffel from becoming established.

QPWS, Moorrinya National Park (2008).

Discussion

- Some blackwood communities on more sandy soils can have a dense and diverse grass layer that requires fire to maintain diversity. However fire severity needs to be kept low to ensure the blackwood trees are not damaged by canopy scorch.
- This community is heavily influenced by the intensity of fires. High-intensity fires often reduce the numbers of acacia while low-intensity, mosaic burning will help minimise the damage to the acacia and promote diversity in the community.
- Be aware that in the long-absence of fire, the canopy of acacia communities may close and become somewhat self-protecting. Prior to undertaking planned burns in open acacia communities, the land manager needs to be clear about how fire will shape the community and the objectives of fire management within that community.

What is the priority for this issue?

Priority	Priority assessment
Medium	Planned burn in areas where **ecosystem health** is **poor** but recoverable.

Assessing outcomes

Formulating objectives for burn proposals

Every proposed burn area contains natural variations in topography, understorey or vegetation type. It is recommended that you select at least three locations that will be good indicators for the whole burn area. At these locations walk around and if visibility is good look about and average the results. Estimations can be improved by returning to the same locations before and after fire, and by using counts where relevant.

Select at least two of the following as most appropriate for the site:

Measurable objectives	How to be assessed	How to be reported (in fire report)
Over several hectares, a mosaic of 50–80 % of blackened ground within the boundary of the burn area.	Choose one of these options: a. Visual estimation of percentage of vegetation burnt— from one or more vantage points, or from the air. b. Map the boundaries of burn area with GPS, plot on GIS and thereby determine the percentage of area burnt. c. In three locations (that take account of the variability of landform and ecosystems within burn area), walk 300 m or more through planned burn area estimating the percentage of ground burnt within visual field.	**Achieved:** 50–80 % reduced. **Partially Achieved:** 25–50 %, **Or** 80–90 %. **Not Achieved:** < 25 % or > 90 %.

Fire has not resulted in the encroachment of invasive grasses.	**After the burn** (after suitable germination/establishment conditions): Walk, and where possible GPS the margin of the community and compare pre and post burn distribution of invasive grasses.	**Achieved:** No encroachment of invasive grasses. **Partially Achieved:** Minor expansion of invasive grasses distribution into community; can be addressed with control measure such as herbicides. **Not Achieved:** Significant encroachment of invasive grasses; and will be difficult to control.

If the above objectives are not suitable refer to the compendium of planned burn objectives found in the monitoring section of the QPWS Fire Management System or consider formulating your own.

Monitoring the issue over time

Many issues are not resolved with a single planned burn and it is important to keep observing the land. To support this, it is recommended that observation points be established. Observation points are usually supported by photographs and by recording observations. Instructions for establishing observation points can be obtained from the monitoring section of the QPWS Fire Management System.

While fire plays no role in the recruitment of blackwood, it may occasionally be required to protect it from high-severity fires.

E.J. Thompson, Queensland Herbarium, Near Ulva Station (2005).

Fire parameters

What fire characteristics will help address this issue?

Fire severity

- A **patchy** or **low** severity fire.

Fire severity class	Fire intensity (during the fire)		Fire severity (post-fire)	
	Fire intensity (kWm^{-1})	Average flame height (m)	Average scorch height (m)	Description (loss of biomass)
Patchy (P)	<< 100	< 0.5	<< 2.0	High percentage of patchiness. Does not remove all the surface fuels (litter) and near surface fuels, some scorching of elevated fuels (no higher than two metres). No canopy scorch.
Low (L)	< 100	< 0.5	< 2.0	Some patchiness, most of the surface and near Surface fuels have burnt. Some scorching of elevated fuels. Little or no canopy scorch.
Moderate (M)	100–500	0.5–1.5	2.0–5.0	All surface and near surface fuels burnt. All or most of mid-storey canopy leaves scorched. Upper canopy leaves may be partly scorched.

Note: This table assumes good soil moisture and optimal planned burn conditions.

Fire frequency / interval (refer to Appendix 2 for discussion)

- Fire frequency should primarily be determined through **on-ground assessment of vegetation health, fuel accumulation and previous fire patchiness** and adjusted for wildfire risk and drought cycles.
- Apply mosaic planned burns across the landscape at a range of frequencies to create varying stages of post-fire response (recently burnt through to the maximum time frame). Consider a broad fire interval range of between six to ten years for open acacia communities.
- Concentrate the greater proportion of burning during wet years. Do not burn during drought years.

Mosaic (area burnt within an individual planned burn)

- 50–80 per cent burnt.

Patchy burns are ideal to mitigate against late season, high severity fires.
Eleanor Collins, QPWS, Moorrinya National Park (2009).

What weather conditions should I consider?

It is important to be aware of conditions prior to and following burns so that undesirable conditions and weather changes can be avoided, or to help with burn planning.

- **Season:** Burn during the wet season to mid-dry season, while the soil retains moisture.
- Do not burn in the late dry season as high-severity fires are likely (August to September have characteristically strong, south-easterly winds).

FFDI: < 11

DI (KBDI): < 80

Wind speed: Beaufort scale 1–3, or < 15 km/hr

Soil moisture: Good soil moisture is essential as it helps protect the underground portion of the vegetation, promotes seedling germination post-fire and prevents erosion issues.

What burn tactics should I consider?

Tactics will be site-specific and different burn tactics may need to be employed at the same location (e.g. due to topographical variation). Also, during the burn tactics should be reviewed and adjusted as required to achieve the burn objectives. What is offered below is not prescriptive, rather a toolkit of suggested tactics.

- **Spot ignition** is often used to alter the intensity of a fire and create the desired mosaic of burnt and unburnt areas. This can be achieved using a range of methods including drip torches, matches and incendiaries. Spots close together will result in a line of a greater intensity (as spots merge they create hot junction zones). Spots further apart or alternatively a single spot ignition will result in a lower-intensity fire and greatly varied mosaic of unburnt and burnt patches. The spacing of the spots may vary throughout the burn due to changes in weather conditions, topography and fuel loads.
- In the late wet season, patches of limited extent can be created by spot ignition late in the afternoon using overnight dew to self-extinguish fires.
- **Progressive burning** is an approach to planned burning where ignition is carried out throughout as much of the year as conditions safely allow. In the Desert Uplands, ignition can begin soon after or even during the wet season providing the fuel has cured sufficiently enough to carry a fire. Numerous small ignitions create a fine-scale mosaic. Continue lighting until fires are beginning to carry well into the night but not overnight. These burnt areas can provide opportunistic or targeted barriers to fire to support burning later in the year as well as providing refuge areas for fauna. Progressive burning helps create a rich mosaic of severities, burnt/unburnt areas and seasonal variability.
- **A low-intensity backing fire**. A slow-moving, low-intensity backing fire will generally result in the more complete coverage of an area. This tactic ensures the fire has a greater amount of residence time while the fire intensity and rate of spread are kept to a minimum.

Issue 3: Manage invasive grasses

It is important to be aware of the presence of invasive grasses as they can dramatically increase fire severity, are often promoted by fire and may result in significant impacts upon the vegetation community. Buffel grass *Pennisetum ciliare* in particular poses a significant threat to acacia communities as it alters fuel characteristics and promotes a cycle of damaging high-severity fires which gradually result in the fragmentation and overall decline in the extent of these areas.

Refer to Chapter 5 (Issue 5), regarding fire management guidelines.

Gidgee with buffel grass.
Justine Douglas, QPWS, Moorrinya National Park (2011).

Chapter 4: Riparian, spring and fringing communities

This fire vegetation group includes riparian areas, open fringing woodlands of melaleuca or eucalypt and springs associated with the Great Artesian Basin's recharge and discharge areas. It also includes ephemeral lake beds/herbfield or sparse fringing shrublands of lakes (which generally will not burn due to their low fuel loads).

Fire management issues

Most of the species in these communities are fire sensitive—do not intentionally burn them. When burning adjacent fire-adapted communities, limit fire encroachment by burning under suitable conditions and using tactics such as burning away from the edges. Springs have a biodiversity status of **'endangered'** or **'of concern'** and a number of near-threatened and endangered species are associated with the Great Artesian Basin's discharge springs. Also endangered, are many of the communities surrounding Lake Buchanan including clay pans, open sedgelands and sparse-tussock grasslands.

Implementing planned burns late in the wet season or early in the dry season may assist in preventing unplanned wildfires in riparian and fringing areas. Fire may also assist if riparian areas are to be used as barriers to fire (to break up extensive areas of fire-adapted communities).

Woody weeds such as rubber vine and parkinsonia are present in fringing areas such as the shores of Lake Galilee. Implementing burns where possible may assist in managing this issue.

Issues:

1. Limit fire encroachment into riparian, spring and fringing communities.
2. Reduce woody weeds.

Extent within bioregion: 318 038 ha, 5 per cent; **Regional ecosystems:** Refer to Appendix 1 for complete list.

Examples of this FVG: White Mountains National Park, 4 567 ha; Forest Den National Park, 1 797 ha; Moorrinya National Park, 1 622 ha; Cudmore Resources Reserve, 519 ha; Cudmore (Limited Depth) National Park, 276 ha; White Mountains Resources Reserve, 175 ha.

Issue 1: Limit fire encroachment into riparian, spring and fringing communities

Many riparian and fringing communities contain a high proportion of fire-sensitive species such as river she-oak *Casuarina cunninghamiana* and/or habitat trees. Too-frequent and/or severe fire removes or inhibits the development of structurally complex ground and mid-strata vegetation and may open up the canopy. This in turn may increase the risk of weed invasion and soil erosion, leading to a greater production of fine fuel (mainly grass) and hence an increase in the fire hazard. It is highly desirable to exclude fire (or at least minimise the frequency and intensity of fire) in many riparian communities in order to promote structurally-complex ground and mid-strata vegetation and retain mature habitat trees. To achieve this, allow fire to occasionally trickle into riparian areas from adjacent fire-adapted communities to maintain low fuel loads.

Refer to Chapter 5 (Issue 6), regarding fire management guidelines.

Manage adjacent fire-adapted vegetation to protect riparian areas.

E. J. Thompson, Queensland Herbarium, Tributary to Cape River.

Fire should be allowed to occasionally trickle into fringing eucalypt woodlands. Fire lit in adjacent ironbark woodland was allowed to trickle in to this adjacent river red gum riparian community. This helped prevent late dry season wildfire.

Paul Williams, Vegetation Management Science Pty Ltd, Moorrinya National Park, Bullock Creek (2011).

Dry, ephemeral lake beds will generally not burn due to the sparse nature of fuels.

E. J. Thompson, Queensland Herbarium, Lake Galilee.

Springs fed by the Great Artesian Basin are considered 'of concern'.

E. J. Thompson, Queensland Herbarium, Edgbaston Station (2010).

Issue 2: Reduce woody weeds

Rubber vine is presently found predominantly in the north of the bioregion in moderate to low density infestations. Much of the northern half of the Desert Uplands is considered a priority management area for rubber vine. Rubber vine may be controlled using fire; however using fire in fire-sensitive communities should be generally avoided. Some tactics such as targeting individual plants in riparian areas using a heli-torch may be an option.

Woody weeds such as parkinsonia are present in fringing areas such as the shores of Lake Galilee. Implementing burns where possible, may assist in managing this issue.

Refer to Chapter 5 (Issue 4), regarding fire management guidelines.

Chapter 5: Common issues

In the Desert Uplands bioregion there are some issues where the fire management approach is similar irrespective of fire vegetation group. Rather than repeating these issues for each fire vegetation group, they are gathered in this chapter and cross referenced where relevant in each fire vegetation group chapter.

Fire management issues

1. Hazard reduction (fuel management) burns.
2. Planned burning near sensitive cultural heritage sites.
3. Reduce overabundant saplings and seedlings.
4. Reduce woody weeds.
5. Manage invasive grasses.
6. Limit fire encroachment into non-target fire vegetation groups.
7. Manage severe storm or flood disturbance.

Issue 1: Hazard reduction (fuel management) burns

In many cases it is important to use fire to reduce fuels. In the QPWS Fire Management System, protection zones aim to create areas of simplified vegetation structure and reduced fuel levels around key infrastructure, property and natural and cultural resources that may be damaged by fire. Protection zones should be maintained in a relatively low fuel hazard state by planned burning as often as fuel levels allow. In wildfire mitigation zones the aim of planned burning is to simplify the structure and reduce the quantity of fuel (within the ecological regime for the community) to mitigate flame height, spread and intensity of subsequent wildfires; and therefore improve their controllability.

Awareness of the environment

Main indicators of where fire management is required

- The combined accumulation of all fuels (surface fuels, near-surface fuels, elevated fuels and bark hazard) exceeds a **low** to **moderate** overall fuel hazard as per the Overall Fuel Hazard Assessment Guide (Hines et al. 2010b). Note that this is the preferred assessment method.

Or

- The combined accumulation of all fuels (surface fuels, near-surface fuels, elevated fuels and bark hazard) exceeds five tonnes per hectare (see Step 5 of the supporting guideline: How to assess if your burn is ready to go, for a fuel load estimation technique).

Descriptive indicators of where fire management is required
(Not all of these indicators will apply to every fire vegetation group)

- Containment hazards (e.g. stumps, logs and stags) are present along firelines within protection zones.
- A high bark hazard is present.
- Dead material has accumulated around the base of grasses, sedges and ferns.
- There is an accumulation of continuous surface fuels that will carry a fire.
- Ground layer plants or shrubs are smothered by leaf litter in some areas.
- Shrub branches have significant dead material.
- Ribbon bark, leaf litter and fine branch material is perched in shrub and sapling foliage.
- An accumulation of coarse fuels with a diameter greater than six millimetres is present on the ground or perched in shrubs and trees.
- The mid or lower stratum is difficult to see through or walk through.

Early dry season burns can reduce fuel loads for the protection of fire-sensitive vegetation communities.

Eleanor Collins, QPWS, White Mountains (2010).

Discussion

- To estimate fuel hazard (recommended for use in open forests and woodlands) use the DSE Overall Fuel Hazard Assessment Guide (Hines, et al. 2010b).
- To estimate fuel load, refer to Step 5 of the QPWS Planned Burn Guidelines: How to Assess if Your Burn is Ready to Go.
- The terms fuel load and fuel hazard are widely used to describe fuels, often interchangeably. While they are related, they do differ significantly (refer to Photos 1a and 1b below) and can be defined as:

Fuel hazard – the "condition of the fuel taking into consideration such factors as quantity, arrangement, current or potential flammability and the difficulty of suppression if fuel should be ignited" (Wilson 1992).

Fuel load – "the dry weight of combustible materials per area, usually expressed as tonnes per hectare. A quantification of fuel load does not describe how the fuel is arranged nor its state or structure" (Hines et al. 2010a).

Demonstration of the difference between **fuel load** and **fuel hazard.**

Photo 1a: The two samples above have the **same fuel load** (eighteen pages of newspaper) but a different fuel arrangement.
Troy Spinks, QPWS (2010).

Photo 1b: The fuel arrangement contributes to the difference in **fuel hazard.**
Troy Spinks, QPWS (2010).

- It is important to maintain a simplified vegetation fuel structure in protection zones and wildfire mitigation zones, which means addressing issues such as suspended and elevated fuel and overabundant saplings and seedlings.
- Fire management that favours grasses will assist in achieving an open structure suitable for wildfire management and mitigation. Moist conditions and low-severity burns that retain the bases of grasses will give them a competitive advantage over woody species.
- In wildfire mitigation zones it is essential to maintain ecosystem health. Ensure the use of appropriate conservation objectives for the fire vegetation group in addition to a fuel reduction objective (refer to fuel reduction objectives below).
- When establishing protection zones or wildfire mitigation zones favour fire vegetation groups that support a simplified vegetation fuel structure. Where possible avoid fire vegetation groups containing species that naturally produce high-severity fire during wildfire conditions (e.g. heath).
- It is not always possible to contain planned burns within the protected area due to the location of park boundaries (firelines may not exist along park boundaries as they are often in inaccessible areas and have continuous fuel levels. Cooperative fuel reduction burns with neighbours are often the only way to achieve the objectives of protection and wildfire mitigation zones. Refer to the QPWS Good neighbour policy and Notifying external parties of planned burn operations procedural guide.
- Planned burning often creates a smoke management issue particularly where burns are undertaken close to residential areas or commercial operations (e.g. agriculture, airports, major roads and high voltage power lines). Planning needs to consider factors such as fuel type, fuel hazard, temperature inversion and wind speed and direction all of which can have significant effects on the quantity of smoke generated and how it is distributed.

What is the priority for this issue?

Priority	Priority assessment
Highest	Planned burn required to **protect life** and/or **property**, usually within **protection zones**.
Very high	Planned burn required to **mitigate hazard** or **simplify vegetation structure**, usually within **wildfire mitigation zones**.

Assessing outcomes

Formulating objectives for burn proposals

Every proposed burn area contains natural variations in topography, understorey or vegetation type. It is recommended that you select at least three locations that will be good indicators for the whole burn area. At these locations walk around and if visibility is good look about and average the results. Estimations can be improved by returning to the same locations before and after fire, and by using counts where relevant.

Measurable objectives	How to be assessed	How to be reported (in fire report)
Reduce overall fuel hazard to low or moderate. **Or** Reduce fuel load to < 5 tonnes/ha.	**Post fire:** use the Overall Fuel Hazard Assessment Guide (Hines et al. 2010b) **Or** Step 5 of the QPWS Planned Burn Guidelines: How to Assess if Your Burn is Ready to Go, to visually assess the remaining fuel in at least three locations.	**Achieved:** Fuel hazard has been reduced to low or moderate **Or** fuel load has been reduced to < 5 tonnes/ha. **Not Achieved:** Fuel hazard has not been reduced to low or moderate **Or** fuel load is > 5 tonnes/ha.

Burn 90–100 % (for protection zone) 60–80 % (for wildfire mitigation zone).	Choose one of these options: a. Visual estimation of percentage of vegetation burnt – from one or more vantage points, or from the air. b. Map the boundaries of burnt areas with GPS, plot on ParkInfo and thereby determine the percentage of area burnt. c. In three locations (that take account of the variability of landform and ecosystems within burn area), walk 300 m or more through planned burn area estimating the percentage of ground burnt within visual field.	**Protection zone** **Achieved:** > 90 % burnt. **Partially Achieved:** 80–90 % burnt, the extent and rate of spread of any subsequent wildfire would still be limited. **Not Achieved:** < 80 % burnt. High proportion of unburnt corridors extend across the area (the extent and rate of spread of any subsequent wildfire would not be sufficiently limited). **Wildfire mitigation zone** **Achieved:** 60–80 % burnt. **Partially Achieved:** 50–60 % burnt. **Not Achieved:** < 50 % burnt. High proportion of unburnt corridors extend across the area (the extent and rate of spread of any subsequent wildfire would not be sufficiently limited).

If the above objectives are not suitable refer to the compendium of planned burn objectives found in the monitoring section of the QPWS Fire Management System or consider formulating your own.

Fire parameters

What fire characteristics will help address this issue?

Fire severity

- **Low** and occasionally **moderate**. Where there is a high fuel load or elevated fuels (e.g. when first establishing a protection zone) the initial fire may result in a **moderate** to **high** severity. Following this initial burn, aim to reinstate a regime that will promote **low** severity planned burns. Severity should be sufficient to reduce elevated fuels and bark hazard (i.e. allow fire to run up trunks).

Fire frequency / interval (refer to Appendix 2 for discussion)

- **Protection zones:** Fuel management planned burns within protection zones are carried out as soon as possible after they can carry a fire in order to maintain a relatively low fuel hazard.
- **Wildfire mitigation zones:** Planned burns within wildfire mitigation zones are undertaken within the fire frequency recommended for the fire vegetation group but generally towards the lower end of that range.

Mosaic (area burnt within an individual planned burn)

- **Protection zones:** 90 per cent burnt.
- **Wildfire mitigation zones:** 70–80 per cent burnt.

While the objective of hazard reduction burning is to reduce fuels, aim to retain habitat features (such as logs) where possible.
QPWS Bullock Creek, Moorrinya (2008).

What weather conditions should I consider?

It is important to be aware of conditions prior to and following burns so that undesirable conditions and weather changes can be avoided, or to help with burn planning.

Season: Early to mid dry season, depending on seasonal conditions

FFDI: < 11

DI (KBDI): < 100 for soil moisture

Wind speed: Beaufort scale: 1–3, or < 15 km/hr

Soil moisture: While the aim of hazard reduction burning is to reduce the amount of fuel, good soil moisture is desirable to:

- reduce scorch height and limit leaf drop post fire
- minimise impact upon habitat trees, soils and other environmental values
- reduce the likelihood of a thicket of woody species developing post fire
- favour grasses over woody species (woody species will create undesirable fuel conditions and favour native grasses over exotic).

What burn tactics should I consider?

Tactics will be site-specific and different burn tactics may need to be employed at the same location (e.g. due to topographical variation). Also, during the burn tactics should be reviewed and adjusted as required to achieve the burn objectives. What is offered below is not prescriptive, rather a toolkit of suggested tactics.

- **Spot ignition** can be used effectively to alter the desired intensity of a fire particularly where there is a high accumulation of available and volatile fuels. Spots closer together will result in a line of a greater intensity (as spots merge and create hot junction zones) while increased spacing between spots will result in a lower intensity fire. The spacing of the spots will regularly vary throughout the burn due to changes in weather conditions, topography, fuel loads, etc.
- **Commence lighting on the leeward (smoky) edge** to contain the fire and promote a low intensity backing fire. Depending on available fuels and the prevailing wind on the day, use either spot or strip lighting or a combination of both.
- **A low intensity backing fire** is usually slow moving, and will generally result in a more complete coverage of an area and a better consumption in continuous fuel. This tactic ensures the fire has a greater amount of residence time and reduction of available fuels, particularly fine fuels (grasses, leaf litter, twigs etc), while minimising fire severity and rate of spread.
- While a low intensity backing fire is recommended, a **running fire** of a higher intensity may be required in discontinuous or elevated fuel. Use with caution and be aware of environmental impacts that may result. To create higher intensity, contain the smoky side first, then **spot light the windward (clear) edge**. Caution is required if the area is small in size or a narrow strip and the two lit lines will converge, creating a hot junction zone and greater than desired severity with the chance of fire escaping through a spot-over.

Issue 2: Planned burning near sensitive cultural heritage sites

It is important to have knowledge of the location of significant cultural heritage sites, items and places of Indigenous or European heritage when planning fire management. The local fire strategy should identify these locations (it is important to note that some locations will be culturally sensitive and therefore their location will not be specifically identified in text or on maps). Consulting Traditional Owners, the Department of Aboriginal and Torres Strait Islander and Multicultural Affairs (DATSIMA) Indigenous cultural heritage branch and the Department of Environment and Heritage Protection (EHP) European cultural heritage branch during fire strategy preparation will help to identify these places, items and issues.

Awareness of the environment

Key indicators of Indigenous cultural heritage sites:

- Raised mounds (especially with visible shell debris) or the presence of shell debris scattered on the ground can indicate the presence of shell middens.
- Rock shelters, especially if they have rock paintings, stone tools, artefact bundles, wrapped material or bones inside.
- Engravings on trees or rock faces.
- Arrangements of stones or raised earth patterns on the ground, or artefacts scattered on the ground.
- The presence of trees that have been scarred or carved (e.g. a scar in the shape of a canoe).

Caves such as this may contain cultural material vulnerable to smoke impacts.
David Cameron, DNRM, Unspecified location.

Indigenous markings such as scarred trees (e.g. to make containers, canoes, or temporary shelters) are potentially vulnerable to fire if fuel builds up around their bases.

David Cameron, DNRM (2004).

Rocks on the ground that appear to have been purposefully arranged are likely to have cultural heritage significance.

David Cameron, DNRM, Atherton (2002).

Shell material strewn across the ground or visible in a mound structure usually indicates the presence of a midden. Middens are potentially vulnerable from radiant heat, fire line construction or vehicle or machinery operations.

David Cameron, DNRM, Bribie Island (2005).

Key indicators of European cultural heritage sites:

- Ruined buildings, corrugated iron shacks, wooden house stumps, old fence posts, old stock yards, tomb stones, wells, graves, bottle dumps, old machinery and iron debris may all indicate the presence of a significant site.
- Quarries and old mine sites, deep holes sometimes covered with corrugated iron or wood.
- Plane wreckage.
- Forestry artefacts including marked trees (shield trees), springboard trees (stumps or trees with axe notches cut into it to support boards) and old machinery such as winders (timber tramways) and timber jinkers (timber lifting wagon).

Early European explorers sometimes left marks, plaques, and paint on trees. These may be vulnerable to fire especially if fuel has built up around the base of the tree.

David Cameron, DNRM, Dogwood Creek (2005).

In bushland areas, forestry and timber getting operations left a number of items that are now of cultural heritage significance including from the top left: shield trees (this one marks an apiary site), road signs (and other signs), timber getting equipment such as this timber winch, springboard trees, campsite remains (and other ruins from huts and fire towers).

Because of their location in forested areas, these are often vulnerable to fire, and need to be protected from wildfire through appropriate planned burning or mechanical fuel reduction.

When planning burns, consider if particular mild weather conditions, tactics, chipped lines or mechanical fuel reduction (e.g. raking) is required prior to implementing the burn.

David Cameron, DNRM, various locations.

Discussion

- **Do not** disturb any cultural heritage site or artefact. Leave all materials in place and treat the location with respect. If you are not sure whether the location or artefacts have been reported, consult the cultural heritage coordination units of DATSIMA (for Indigenous sites) or EHP (for European sites). Also refer to the Duty of Care Guidelines provided in the *Aboriginal Cultural Heritage Act 2003* (Queensland Government 2004).
- When planning burns in and adjacent to sensitive cultural heritage places there is a duty of care to ensure appropriate people are involved. Appropriate people may include Traditional Owners, indigenous rangers, historical societies and cultural heritage experts. If you are unsure who the appropriate people are, refer to the DATSIMA and/or EHP cultural heritage coordination units.
- Be aware of QPWS policy and procedures Management of cultural heritage places on NPRSR estate (DERM 2010a, 2010b) which recommends fire management of a heritage place involve burning only the area surrounding the place that does not contain objects or areas related to the cultural heritage place (e.g. fences or gravestones).
- Large-scale wildfires are known to damage cultural heritage values. A landscape proactively managed with mosaic burning will help limit the spread and severity of wildfires giving better protection to cultural heritage artefacts and sites.
- The key risks to cultural heritage sites and artefacts from fire are direct contact with flames, radiant heat and smoke (e.g. radiant heat can exfoliate the surface of rock art sites, flame can crack or burn items and smoke can damage paintings).
- To manage impacts from flame and radiant heat, consider reducing fuel levels though manual, mechanical, or herbicide means or a combination of these. If it is not necessary to reduce fuel it is preferable to leave the site completely undisturbed.
- For larger culturally significant sites it may be necessary to create a secure burnt edge by backing fire away from these locations. Use this tactic prior to broader-scale planned burns.
- For sites that may be impacted by smoke (e.g. rock paintings and rock shelters) use wind to direct smoke away from the site.

What is the priority for this issue?

Priority	Priority assessment
Highest	Fuel management through the implementation of planned burns within **Protection zones** to protect life, property and conservation values.
Very high	Burns protecting **significant cultural heritage sites**.

Assessing outcomes

Formulating objectives for burn proposals

As required, choose three or more locations that will be good indicators for the whole burn area. Return to the same locations before and after the fire.

Measurable objectives	How to be assessed	How to be reported (in fire report)
No impact on item or site of cultural heritage significance.	Visual inspection of site or items taking photographs before and after fire.	**Achieved:** no impact on site or item. **Not Achieved:** there was some impact on site or item.

Fire parameters

What fire characteristics will help address this issue?

Fire severity

- Burn within the parameters recommended for the fire vegetation group. **Low**-severity fires will be less likely to impact on cultural heritage sites.

Fire frequency / interval (refer to Appendix 2 for discussion)

- Be guided by the fire zoning plan and recommendations for the specific fire vegetation group within the planned burn area.

Mosaic (area burnt within an individual planned burn)

- If possible, a patchy fire will give greater overall protection to cultural heritage sites and items unless burning in adjacent areas where the object is to reduce fuel, in which case a good coverage of fire is recommended.

Landscape mosaic

- A landscape proactively managed with mosaic burning will help reduce fuel hazard and thereby limit the spread and severity of wildfires, giving overall better protection to cultural heritage artefacts and sites.

What weather conditions should I consider?

It is important to be aware of conditions prior to and following burns so that undesirable conditions and weather changes can be avoided, or to help with burn planning.

Season: Favour early season burning and moist conditions.

FFDI: < 11

DI (KBDI): < 100

Wind direction: Closely monitor the wind direction to avoid smoke, flame and/or radiant heat coming into contact with sensitive cultural heritage sites.

Wind speed: < 15 km/hr

Soil moisture: Ensure good soil moisture is present.

Using spot ignition and still conditions kept smoke away from this rock art site.
Mark Parsons, QPWS, Fishers Creek (2010).

What burn tactics should I consider?

Tactics will be site-specific and different burn tactics may need to be employed at the same location (e.g. due to topographical variation). Also, during the burn tactics should be reviewed and adjusted as required to achieve the burn objectives. What is offered below is not prescriptive, rather a toolkit of suggested tactics.

- **Manual fuel management.** Prior to undertaking planned burns near sites of cultural significance (e.g. scar trees and rock art sites), manual reduction of fuel may be required. This may include the raking, clearing (e.g. rake-hoe line), trimming or leaf blowing the surface fuels away from the site to limit potential impacts. If it is not necessary to manually reduce the fuel level, it is preferable to leave the site completely undisturbed.
- **Spot ignition** can be used to effectively alter the desired intensity of a fire (particularly where there is an accumulation of available and volatile fuels next to a site of interest). Widely-spaced spot ignition is preferred around cultural heritage sites as it will promote a slow-moving and manageable low-severity fire and limit the chances of a high-severity junction zone developing.
- **A low-severity backing fire.** A slow-moving, low-severity backing fire can help ensure fire severity and rate of spread are kept to a minimum. Depending on the conditions, **spot light the windward (clear) edge** to direct the active fireline and smoke away from the cultural heritage site. Use a chipped or wet line around the site so the resulting backing fire can be extinguished or self-extinguish at the chipped or wet line.

Issue 3: Reduce overabundant saplings and seedlings

In the Desert Uplands bioregion overabundance of currant bush *Carissa* spp., false sandalwood *Eremophila mitchellii*, flowering lignum *Eremophila polyclada* or saplings/seedlings of acacia or eucalypt (and occasionally other species) can reduce the health and diversity of the ground layer through competition and shading. If left unmanaged, the structure of woodlands and forests can become more closed and grasslands can become woodlands—a process known as woody thickening. As woody thickening progresses, fires become more difficult to reintroduce.

Awareness of the environment

Key indicators:

- Young trees including currant bush, false sandalwood, acacia, eucalypt, or other species are beginning to rise above ground layer plants.
- The mid stratum is becoming difficult to see or walk through.
- Ground layer plants are declining in health, diversity and abundance due to shading.
- Grasses are scattered, poorly formed and collapsing. Other ground layer plants have reduced in abundance and health.

Notice the seedlings of blackwood emerging above the Mitchell grasses. Now is an ideal time to apply fire to maintain the open structure of this community.

QPWS, Bull Prairie, Moorrinya National Park (2008).

Flowering lignum can become dense in some areas. Once grass fuels become thin, fires can become difficult to re-introduce.

Eleanor Collins, QPWS, Kennedys Bore, Moorrinya National Park (2009).

Discussion

Why are saplings overabundant?

An overabundance of saplings in the understorey may be triggered in response to the following:

- Repeated low-severity, early-season fires which reduce the shrubs and trees to ground level but generally do not kill them.
- Certain acacias can germinate en masse. In the absence of fire, seed stocks can build-up which is likely to lead to a mass germination event after fire. Where this has occurred, it is likely that more than one fire will be required to address the issue. Post-fire observations are essential to monitor the kill rate and germination of acacias in order to ascertain the need for subsequent fires. In the Desert Uplands there may be insufficient fuel accumulation in the two to three years prior to seed-set in acacias, meaning the opportunity to burn before this time is reduced.
- Woody thickening becomes much more severe where stock grazing is combined with repeated early season burns or a lack of fire. Stock grazing reduces fuel loads, preventing fires of sufficient severity to manage overabundant seedlings/saplings. This is further compounded by cattle concentrating on regrowth grasses in the recently burnt areas, allowing woody species the competitive advantage.
- Seed germination and recruitment of some species in the Desert Uplands may be linked to rainfall events (which possibly only occur every decade or so) and may occur in the absence of fire. These species include: blackwood *Acacia argyrodendron*, ghost gum *Corymbia dallachiana* or coolabah *Eucalyptus coolabah*. Some of the trees which establish are then thought to dieback in years of drought.

Potential impacts of overabundant saplings

- A thickening of trees may result in a lower diversity of plants within the understorey due to shading.
- Canopy species in the understorey are necessary for the eventual replacement of canopy. Continued observation will ascertain if the canopy species are becoming overabundant (are beginning to shade out the understory).

What is the priority for this issue?

Priority	Priority assessment
Very high	Planned burn required to maintain areas of **special conservation significance**.
High	Planned burns to **maintain ecosystems** in areas where ecosystem **health** is **good**.
Medium	Planned burn in areas where **ecosystem health** is **poor** but recoverable.
Low	Planned burn in areas where **ecosystem** structure and function has been **significantly disrupted**.

Assessing outcomes

Formulating objectives for burn proposals

Every proposed burn area contains natural variations in topography, understorey or vegetation type. It is recommended that you select at least three locations that will be good indicators for the whole burn area. At these locations walk around and if visibility is good look about and average the results. Estimations can be improved by returning to the same locations before and after fire, and by using counts where relevant.

Select at least two of the following as most appropriate for the site:

Measurable objectives	How to be assessed	How to be reported (in fire report)
> 75 % of mid stratum saplings are reduced.	Select one or more sites or walk one or more transects (taking into account the variability of landform and likely fire intensity), estimate the percentage of overabundant saplings (above ground components) scorched.	**Achieved:** > 75 %. **Partially Achieved:** 25–75 %. **Not Achieved:** < 25 %.
Increase the size of a grassland.	At a number of locations on the boundary of grasslands and woodlands establish photo monitoring points. Return to these locations within a year of each burn to check the grassland is expanding/woodland retreating.	**Achieved:** Grassland expanding/woodland retreating. **Partially Achieved:** grassland not expanding/woodland not retreating. **Not Achieved:** Grassland continues to retreat/woodland expand.

If the above objectives are not suitable refer to the compendium of planned burn objectives found in the monitoring section of the QPWS Fire Management System or consider formulating your own.

Monitoring the issue over time

Many issues are not resolved with a single planned burn and it is important to keep observing the land. To support this, it is recommended that observation points be established. Observation points are usually supported by photographs and by recording observations. Instructions for establishing observation points can be obtained from the monitoring section of the QPWS Fire Management System.

Fire parameters

What fire characteristics will help address this issue?

Residence time

- Slower-moving backing fires that create a high residence time around the base of overabundant saplings/seedlings are a good management technique for some species, where fuel loads are available.

Mosaic (area burnt within an individual planned burn)

- Burn as much of the area dominated by mid-stratum saplings as possible.

Fire frequency / interval (refer to Appendix 2 for discussion)

- It is likely that more than one planned burn will be required to manage this issue. Monitor the outcomes until the overabundant saplings/seedlings are controlled.
- *Eremophila* spp. are resistant to annual spring burns but can be killed by two consecutive autumn burns (Bull 2002). While this strategy has been successful in south-west Queensland, its effectiveness within the bioregion is yet to be trialed.

Fire severity (refer to relevant chapter for the severity table):

- **Moderate** for most situations where young trees are less than one metre tall. Avoid lower-severity burns, as this will exhaust fuel and reduce opportunities for subsequent higher-severity burns. For saplings greater than one metre tall, a **high**-severity fire might be required (do not use high-severity fire in acacia communities).

Other considerations

- It is important to observe post-fire germination, regeneration and kill rates to ascertain the need for subsequent fires. If the initial fire triggers a flush of new seedlings, follow-up with a planned burn within two years using a **moderate**-severity fire.
- If a fire has triggered a flush of eucalypt seedlings, allow the fuels to accumulate so that the fire will kill the seedlings. Be aware that some seedlings will be required to eventually replace the canopy. Occasional seedlings of canopy trees are not an issue.
- Once the area has recovered, the recommended regime for the fire vegetation group can be resumed (refer to relevant chapter).

Trees, such as these blackwood, which have reached more than one metre tall, may be more difficult to manage with fire alone. Note: False sandalwood (left side of image) can also become an issue in some areas.

QPWS, Moorrinya National Park (2008).

What weather conditions should I consider?

It is important to be aware of conditions prior to and following burns so that undesirable conditions and weather changes can be avoided, or to help with burn planning.

Season: Progressive burning through the year as conditions allow in surrounding healthy areas will make it much easier to achieve burns **later in the season** that will help address overabundant saplings.

FFDI: 8–18

KBDI: < 120 but ideally < 100

Wind speed: < 23 km/hr. Winds greater than 15 km/hr can help fire carry where fuels are low.

What burn tactics should I consider?

Tactics will be site-specific and different burn tactics may need to be employed at the same location (e.g. due to topographical variation). Also, during the burn tactics should be reviewed and adjusted as required to achieve the burn objectives. What is offered below is not prescriptive, rather a toolkit of suggested tactics.

- While a moderate-severity fire is recommended to address this issue, this is largely dependant upon the height of the saplings. A **running fire** of a higher intensity may be required initially where there is a lack of surface and near-surface fuels (due to shading or if the thicket is well developed). **Line or strip ignition** is used to create a fire of higher intensity or to help fire carry through moist or inconsistent fuels. In this instance a follow-up planned burn will be required in the one to three years post-fire to kill the surviving and new seedlings/saplings. Poorer soils will take longer to accumulate sufficient fuel to carry a fire.
- **A backing fire with good residence time.** For some species a slow-moving backing fire (lit against the wind on the smoky edge) ensures a greater amount of residence time at the base of the plant, while fire intensity and rate of spread are kept to a minimum. Greater residence time is useful in reducing these overabundant seedlings/saplings.

Issue 4: Reduce woody weeds

Rubber vine *Cryptostegia grandiflora*, parkinsonia *Parkinsonia aculeata*, prickly mimosa *Vachellia farnesiana,* prickly acacia *Acacia nilotica* and mesquite *Prosopis* spp. are woody weeds found within the Desert Uplands bioregion. Fire may assist in the control of these species.

Rubber vine has the ability to smother trees and shrubs and shade-out grasses, making fire difficult to apply. It is usually found in riverine areas, floodplain woodlands and dry creek beds.

Parkinsonia forms dense thickets particularly along water courses, floodplains and in wetlands. This weed endangers many threatened species and communities through the displacement of native species, erosion and clogging of watercourses.

Prickly mimosa (also known as **mimosa bush**) grows in similar circumstances to parkinsonia but can also invade dry open grasslands and is able to form dense stands.

Prickly acacia is particularly damaging to grasslands where it can shade-out native species, form dense thickets and eventually replace grasslands with shrubland/woodlands in which fires become difficult to reintroduce.

Mesquite is considered one of Australia's worst weeds due to its ability to form impenetrable thickets and displace native vegetation. Its potential distribution is up to 70 percent of the Australian mainland.

Awareness of the environment

Key indicators of where woody weeds can be managed with fire:

- Fire management can be used where woody weeds occur in fire-adapted vegetation or where the fire extent can be limited in fire-sensitive vegetation.
- The grass or forbland fuels are sufficiently continuous to carry fire, despite the occurrence of woody weeds.
- The grass fuel crumbles in the hand indicating it is cured sufficiently enough to carry a fire.
- Biocontrol agents are present (rubber vine is infected with rubber vine rust or parkinsonia is affected with parkinsonia dieback). These increase the effectiveness of fire as a control method.

Key indicators where care should be taken using fire or where fire alone would be insufficient in the management of woody weeds:

- Woody weeds occur in areas of insufficient fuel to sustain a fire.
- Woody weeds occur in fire-sensitive vegetation.
- Risk of the fire escaping beyond the burn area (e.g. spotting across a creek).

Prickly acacia is of particular concern to native grasslands. If detected early, fire can be used to control the saplings and seedlings. However fire is much less effective on mature plants.

Kerensa McCallie, QPWS, 30 km east of Hughenden (2011).

Considerable effort has been put in to the control of parkinsonia on Moorrinya National Park.

Eleanor Collins, QPWS, Moorrinya National Park (2003).

Parkinsonia flowers.

Eleanor Collins, QPWS, Moorrinya National Park (2003).

Prickly mimosa (mimosa bush) likes wetter sites such as this dam bank. This infestation has since been eradicated.

Eleanor Collins, QPWS, Moorrinya National Park (2009).

Rubber vine control by 'heli-torch'. One technique used with success in areas where fire is not desired is aerial ignition using flammable gel. The gel produces fires of limited extent.

Barry Nolan, QPWS, Cape Upstart (2008).

Discussion

- A single fire can be used to reduce or eliminate seeds, seedlings and young plants of some woody weeds where sufficient fuel is available (success rate is dependent on species). Follow up fires may be required should some seeds survive in the seed bank or plants resprout.
- While most woody weeds described here are not presently common in parks within the Desert Uplands, monitor and identify new infestations as they emerge. Young plants/seedlings of these species are more easily controlled with fire.
- Planned burning in areas with woody weeds, using soil moisture, allows native species, especially grasses and forbs, the best chance of re-establishing.
- In areas where rubber vine or parkinsonia has shaded-out native grasses, mechanical or chemical control may be necessary. A combination of fire and chemical control could also be useful where grasses abut an infestation. A backing fire into the woody weeds may reduce the area requiring chemical treatment or increase accessibility into the area.
- Care should be taken when using fire where the fire-adapted communities abut fire-sensitive communities. Dead plant material or high-severity fire could draw fire into these communities.
- Be aware of weed hygiene issues when planned burning in areas with woody weeds. Fire vehicles and machinery can aid seed spread along firelines roads and tracks and should be washed down after exposure.

Parkinsonia

- Parkinsonia is widespread within the bioregion with most areas affected to varying degrees. In the worst affected areas of the Desert Uplands parkinsonia is widespread and abundant (DPIF 2011). It is presently found at Moorrinya National Park where mechanical/herbicide control has kept the weed under control.
- Fire will kill seeds on or close to the ground and has been shown to reduce the viability of the seeds remaining on the plant.
- Where 'parkinsonia dieback' (a soil-borne fungus) is present, fire seems to promote the rapid spread of this pathogen amongst the surviving plants. Parkinsonia affected with the dieback will appear to be dying from the tips of the branches—dead leaves remaining attached to the plant. Brown staining within the stems and branches can also be an indicator of dieback. In well-established areas of dieback, the fungus will spread through the soil infecting nearby trees.
- Record the results of fire trialed on parkinsonia plants/infestations and use this information to guide future fire management.

Rubber vine

- Rubber vine is not restricted to disturbed vegetation and prefers a good layer of organic material in the soil. It is restricted to areas where fires are absent or infrequent (Mackey et al. 1996). Rubber vine is common and widespread in the north-east of the bioregion with abundant, localised distribution elsewhere (DPIF 2011). It is present as scattered individuals along Bullock Creek at Moorrinya and on the western side along the Flinders River at White Mountains National Park.
- A 'heli-torch' can be used to control rubber vine in fire-sensitive communities, inaccessible areas or where chemical use is not viable. The flammable petroleum-based gel is applied directly to the plant then ignited. The success of this method is generally reliant upon the moisture content of rubber vine which needs to be high enough to boil the sap and kill the plant. In some areas this method has been very successful. However mixed results in other areas have been reported.
- Using fire to control rubber vine is more successful in areas where rubber vine rust occurs. While rarely killing mature plants, leaf-drop caused by the rust increases the fuel depth directly below the infected plants and opens-up the canopy allowing grasses to grow. These conditions increase the residence time or carry the fire through areas where it may previously have extinguished, increasing the effectiveness of fire as a control method.

Dense parkinsonia below the high water mark at Lake Galilee. Careful navigation is required to avoid tyre stakes from the sharp thorns.

Peter Stanton, Environmental Consultant Pty Ltd, Lake Galilee (1976).

Prickly acacia

- Prickly acacia occurs predominantly in the west and south-west of the bioregion. In some areas the infestations are widespread and abundant (particularly the central-west) becoming common and occasional further to the east and south (DPIF 2011).
- Prickly acacia seedlings are known to be fire-killed. However mature plants are quite fire-resistant—where top-kill has occurred they tend to resprout from the base. Early detection of an infestation is the key to successful management as seedlings and saplings are much more susceptible to fire.

Prickly mimosa

- Prickly mimosa is found within the Desert Uplands bioregion but little information is available on its distribution. It is however widely distributed at Moorrinya National Park along watercourses, old dams and disturbed sites such as cattle yards.
- Fire can be used to reduce this species to ground level and allow native grass species to compete. Regular fire may be required to keep this species low in the ground stratum.

Mesquite

- Mesquite infestations are occasional, and localised to the west and south of the bioregion (DPIF 2011).
- Fire can be used to control mesquite. It is most effective on the tree-form of mesquite, *Prosopis pallida*, but can also be used in the control of some shrub-form species. It is more effective where infestations are of a low and medium density, where sufficient fuel remains for fire to carry, or in areas that have first been chain pulled and allowed time to dry out.
- Fire can also help deplete the soil seed bank and kill seeds to a depth of two centimetres. However seedlings that germinate from undamaged seeds may appear after the following wet season—follow-up control may be required.
- Fires need to be of a high-severity. DNRM (2003) found that late dry-season fires in mesquite with a high fuel load have been effective.

What is the priority for this issue?

Priority	Priority assessment
High	Planned burns to **maintain ecosystems** in areas where ecosystem **health** is **good**.
Medium	Planned burn in areas where **ecosystem health** is **poor** but recoverable.

Assessing outcomes

Formulating objectives for burn proposals

Every proposed burn area contains natural variations in topography, understorey or vegetation type. It is recommended that you select at least three locations that will be good indicators for the whole burn area. At these locations walk around and if visibility is good look about and average the results. Estimations can be improved by returning to the same locations before and after fire, and by using counts where relevant.

Choose from below as appropriate:

Measurable objectives	How to be assessed	How to be reported (in fire report)
> 60 % reduction in number of seedlings, saplings and young or mature plants.	**Before and after the burn** (after suitable germination/ establishment conditions, or a growing season): In three locations (that take account of the variability of landform and weed density within burn area), one year after fire estimate what the percentage saplings have been killed. **Or** If using the 'heli-torch' method, retrace the flight path in three locations and estimate the percentage of mature rubber vine plants killed.	**Achieved:** > 60 % plants killed*. **Partially Achieved:** 40–60 % plants killed*. **Not Achieved:** < 40 % plants killed*. *It is not necessarily a good outcome if you have killed most of the plants and yet the fire was too severe.

Significant reduction in abundance of woody weeds.	Seek advice from resource staff and/or publications such as the Parks Victoria Pest Plant Mapping and Monitoring Protocol (Parks Victoria 1995). One option is given here. **Before and after the burn** (after suitable germination/ establishment conditions, and if using cover, a growing season): define the density of the infestation using the following criteria (from Parks Victoria Protocol [Parks Victoria 1995]): • Rare (0–4 % cover) = Target weed plants very rare. • Light (5–24 % cover) = Native species have much greater abundance than target weed. • Medium (25–50 % cover) = 1/4 weed cover to equal proportions of weed to native species. • Medium–Dense (51–75 %) = equal proportions of native to ¾ weed cover. • Dense (> 75 %) = monoculture (or nearly so) of target weed.	**Achieved:** Weed infestation 'drops' two 'density categories' (e.g. goes from medium-dense before the fire to light after the fire). **Partially Achieved:** Weed infestation 'drops' one 'density category'. **Not Achieved:** No change in density category or weed density gets worse.

If the above objectives are not suitable refer to the compendium of planned burn objectives found in the monitoring section of the QPWS Fire Management System or consider formulating your own.

Monitoring the issue over time

Many issues are not resolved with a single planned burn and it is important to keep observing the land. To support this, it is recommended that observation points be established. Observation points are usually supported by photographs and by recording observations. Instructions for establishing observation points can be obtained from the monitoring section of the QPWS Fire Management System.

Fire parameters

What fire characteristics will help address this issue?

Key factors

- The principal factor in successful control is residence time. Slow moving fire is required to kill mature trees although fire intensity is also important.
- Seeds, seedlings and saplings of most woody weeds are the life-stage that is most vulnerable to fire. Planned burning should be conducted as soon as an infestation is detected. This will increase its effectiveness.

Fire frequency / interval (refer to Appendix 2 for discussion)

- In some cases, applying the recommended fire frequency for the fire vegetation group in which woody weeds occur may be sufficient enough to control the issue. Increasing the fire frequency for a period of time may further assist in their control.
- Apply a follow-up burn if observations indicate that the issue is not under control (e.g. mature plants have re-sprouted or seedlings have emerged from the seed bank). In some cases a third fire may be required to completely remove the infestation. Once resolved, re-instate the recommended fire regime for the fire vegetation group. Continue Monitoring the issue over time.
- Due to the low fuel loads in many communities of the Desert Uplands, it may be necessary to implement burns following high rainfall events to ensure sufficient fuels exist to carry a fire.

Fire severity

- **Low** to **moderate**. Best results have been achieved utilising a slow-moving backing fire with good residence time with high soil moisture. Fire severity should generally remain within the recommendations for the fire vegetation group in which the woody weed occurs.

What weather conditions should I consider?

It is important to be aware of conditions prior to and following burns so that undesirable conditions and weather changes can be avoided, or to help with burn planning.

Season: Early to mid dry and occasionally late dry

GFDI: < 11

DI (KBDI): 120 ideally ‹ 100

Wind speed: < 23 km/hr. Variable, depending on the objective and the density of the infestation (denser infestation may require some fanning by wind in order for the fire to carry).

Other considerations: In some western areas, greater woody weed control has been achieved using low humidity and high temperatures (e.g. 20 per cent humidity and 30ºC).

What burn tactics should I consider?

Tactics will be site-specific and different burn tactics may need to be employed at the same location (e.g. due to topographical variation). Also, during the burn tactics should be reviewed and adjusted as required to achieve the burn objectives. What is offered below is not prescriptive, rather a toolkit of suggested tactics.

- A **running fire** of a higher-severity may be required to carry fire through areas of low fuel or dense thickets.
- **As part of a control program**. In areas where dense woody weeds shade-out grasses and limit the fuel available for fire, initial herbicide treatment or mechanical methods can be used. Care should be taken when applying fire to dead rubber vine plants which remain hanging in the canopy as they may act as elevated fuels.
- **A low to moderate-severity backing fire.** Where woody weeds are scattered in the understorey, a slow-moving, low to moderate-severity backing fire with good soil moisture (and sufficient surface fuels), ensures a greater residence time at ground level. This has proven to be successful in killing seeds, seedlings, young and some mature plants.
- **Aerial incendiary using a 'heli-torch'**. Applying fire using a heli-torch may help control woody weeds that have invaded communities where fire is either not required or desired (such as those which are fire sensitive) (refer to Figures 1 and 2 below). This tactic involves an aerial incendiary drop using gelled-gasoline to directly ignite the base of the plants. The surrounding vegetation needs to be moist to wet to ensure the fire doesn't spread. Aim to strike a balance between ensuring the surrounding vegetation is moist enough that it will not ignite and ensuring the woody weeds are dry enough that it will.

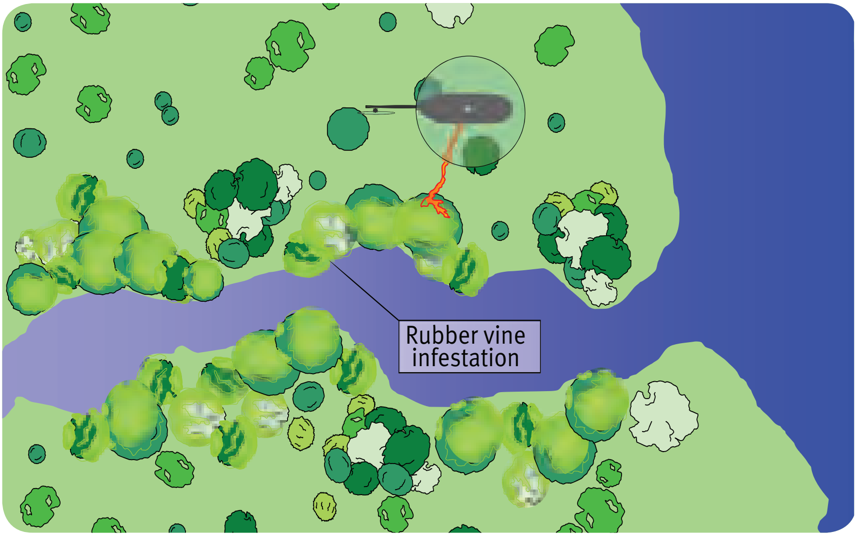


Figure 1: Aerial incendiary using a 'heli-torch': Fire should be applied to the base of the plants allowing sufficient time for the latex to boil.

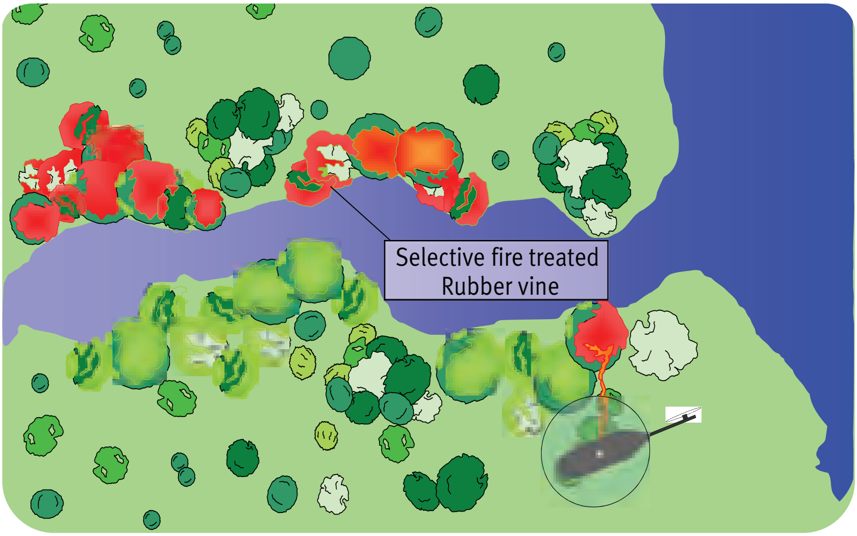


Figure 2: Aerial incendiary using a 'heli-torch'—selective rubber vine fire treatment.

Issue 5: Manage invasive grasses

Exotic grasses are capable of outcompeting native species to form dominant stands. High-biomass grasses of concern in the desert uplands are buffel grass *Pennisetum ciliaris* and the emerging weeds thatch *Hyparrhenia rufa* and grader grass *Themeda quadrivalvis*. They have the ability to increase fuel loads, fire intensity, spotting and flame height which leads to increased fire severity and spread. This results in greater tree death and loss of habitat features with flow-on effects to species. Exotic grasses can carry fire into fire-sensitive vegetation resulting in considerable damage. Fire can be used as part of a control program for some exotic grasses. At the same time, high-biomass grasses both promote fire and many are promoted by fire. They tend to occur as a result of disturbance and spread along firelines and utility easements. It is important to be aware of the presence of high-biomass grasses during planned burn operations.

Awareness of the environment

Key indicators:

Note: be on the lookout for newly-forming stands; control is much easier if their presence is detected early.

- The presence of high-biomass grasses, usually occurring in a dense infestation.
- High-biomass grasses are generally forming single-species dominated stands.
- The grasses are generally taller than the native species.
- They have a lot of mass and/or dead material.

A close-up of the flowering head and clump mass of buffel grass.
Paul Williams, Vegetation Management Science Pty Ltd, Bald Rock (2005).

Grader grass seed head.
Kerensa McCallie, QPWS, Jubilee Pocket (2011).

Discussion

- Be on the lookout for newly-forming stands and be especially vigilant in disturbed areas (particularly those where disturbance is ongoing, e.g. roadsides) and areas adjacent to or down stream from existing high-biomass grass infestations (Melzer and Porter 2002). Control is often easier if their presence is detected and addressed early—before it has become established.
- Prior to undertaking planned burns in areas where high-biomass grasses occur, become familiar with the response of this grass to fire (e.g. if it is promoted or killed) and other factors such as fire severity type and weather conditions which may favour and further its spread.
- The closed canopy of healthy, mature acacia stands will often suppress the encroachment and establishment of invasive grasses.
- Invasive grasses cause the progressive loss of fire sensitive communities and also increase the risk of wildfires (particularly during dry conditions) carrying into the canopy of the community and causing the loss of mature trees. This contributes to the gradual decline and fragmentation of the extent, and/or loss of a population, of fire sensitive communities.
- There is a relationship between fire timing, frequency and severity and the ability of these grasses to invade which is still poorly understood. Aim to record observations regarding these species' response to fire.
- Be aware of weed hygiene issues when planned burning in areas with high-biomass grasses. Fire vehicles and machinery can aid seed-spread along firelines and should be washed down after exposure.
- In many cases, it is desirable to avoid burning high-biomass invasive grasses due to the likely increase in fire severity and the potential to promote them. However the risk of wildfire later producing an even higher-severity fire must be considered. In some situations, burning high-biomass grasses under mild conditions with planned fire is more desirable than allowing them to burn with wildfire.
- Once an area has been impacted by invasive grasses (in particular within fire-sensitive communities) the aim often becomes one of fuel management. This may involve implementing mild or cool fires (both within the site and the surrounding areas) by implementing appropriate tactics that burn away from the non-target community (and therefore limit edge-effects on the margin). Other techniques which may be effective include slashing, spraying with herbicide and in some instances grazing (Melzer and Porter 2002; Butler and Fairfax 2003).

Buffel grass *Cenchrus ciliaris*

- Fire is not known to be an effective tool to manage buffel grass. A "positive feedback" loop has been described for the relationship between buffel grass and hot fires (Butler and Fairfax 2003)—buffel grass increases fuel loads and thus damages remnant vegetation. This also creates a disturbance which favours its spread. The same phenomenon has been observed to occur with increased grazing pressure (Eyre et al. 2009). Buffel grass is further promoted by fire, as seeds germinate more quickly when sown on burnt ground. Under normal (non-fire) grass establishment, it can take up to two years for seeds to germinate.
- Buffel grass is of particular concern to fire-sensitive communities. This species can penetrate and establish a dense sward up to several hundred metres into open acacia woodland across a front several kilometres long, greatly increasing fuel loads and future impacts upon open acacia communities (Butler and Fairfax 2003).
- The use of fire to control buffel grass is often debated. While not a direct control measure, fire may assist in facilitating other control methods such as spraying or grazing. Be aware that follow-up spraying of the affected site will need to be continued for some time—buffel grass will usually germinate en masse after fire and rain. Any fire applied to buffel should be of a **low-**severity. Using night-time burns (where moisture is high) may assist in achieving a low-severity burn.
- At the end of the growing season, buffel grass is more susceptible to fire as it stores reserves at this time. Late summer fires may reduce its ability to compete with native species over time (Chamberlain 2003).
- The curing rate for buffel grass differs from that of some native grasses and tends to remain greener for longer periods of time (note: blue grass *Dichanthium* spp. stays green longer than buffel). In some instances, creating a buffer by mechanical or chemical means adjacent to an area of buffel grass may be useful in limiting its further spread. Creating a buffer between the buffel infestation and the margin of neighbouring communities of between 50–100 m may also be an option. Care should be taken to ensure the buffel infestation does not spread into the buffer.

Grader grass *Themeda quadrivalvis*

- Grader grass is an emerging weed in the Desert Uplands bioregion. Be aware of new infestations which can quickly take hold and ensure they are dealt with as a matter of priority.
- Grader grass is a weed of disturbance. Soil disturbance (e.g. road grading) can expose seed allowing favourable conditions for its establishment and spread.
- Fire is not considered to be an effective tool to manage grader grass as it can encourage seed germination. If fire can not be avoided in areas of grader grass, the fire frequency should be limited to > 5 years.

Thatch grass *Hyparrhenia rufa*

- Fire is not known to be an effective tool to manage thatch grass. However, frequent fire (every one to two years) promotes their spread through disturbance mechanisms and possibly through reducing canopy cover.
- The distribution of thatch grass within the Desert Uplands is unknown, however it is considered to be an emerging weed.
- Post-fire herbicide control has been effective but needs to be ongoing.
- If thatch grass must be burnt, timing is a critical factor. Avoid burning late in the season for a variety of reasons including the risk of creating high severity fire and encroachment into riparian zones.

What is the priority for this issue?

Priority	Priority assessment
High	It is important to be aware of the presence of invasive grasses (particularly where it is a new infestation) so that their negative effects can be managed and the potential for effective control can be considered.

Buffel grass is fire-promoted and drought-tolerant. Following a disturbance (such as fire) buffel grass is able to rapidly invade and form dense swards within a vegetation community.

Bronwyn Terry, QPWS, Moorrinya National Park (2012).

Thatch grass is easily identifiable by its striped appearance which is particularly prominent when young. Be on the look out for new infestations.

John Clarkson, QPWS (2007).

Assessing outcomes

Formulating objectives

Every proposed burn area contains natural variations in topography, understorey or vegetation type. It is recommended that you select at least three locations that will be good indicators for the whole burn area. At these locations walk around and if visibility is good look about and average the results. Estimations can be improved by returning to the same locations before and after fire, and by using counts where relevant.

Choose from below as appropriate:

Measurable objectives	How to be assessed	How to be reported (in fire report)
Distribution of invasive grass has not increased as the result of the burn.	**Before and after the burn** (after suitable germination / establishment conditions): GPS the boundary of the invasive grass in the area or take photographs. Compare the pre and post burn distribution of the weed species.	**Achieved:** No increase in the distribution of the weed. **Partially Achieved:** Minor expansion of weed species distribution; will not increase fuel loads (e.g. scattered individuals spread into burn area; easily controlled) or no change. **Not Achieved:** Significant advance in the spread of the weed; will increase fuel loads in the newly invaded areas.

Reduction of fuels adjacent to non-target communities to low.	**Post fire:** use the Overall Fuel Hazard Assessment Guide (Hines et al. 2010b), or Step 5 of the QPWS Planned Burn Guidelines: How to Assess if Your Burn is Ready to Go, to visually assess the remaining fuel in at least three locations.	**Achieved:** Fuel hazard has been reduced to low. **Not Achieved:** Fuel hazard has not been reduced to low.

If the above objectives are not suitable refer to the compendium of planned burn objectives found in the monitoring section of the QPWS Fire Management System or consider formulating your own.

Monitoring the issue over time

Many issues are not resolved with a single planned burn and it is important to keep observing the land. To support this, it is recommended that observation points be established. Observation points are usually supported by photographs and by recording observations. Instructions for establishing observation points can be obtained from the monitoring section of the QPWS Fire Management System.

Fire parameters

Varies depending on species, see discussion above.

Dense buffel grass can significantly increase fire severity.

Justine Douglas QPWS, Boodjamulla (Lawn Hill) National Park (2012).

What burn tactics should I consider?

Tactics will be site-specific and different burn tactics may need to be employed at the same location (e.g. due to topographical variation). Also, during the burn tactics should be reviewed and adjusted as required to achieve the burn objectives. What is offered below is not prescriptive, rather a toolkit of suggested tactics.

- **As part of a control program**. An initial fire to reduce the biomass of invasive grasses, followed by chemical control of the new shoots has been an effective method of control. Similarly, grazing can also reduce fuel loads.
- **Spot ignition** can be used to effectively alter the desired intensity of a fire, particularly where there is a high-biomass grass infestation. Increased spacing between spots will result in a fire of lower-intensity. The spacing of the spots may vary throughout the burn due to changes in weather conditions, topography and fuel loads.
- **A low-intensity backing fire.** A slow-moving, low-intensity backing fire (against the wind or down slope) will generally result in the more complete coverage of an area and a better consumption of available fuels. This tactic ensures the fire has a greater amount of residence time, reduction of available fuels (particularly fine fuels) and ensures the fire intensity and rate of spread are kept to a minimum. Lighting fires at night can assist in decreasing fire intensity.
- **Limit fire encroachment into non-target communities.** Use appropriate lighting patterns (e.g. spot lighting with matches) along the margin of the community in combination with favourable weather conditions to promote a low-intensity backing fire that burns away from the non-target community. Undertaking burning in areas adjacent to invasive grass infestations while the grass is green, under mild conditions, early morning on the dew, late afternoon or at night will assist in creating a low-severity fire that burns away from the non-target community. Where the non-target community is present in low-lying areas (e.g. drainage lines) use the surrounding topography to create a low-intensity backing fire that travels down slope towards the non-target community. In both instances, ensure good soil moisture is present within the non-target community.
- **Fire exclusion.** Excluding fire from buffel grass infestations may provide the opportunity for species such as brigalow or other acacias to out-compete the buffel grass. Ideally the acacia community will remain unburnt long enough to form a closed canopy that shades out and disadvantages the buffel grass. This requires active fire management in the surrounding fire-adapted communities to prevent unplanned fire.

Issue 6: Limit fire encroachment into non-target fire vegetation groups

Non-target fire vegetation groups include riparian, spring, fringing melaleuca woodlands, chenopod shrublands and fire-sensitive acacia communities. These communities are often self-protecting if fire is used under appropriately mild conditions or due to low fuel loads. Tactics such as burning away from these communities can be used to further protect them. A succession of high rainfall years can promote fuels in otherwise self-protecting communities. Care should be taken to manage fuel around fire-sensitive communities under these conditions. Other areas where you may wish to limit fire encroachment include communities containing buffel grass or other fire vegetation groups which are not ready to burn.

Awareness of the environment

Indicators of fire encroachment risk:

- Conditions are not mild enough or fuels sufficiently sparse to ensure fire extinguishes on the edge of fire vegetation group.
- Where invasive grasses or woody weeds are invading fire-sensitive communities.
- The non-target community is upslope of a planned burn area.
- Where the riparian community or other fire-sensitive community is adjacent to a planned burn area.

Discussion

- Because wildfire often occurs under dry or otherwise unsuitable conditions (and high fuel loads from successive high rainfall years) it has the potential to damage non-target and fire-sensitive fire vegetation groups. Proactive broad-scale management of surrounding fire-adapted areas with mosaic burning is one of the best ways to reduce the impacts of unplanned fire on non-target and fire-sensitive communities.
- Under appropriate planned burn conditions with good soil moisture, fire-sensitive communities tend to self-protect and additional protective tactics may not be required. Sometimes where a fire-sensitive community occurs at the top of a slope, it is necessary to avoid running fires upslope (even in ideal conditions).
- The presence of invasive grasses increases the severity of fire and may contribute to the contraction of fire-sensitive communities such as acacia. If high-biomass grasses are present, use fire with caution (refer to Issue 5).
- Many riparian communities contain a high proportion of fire-sensitive species and/or habitat trees. Too frequent and/or severe fire removes or inhibits the development of structurally complex ground and mid-strata, and may open up the canopy. This in turn may increase the risk of weed invasion and soil erosion and lead to greater production of fine fuel (mainly grass) and hence an increase in the fire hazard. It is highly desirable to exclude fire or at least minimise the frequency and intensity of fire in many riparian communities in order to promote structurally complex ground and mid-strata while retaining mature habitat.

What is the priority for this issue?

Priority	Priority assessment
Very high	For burn proposals in areas with non-target communities, it is important to avoid encroachment of fire.

Assessing outcomes

Formulating objectives for burn proposals

Every proposed burn area contains natural variations in topography, understorey or vegetation type. It is recommended that you select at least three locations that will be good indicators for the whole burn area. At these locations walk around and if visibility is good look about and average the results. Estimations can be improved by returning to the same locations before and after fire, and by using counts where relevant.

Measurable objectives	How to be assessed	How to be reported (in fire report)
No scorch of margin of non-target fire vegetation group.	**After the burn** (immediately or very soon after): visual estimation of percentage of margins scorched from one or more vantage points, or from the air. **Or** **After the burn** (immediately or very soon after): walk the margin of the non-target community or representative sections (e.g. a 100m long section of the margin in three locations) and estimate the percentage of margin scorched.	**Achieved:** No scorch. **Partially Achieved:** < 25 % scorched. **Not Achieved:** > 25 % scorched.
Fire penetrates no further than 10 m into the edge (if there is a well defined edge)	**After the burn** (immediately or very soon after): visual assessment from one or more vantage points, or from the air. **Or** **After the burn** (immediately or very soon after): walk the margin of the non-target community, or representative sections (e.g. a 100m long section of the margin in three locations) and determine whether the fire has penetrated further than 1m into the edge.	**Achieved:** In 90 % of area surveyed fire penetrates no further than 10 m into the edge. **Not Achieved:** Fire penetrates further than 10 m into the edge in > 10 % of area surveyed.

If the above objectives are not suitable refer to the compendium of planned burn objectives found in the monitoring section of the QPWS Fire Management System or consider formulating your own.

Fire parameters

What fire characteristics will help address this issue?

The below characteristics apply to fires in areas adjacent to the non-target fire vegetation group.

Fire severity

- A **low**-severity fire in the adjacent fire-adapted community will help achieve the objective of limited fire encroachment. A backing fire will help ensure good coverage. If there are overabundant saplings in the area being burnt, a higher-severity fire may be required (in which case appropriate tactics and moisture conditions will help to limit scorch of non-target areas).

Mosaic (area burnt within an individual planned burn)

- Consult the recommended mosaic for the fire vegetation group being burnt. Aim for the higher end of the recommended mosaic as this will help mitigate the movement of fire into fire-sensitive communities.

Landscape mosaic

- Proactive broad-scale management of surrounding fire-adapted areas with mosaic burning is one of the best ways to reduce the impacts of unplanned fire on non-target and fire-sensitive communities.

What weather conditions should I consider?

It is important to be aware of conditions prior to and following burns so that undesirable conditions and weather changes can be avoided, or to help with burn planning.

FFDI: Refer to relevant fire vegetation group

DI (KBDI): Refer to relevant fire vegetation group

Wind speed: Beaufort scale 1–3, or < 15 km/hr

Soil moisture: Good soil moisture will assist in avoiding non-target communities.

What burn tactics should I consider?

Tactics will be site-specific and different burn tactics may need to be employed at the same location (e.g. due to topographical variation). Also, during the burn tactics should be reviewed and adjusted as required to achieve the burn objectives. What is offered below is not prescriptive, rather a toolkit of suggested tactics.

- **Test burn** the site to ensure the non-target communities will not be affected.
- **Do not create a running-fire**. When burning in adjacent sclerophyll forest during dry conditions use a low-intensity perimeter burn from the edge of low-lying communities to protect its margins.
- **Commence lighting on the leeward (smoky) edge** to establish the fire and promote a low-intensity backing fire. Depending on available fuels and the prevailing wind on the day, this may require either spot or strip lighting or a combination of both.
- **Afternoon ignition.** Planned burning in areas adjacent to non-target communities can be undertaken late in the afternoon. The milder conditions during this time will assist in promoting a low-severity fire that trickles along the edge and generally self-extinguishes, (particularly during winter).
- **Limit fire encroachment into non-target communities.** Where the non-target community is present in low-lying areas (e.g. sedgelands), utilise the surrounding topography to create a low-intensity backing fire that travels down the slope towards the non-target community. If conditions are unsuitable (e.g. the non-target community is too dry to ensure fire will self-extinguish on its boundary or it is upslope of a potential run of fire) use appropriate lighting patterns along the margin of the non-target community. This will promote a low-intensity backing fire that burns away from the non-target community.
- **Use strip ignition** to draw fire away from the non-target community's edge. When more than one line of ignition is used it can create micro wind conditions that can draw fire away from non-target areas. It is important to have safe refuges when undertaking this type of burning.

Issue 7: Manage severe storm or flood disturbance

In the event of a severe storm, the canopy of trees and shrubs may be stripped with debris accumulating on the ground or left suspended. Snapped limbs and trees can cross fire breaks and accumulate in flooded riparian areas increasing the extent or severity of a fire. In addition, high rainfall events can increase grass fuels and present an increased risk of wildfire.

Major flood events can have a significant impact on riparian communities. These events can remove ground and mid-stratum vegetation and in some cases canopy trees. Invasion of exotic grasses and other weeds may often follow, increasing fuel loads and creating a fire-prone community which can inhibit the recovery of riparian vegetation.

Changed fuel conditions from severe storm or flood disturbance may lead to:

- the potential for high-severity wildfires
- an increased fuel hazard close to assets and infrastructure
- altered fire behaviour during planned burning operations in the months and years following a severe storm or flood event. These can include increased fire severity or ignition problems due to silt suspended in flood waters coating grasses)
- fire-sensitive communities (e.g. riparian) becoming vulnerable to fire encroachment during drought periods that follow.
- an increased risk of fire crossing control lines through fallen trees and debris
- access issues caused by damage to infrastructure such as causeways.
- an opportunity to re-introduce fire into areas with overabundant saplings at an advanced stage.

An initial assessment and review of strategic fire control lines and the fire management zoning plan will usually be required. Possible strategies to manage changed fuel conditions include: strategic planned burning with high soil moisture and avoiding dry conditions, encouraging neighbouring landholders to mechanically reduce fuel, avoiding ignition sources during risk periods and reviewing scheduled planned burns to make use of moister seasonal conditions.

Severe storm events can dramatically alter the forest structure. Reassessment of zoning plans may be required in response to greatly increased fuel loads.

Peter Cavendish, QPWS, D'Aguilar National Park (2008).

Riparian vegetation has been completely removed during a severe flood event and replaced by flammable exotic grasses. Although previously used as a fireline, flood impacts have instead created a potential fire corridor.

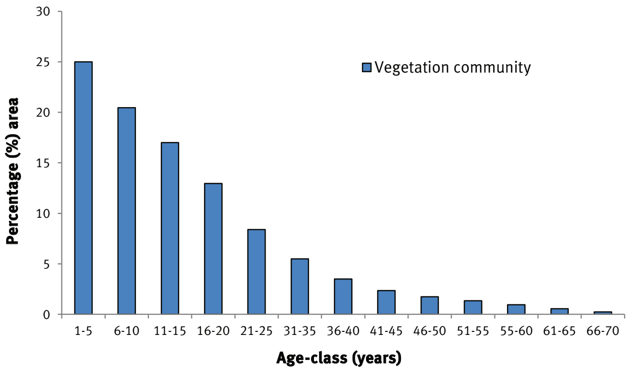
Dave Kington, QPWS, Lockyer National Park (2011).

Flood events can create concentrated areas of high fuel hazard. Large debris deposits adjacent to or within fire-sensitive communities can increase the risk of fire encroachment.

Dave Kington, QPWS, Lockyer National Park (2011).

Glossary of fire terminology

(**Primary source:** Australasian Fire Authorities Council 2012).

Terminology	Definition
Aerial ignition	The lighting of fine fuels for planned burning by dropping incendiary devices or materials from aircraft.
Available fuel	The portion of the total fuel that would actually burn under current or specified conditions.
Age-class distribution	The distribution of groups of similar aged vegetation (age-class) of a particular vegetation community after fire. In fire ecology this is used to indicate the success of mosaic burning in achieving varied habitat conditions. This is usually represented as a plot of areas (y-axis) versus age-class (x-axis) (e.g. 25 per cent of a fire vegetation group burnt between one and five years ago) (refer to Figure 1). **Figure 1: Idealised age-class distribution (concept only)** 
Burn severity	Relates to the amount of time necessary to return to pre-fire levels of biomass or ecological function.
Backing-fire	The part of a fire which is burning back against the wind or down slope, where the flame height and rate of spread is minimal.

Terminology	Definition
Beaufort scale	A system of estimating and reporting wind speeds, invented in the early nineteenth century by Admiral Beaufort of the Royal Navy. It is useful in fire management to indicate wind speed and relies on visual indicators rather than instruments. It equates to: • Beaufort force (or Beaufort number) • wind speed • visible effects upon land objects or seas surface.
BOM	Bureau of Meteorology.
Crown scorch	Browning of the needles or leaves in the crown of a tree or shrub caused by heat from a fire.
Char height	The height to which former green leaves still suspended on plants that are turned black by the flame of the fire. NB: This cannot be measured on the stems of plants as fire 'climbs' the bark.
Dew point temperature	This is a measure of the moisture content of the air and is the temperature to which air must be cooled in order for dew to form. The dew-point is generally derived theoretically from dry and wet-bulb temperatures, with a correction for the site's elevation (BOM).
Drought	A **drought** is defined by the Bureau of Meteorology (BOM) as an 'acute rainfall deficiency'. For the purpose of quantifying the severity of a drought, the BOM describe rainfall deficiency in two categories: '**Serious** rainfall deficiency—rainfall lies above the lowest five per cent of recorded rainfall but below the lowest 10 per cent (decile 1 value) for the period in question, **Severe** rainfall deficiency—rainfall is among the lowest five per cent for the period in question.' For more information, refer to <www.bom.gov.au/climate/glossary/drought.shtml>
Drought index (DI)	A numerical value (e.g. the Byram-Keetch Drought Index), reflecting the dryness of soils, deep forest litter, logs and living vegetation.
Duff layer	Refer to 'humus layer'.

Terminology	Definition
Fire behaviour	The manner in which a fire reacts to variables of fuel, weather and topography.
Fire Danger Index (FDI)/ Fire Danger Rating (FDR)	A relative number and rating denoting an evaluation of rate of spread, or suppression difficulty for specific combinations of fuel moisture and wind speed.
FFDI/FFDR	Forest Fire Danger Index/Danger Rating.
Fire frequency	The frequency of successive fires for a vegetation community in the same point of the landscape (refer to fire interval).
Fire extent	Refer to patchiness.
Fire intensity	The amount of energy released per unit length of fire front, in units of kilowatts per metre of the fireline (also known as the Byram fire-line intensity).
Fire interval	The interval between successive fires for a vegetation community in the same point of the landscape. Often expressed as a range indicating a minimum and maximum number of years that an area should be left between fire events (refer to Appendix 2).
Fireline	Constructed or treated lines/trails (sometimes referred to as fire trails or control lines) or environmental features that can be used in the management of a fire. Permanent firelines should (usually) have a primary purpose other than that of a control line (e.g. access track to a campground). Firelines are **NOT** fire breaks. Although the term 'fireline' is not without its shortcomings it should be used in preference to 'firebreak' to avoid the perception that a fire will stop at a break.

Terminology	Definition
Clarification over the terms **'fire vegetation group'** and **'fire management zone'.**	The fire management requirements within a **conservation fire management zone** are based on the **fire vegetation groups** (FVGs)—groups of related ecosystems that share common fire management requirements. Fire regimes for FVGs are identified in the Bioregional Planned Burn Guidelines and are reflected in fire strategies. Other fire management zones (e.g. protection, wildfire mitigation, special conservation, sustainable production, rehabilitation, exclusion, and reference) will have specific management objectives that override the FVG fire regime requirements. Further, if there are a number of these other zones within a strategy they are identified as **fire management subzones** (FMSz) (e.g. P1, P2, P3, WM1, WM2, etc) each with specific fire management requirements.
Fire perimeter	The outer containment boundary in which fire is being applied.
Fire regime	The recommended use of fire for a particular vegetation type or area including the frequency, intensity, extent, severity, type and season of burning.
Fire regime group (FRG)	A group of related ecosystems that share a common fire management regime including season, severity, recommended mosaic etc. These are a sub-grouping of the fire vegetation groups to provide more detail about specific fire management requirements. Fire regime groups are provided as a more detailed alternative for use with fire strategies or in mapping.

Fire management zone	Fire management sub-zone or Fire vegetation group
Conservation	FVG1
	FVG2
Protection	P1
	P2
Wildfire mitigation, etc	W1
	W2

Terminology	Definition
Fire season	The period(s) of the year during which fires are likely to occur, spread and cause sufficient damage to warrant organised fire control.
Fire severity	A measure of the effect of fire on vegetation and soil immediately after the fire (e.g. vegetation consumption, vegetation mortality, soil alteration). Can be used to indicate fire intensity.
Fire vegetation group (FVG)	A group of related ecosystems that share common fire management requirements. For the purpose of practical fire management, these ecosystems are treated as a group.
Flame height	The vertical distance between the average tip of the flame and ground level, excluding higher flares.
Fuel	Any material such as grass, leaf litter and live vegetation, which can be ignited and sustains a fire. Fuel is usually measured in tonnes per hectare.
Fuel hazard	The condition of the fuel and takes into consideration such factors as quantity, arrangement, current or potential flammability and the difficulty of suppression if fuel should be ignited.
Fuel load	The dry weight of combustible materials per area, usually expressed as tonnes per hectare. A quantification of fuel load does not describe how the fuel is arranged, nor its state or structure.
Fuel moisture content	The water content of a fuel particle expressed as a percentage of the oven dry weight of the fuel particle (% ODW).
Grid ignition	A method of lighting prescribed fires where ignition points are set at a predetermined grid-like spacing through an area.
GFDI/GFDR	Grassland Fire Danger Index/Danger Rating.

Terminology	Definition
High biomass grasses	Tend to be exotic species of grasses which can out-compete native species to form dense mono-specific stands. They: • are generally taller than native species • can lead to decreased biodiversity • increase biomass • increase fire severity • increase threat to life and property.
Humus (or duff layer)	The mat of partly decomposed vegetation matter on the forest floor, the original vegetative structures still being recognisable.
Junction zone	An area of greatly increased fire intensity caused by two fire fronts (or flanks) burning towards one another.
Keetch-Byram Drought Index (KBDI)	A numerical value reflecting the dryness of soils, deep forest litter, and heavy fuels and expressed as a scale from 0–203.
Landscape mosaic	A mosaic burn at a landscape level, usually achieved by planning a series of fires across a reserve, a bioregion or broader area.
Lighting pattern	The lighting pattern adopted by fire fighters during planned burning operations, or indirect attack.
Litter	The top layer of the forest floor composed of loose debris of dead sticks, branches, twigs, and recently fallen leaves and needles, little altered in structure by decomposition. (The litter layer of the forest floor).
Mesophyll pioneers	Large-leaved (12.5–20 cm long) rainforest tree species able to establish in neighbouring communities.
Mineral earth	Being completely free of any vegetation or other combustible material.

Terminology	Definition
Mosaic burn	An approach which aims to create spatial and temporal variation in fire regimes. This can occur within an individual burn and at a landscape level (refer to Appendix 2).
Obligate seeders (obligate seed regenerating species)	Shrubs that are killed by fire and rely on soil-stored seed bank to regenerate. In fire ecology, the time it takes obligate seeders to mature and establish a seed bank often indicates the minimum frequency with which a vegetation community should be burnt in order to avoid the local extinction of these species.
Patchiness	A percentage or proportion of the ground layer vegetation (grasses, herbs and trees/shrubs less than one metre) not affected by fire (i.e. 20 per cent patchiness = 80 per cent burnt).
Perennial plants	Plants that last for more than two growing seasons, either dying back after each season as some herbaceous plants do, or growing continuously like many shrubs.
Planned burn	The controlled application of fire under specified environmental conditions to a pre-determined area and at the time, intensity, and rate of spread required to attain planned resource management objectives. In the context of QPWS operations: a fire that is deliberately and legally lit for the purposes of managing the natural and/or cultural and/or production resources of the area (e.g. reducing fire hazard, ecological manipulation), and protecting life and property.

Terminology	Definition
Progressive burning	Progressive burning is an approach to planned burning where ignition is carried out throughout much of the year as conditions allow. In northern Queensland, ignition can begin early in the year after heavy seasonal rain, with numerous small ignitions creating a fine scale mosaic. These burnt areas can provide opportunistic barriers to fire for burning later in the year. They also provide fauna refuge areas. Progressive burning helps create a rich mosaic of intensities, burnt/ unburnt areas, and seasonal variability. Be aware of how fire behaves differently in different seasons. Depending on local climatic conditions, there can be up to four seasons in the wet tropics (this will vary from moister to drier climatic areas): The **early burn period** following seasonal heavy rain where fire self extinguishes overnight and will not burn through areas burnt the year before. **Secondary burn season** where fires will burn through the night and will extinguish within areas burnt the year before. **Falling leaf season**, where a blanket of leaves often crosses natural water features. This is the dry season and fires will not go out. Fires in dry conditions will often favour woody species over grasses. **Storm burning**, where climatic conditions allow, from December through to January, is a useful way to achieve intense, wind supported fire where rain can be reliably expected to follow; providing good conditions for regeneration (Mick Blackman pers. comm., 10 September 2011).
Rate of spread (ROS)	The forward progress per unit time of the head fire or another specified part of the fire perimeter, defined as metres per hour.
Relative humidity (RH)	The amount of water vapour in a given volume of air, expressed as a percentage of the maximum amount of water vapour the air can hold at that temperature.
Scorch height	Is the height to which former green leaves still suspended on plants are turned brown by the heat of a fire.
Strip burning	Setting fire to a narrow strip of fuel adjacent to a fire-line and then burning successively wider adjacent strips as the preceding strip bums out.
Test fire	A controlled fire of limited extent ignited to evaluate fire behaviour.

References

Addicott E 1994, *Forest den resources Document*, Internal report, Queensland Department of Environment and Heritage.

Anchen G, Collins E, Kimlin S, Williams P and Gough R 2006, *White Mountains National Park fire strategy,* Queensland Parks and Wildlife Service. Queensland Government, Brisbane.

Australasian Fire Authorities Council (AFAC) 2012, *Glossary of rural fire terminology*, Australasian Fire Authorities Council, Canberra.

Bull A 2002, Final Report, *Best practice native shrub management in south west Queensland*, The State of Queensland (Department of Natural Resources and Mines), Charleville Queensland.

Butler DW and Fairfax RJ 2003, 'Buffel grass and fire in a gidgee and brigalow woodland: a case study from central Queensland', *Ecological Management and Restoration*, vol. 4, pp. 120–125.

Chamberlin J 2003, *Transcript from NRM workshop*, Nairana National Park.

Commonwealth of Australia 1999, *Environment Protection and Biodiversity Conservation Act 1999*, Sustainability, Environment, Water, Population and Communities, Attorney-General's Department, Canberra.

Department of Employment, Economic Development and Innovation (DEEDI) 2011, *Rubber vine (Cryptostegia grandiflora) fact sheet*, Queensland Government, Brisbane.

Department of Environment and Resource Management (DERM) 2009, *National recovery plans for the Julia Creek dunnart (Sminthopsis douglasi)*. Report to the Department of the Environment, Water, Heritage and the Arts, Canberra. Queensland Parks and Wildlife Service, Brisbane.

Department of Environment and Resource Management (DERM) 2010a, *Operational policy –Management of cultural heritage places on QPWS estate*, Queensland Government, Brisbane.

Department of Environment and Resource Management (DERM) 2010b, *Procedural guide–Management of cultural heritage places on QPWS estate*, Queensland Government, Brisbane.

Department of Natural Resources and Mines (DNRM) 2003, *Best practice manual mesquite: control and management options for mesquite (Prosopis* spp.*) in Australia*, Queensland Government, Cloncurry.

Department of Primary Industries and Fisheries (DPIF) 2011, Pest distribution maps. Department of Employment, Economic Development and Innovation.

Eyre TJ, Wang J, Venz MF, Chilcott C and Whish G 2009, 'Buffel grass in Queensland's semi-arid woodlands: response to local and landscape scale variables, and relationship with grass, forb and reptile species', *The Rangeland Journal*, vol. 31, pp. 293–305.

Fensham R and Fairfax R 2007, *Talking fire: burning for pastoral management in the Desert Uplands*. Desert Uplands Build-up and Development Committee, Barcaldine.

Hines F, Tolhurst KG, Wilson AAG and McCarthy GJ 2010a, *Fuel hazard assessment guide*, 1st edition April 2010, Fire and adaptive management report no. 82. Fire Management Branch, Department of Sustainability and Environment, Victoria.

Hines F, Tolhurst KG, Wilson AAG and McCarthy GJ 2010b, *Overall fuel hazard assessment guide*, 4th edition July 2010, Fire and adaptive management report no. 82, Fire Management Branch, Department of Sustainability and Environment, Victoria.

Hodgkinson K 2002, 'Fire regimes in Acacia wooded landscapes: effects on functional processes and biological diversity', pp. 351–372, in RA Bradstock, JE Williams and AM Gill (eds.), *Flammable Australia: the fire regimes and biodiversity of a continent*, Cambridge University Press, Cambridge.

Mackey AP, Carsten K, James P, March N, Noble K, Palmer B, Vitelli J and Vitelli M 1996, 'Rubber vine *Cryptostegia grandiflora* in Queensland', (Queensland Department of Natural Resources: Brisbane).

Melzer R and Porter G 2002, *Guidelines for the management of buffel grass on conservation reserves*, Queensland Parks and Wildlife Service, Brisbane, unpublished work.

Parks Victoria 1995, *Parks Victoria pest plant mapping and monitoring protocol*, Parks Victoria.

Queensland Government 1992, *Nature Conservation Act 1992*, Queensland Government, Brisbane.

Queensland Government 2004, *Aboriginal Cultural Heritage Act 2003*, Queensland Government, Brisbane.

Queensland Herbarium 2011a, *Regional ecosystem description database (REDD)*, version 6.0b, Department of Environment and Resource Management, Brisbane.

Queensland Herbarium 2011b (16 September), *Survey and mapping of 2006 remnant vegetation communities and regional ecosystems of Queensland spatial layer, version 6.1*, Queensland Government, Brisbane.

Sattler P and Williams R (eds.) 1999, *The conservation status of Queensland's bioregional ecosystems*, Environmental Protection Agency, Queensland.

Williams P, Collins E, Anchen G and Kimlin S 2007, *Contrasting seedling survival, growth and maturing rates of two fire-killed shrubs and a resprouter of the Burra Range, White Mountains National Park*. Queensland Parks and Wildlife Service. Queensland Government, Brisbane.

Williams P, Collins E, Greig C, Devlin T and McLachlan G 2008, *Fire management of lancewood (Acacia shirleyi) forests - seedling survival, growth rates and seed reserves*, internal report, Queensland Parks and Wildlife Service.

Williams P and Tran C 2009, *Evaluating fire management in sandstone landscapes on Queensland parks*, Internal report, Queensland Parks and Wildlife Service, Brisbane.

Wilson AAG 1992, *Assessing the fire hazard on public lands in Victoria: fire management needs and practical research objectives*, research report no. 31, Fire Management Branch, Department of Conservation and Environment, Victoria. In: Hines F, Tolhurst K, Wilson A and McCarthy G 2010a, Fuel hazard assessment guide, 1st edition April 2010, Fire and adaptive management report no. 82. Fire Management Branch, Department of Sustainability and Environment, Victoria.

Appendix 1: List of regional ecosystems

A fire vegetation group is a group of related regional ecosystems that share common fire management intent for the purpose of practical fire management.

Fire vegetation group	Hectares within Desert Uplands bioregion	Percentage
Eucalypt communities	4 409 473	63
Grasslands	141 524	2
Acacia communities	786 416	11
Riparian spring and fringing communities	318 038	5
Non-remnant	1 276 942	18
Other bioregion	49 798	1
TOTAL	**6 982 408**	**100**

Chapter	Issues	Fire vegetation group	Fire regime group	Map label (if required)	**Regional ecosystems** (Sattler and Williams 1999; Queensland Herbarium 2011a; 2011b).
1	1	Eucalypt communities	Eucalypt communities (spinifex or heath dominant)		10.10.3, 10.10.4, 10.10.4a, 10.10.4b, 10.10.4c, 10.10.4d, 10.10.5, 10.10.5a, 10.10.5b, 10.10.5c, 10.10.5d, 10.10.5e, 10.10.7, 10.3.10, 10.3.10x1, 10.3.10x2, 10.3.20, 10.3.29b, 10.5.1, 10.5.1a, 10.5.1b, 10.5.1c, 10.5.1d, 10.5.1e, 10.5.1i, 10.5.10, 10.5.11, 10.5.11a, 10.5.11b, 10.5.11c, 10.5.12, 10.5.5, 10.5.5a, 10.5.5b, 10.5.5c, 10.5.8, 10.5.8a, 10.5.8b, 10.7.10, 10.7.10a, 10.7.10b, 10.7.10c, 10.7.11, 10.7.11a, 10.7.12, 10.7.12a, 10.7.12b, 10.7.2, 10.7.2a, 10.7.2b, 10.7.2e, 10.7.4, 10.7.5, 10.7.7, 10.7.7a, 10.7.7b, 10.7.7c, 10.7.7d, 10.7.8, 10.7.8b, 10.7.9, 10.7.1, 10.7.1a, 10.7.1b, 10.7.1bx1, 10.7.1c, 10.7.1d, 10.7.1e, 10.7.1f.
	2		Eucalypt communities (tussock grass dominant)		10.3.11, 10.3.11a, 10.3.11b, 10.3.11c, 10.3.11d, 10.3.15, 10.3.15a, 10.3.15ax1, 10.3.15b, 10.3.15c, 10.3.15d, 10.3.15dx1, 10.3.15e, 10.3.15f, 10.3.15g, 10.3.15h, 10.3.15hx1, 10.3.15i, 10.3.15j, 10.3.15k, 10.3.15l, 10.3.15m, 10.3.15n, 10.3.15o, 10.3.27, 10.3.27a, 10.3.28, 10.3.28a, 10.3.28b, 10.3.5, 10.3.6, 10.3.6a, 10.3.6ax1, 10.3.6ax2, 10.3.6ax3, 10.3.6ax4, 10.3.9, 10.3.9x1, 10.3.9x2, 10.4.9, 10.5.2, 10.5.2a, 10.5.2ax1, 10.5.2b, 10.5.4, 10.5.4a, 10.5.4b, 10.5.4c, 10.5.9, 10.5.9a, 10.7.2c, 10.7.2d, 10.7.11b, 10.5.9b, 10.9.5, 10.9.5a, 10.9.5ax1, 10.9.5b.
2	1	Grasslands	Grasslands		10.3.7, 10.3.7a, 10.3.7b, 10.3.8, 10.3.8a, 10.3.8b, 10.4.8, 10.4.8x1, 10.4.8x2, 10.4.8x3.

Chapter	Issues	Fire vegetation group	Fire regime group	Map label (if required)	**Regional ecosystems** (Sattler and Williams 1999; Queensland Herbarium 2011a; 2011b).
3	1	**Acacia communities**	Acacia		10.10.1, 10.10.1a, 10.10.1b, 10.10.2, 10.10.2a, 10.10.2b, 10.10.2c, 10.10.2d, 10.3.17, 10.3.17a, 10.3.17b, 10.3.19, 10.3.21, 10.3.4, 10.3.4a, 10.3.4b, 10.3.4c, 10.3.4dx1, 10.4.4, 10.4.5, 10.4.5x1, 10.4.5x2, 10.5.7, 10.5.7a, 10.5.7ax1, 10.5.7b, 10.5.7c, 10.7.3, 10.7.3a, 10.7.3b, 10.7.3c, 10.7.3d, 10.7.3e, 10.7.3ex1, 10.7.3f, 10.7.6, 10.7.6x1, 10.7.6x2, 10.9.1, 10.9.1a, 10.9.1b, 10.9.1c, 10.9.1d, 10.9.1e, 10.9.1f, 10.9.2, 10.9.2a, 10.9.2b, 10.9.2c, 10.9.2d, 10.9.2dx1, 10.9.2dx2, 10.9.6, 10.9.6x1, 10.3.25, 10.3.25x1, 10.3.25x2, 10.3.25x5, 10.3.26, 10.4.6, 10.4.6a, 10.4.6b, 10.9.8, 10.9.8x1, 10.3.29, 10.3.29a, 10.3.30, 10.4.7.
	2		Brigalow and blackwood		10.4.2, 10.4.3, 10.4.3a, 10.4.3b, 10.9.3, 10.9.3a, 10.9.3b, 10.9.3c, 10.4.1, 10.4.1x1, 10.4.1x2, 10.4.1x3, 10.3.3, 10.3.3a, 10.3.3b, 10.3.2, 10.3.2a, 10.3.2b, 10.3.2bx1, 10.3.1.
4	1	**Riparian spring and fringing communities**	Riparian spring and fringing communities		10.10.6, 10.3.12, 10.3.12a, 10.3.12b, 10.3.13, 10.3.13a, 10.3.13b, 10.3.14, 10.3.14a, 10.3.14ax1, 10.3.14b, 10.3.14c, 10.3.14d, 10.3.14e, 10.3.14f, 10.3.14g, 10.3.14h, 10.3.14i, 10.3.14j, 10.3.31, 10.3.31a, 10.3.22, 10.3.22a, 10.3.22b, 10.3.22c, 10.3.22d, 10.3.22f, 10.3.23, 10.3.23a, 10.3.23b, 10.3.23c, 10.3.23d, 10.3.24, 10.3.16, 10.3.16a, 10.3.16b, 10.3.16c, 10.3.16d, 10.3.16e, 10.3.16f, 10.9.7, 10.7.13, 10.7.13x1.

The spatial data is based on version 6.1 of the "Queensland Remnant Vegetation Cover 2006" layer (16 September 2011) data (refer to Figure 1).

Some of the Regional ecosystems (RE) listed above will not be matched in the spatial data. This may be because the Regional ecosystem is "not of a mappable size", the Regional ecosystem "has been moved" (i.e. it has been reclassified into a new RE code), the Regional ecosystem exists only as a sub-dominant RE within the spatial data or the Regional ecosystem has not yet been mapped. In the REDD system, the comments section indicates if the Regional ecosystem is not of a mappable size or if it has been moved.

The RE's listed below are those RE's from the classifications listed above that do not have any matching records in version 6.1 of the Survey and Mapping of 2006 Remnant Vegetation Communities and Regional ecosystems of Queensland spatial layer (16 September 2011).

Unmatched regional ecosystems	10.10.6, 10.10.3, 10.10.7.

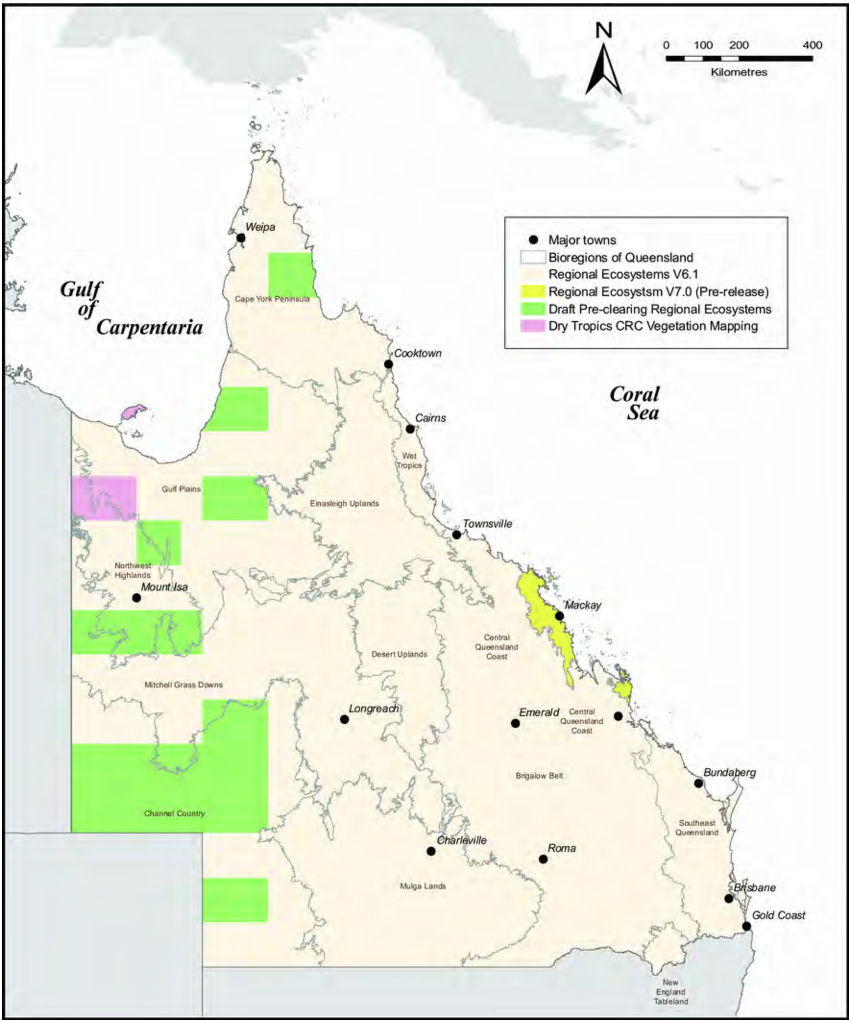


Figure 1: Map of Queensland indicating the different GIS data sources used to produce the spatial fire vegetation group mapping product.

Appendix 2: Mosaic burning

Mosaic burning is an approach to planned burning which aims to maintain and maximise diversity within fire-adapted vegetation communities. At various scales, a mosaic of vegetation in different stages of post-fire response can provide a greater range of habitats for plants and animals including those that prefer open country, those that need dense vegetation or the presence of a particular food source and all ecological requirements in between.

In practice, mosaic burning is achieved through the use of appropriate weather conditions, variation in topography, frequency, intensity, season and ignition patterns to create a patchwork of burnt and unburnt areas. Over time the patches overlay to build a more complex mosaic of vegetation at various stages of response from fire (Figures 1–5 provide a simplified example). This practice can apply to burning at a **landscape scale**—how much of a particular fire vegetation group is targeted within a given year (across a bioregion or management area) or can refer to the area burnt within an individual fire event. Both are important.

The land manager should apply mosaic burning and be guided by the recommended fire frequency. **Note that it is a common mistake to interpret the fire interval as a formula for applying fire.** Consider the following example: A fire strategy might recommend burning with a fire interval of between 8–12 years. In this case the land manager would apply mosaic burning (as often as required) but generally not burning any single patch more frequently than the minimum fire interval (e.g. eight years), or less frequently than the maximum fire interval (e.g. 12 years) (refer to Figures 1–5).

This is relevant because the minimum fire interval represents the amount of time it takes for each species to regenerate sufficiently to tolerate a second fire, and the maximum fire interval represents the amount of time an ecosystem can be left without fire before it begins to decline in health and species might be lost.

As ParkInfo/geographic information systems (GIS) and monitoring tools evolve it will become easier to evaluate if the fire vegetation groups are on track in terms of maintaining an age class distribution and conforming to recommended fire frequencies. Irrespective of monitoring and GIS tools it is important to learn to observe the health of the country and to understand its fire management needs to appropriately apply fire in a way that maintains a healthy ecosystem. This planned burn guideline provides key indicators supported by photographs to help you assess the health of the ecosystems and their fire management needs.

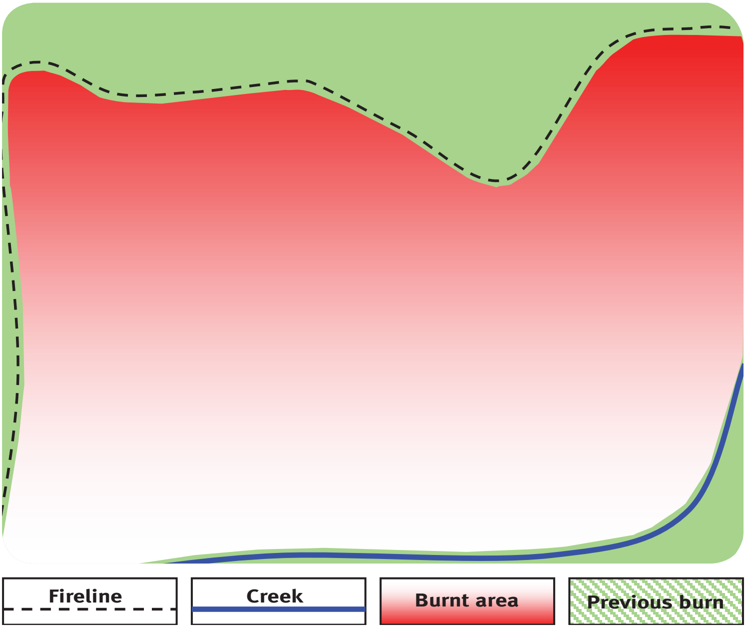


Figure 1: Example area between fireline and creek burnt in a wildfire—year 0. (Recommended fire interval for fire vegetation group is eight–12 years).

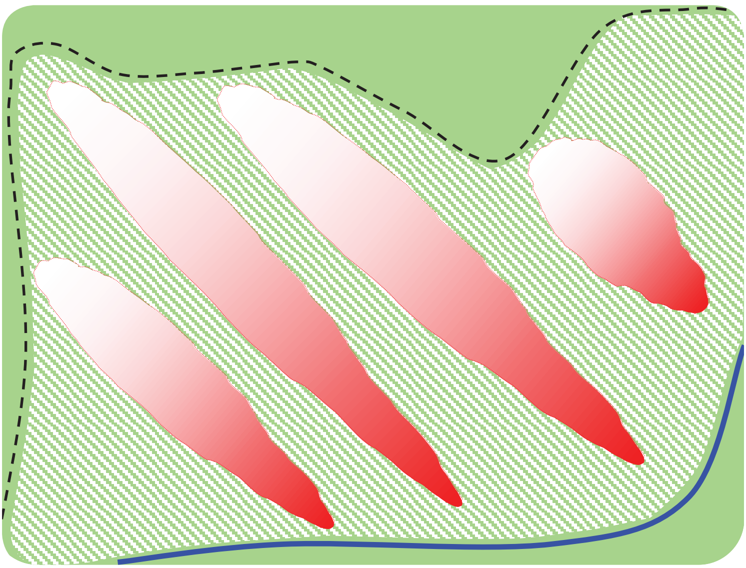


Figure 2: Planned mosaic burn—year 8.

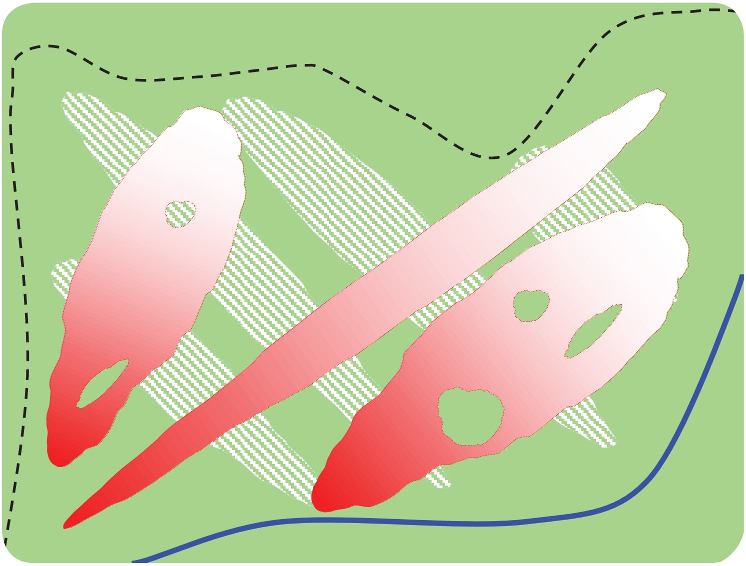


Figure 3: Planned mosaic burn—year 20.

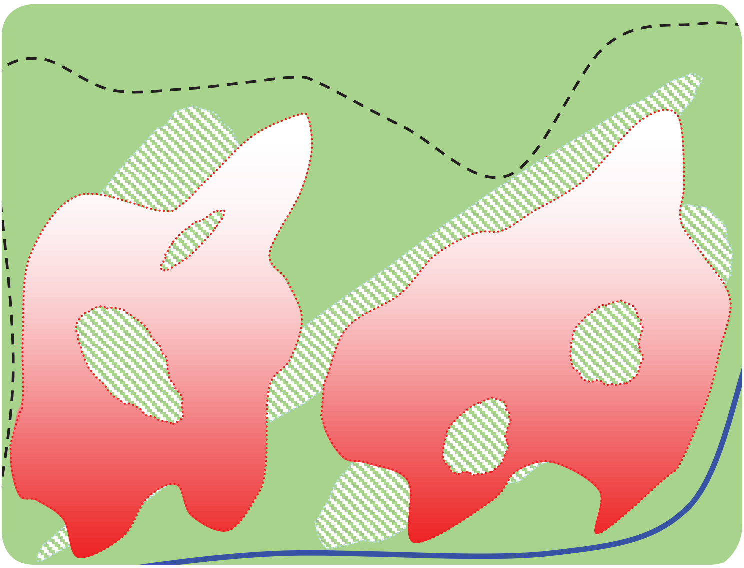


Figure 4: Planned mosaic burn—year 28.

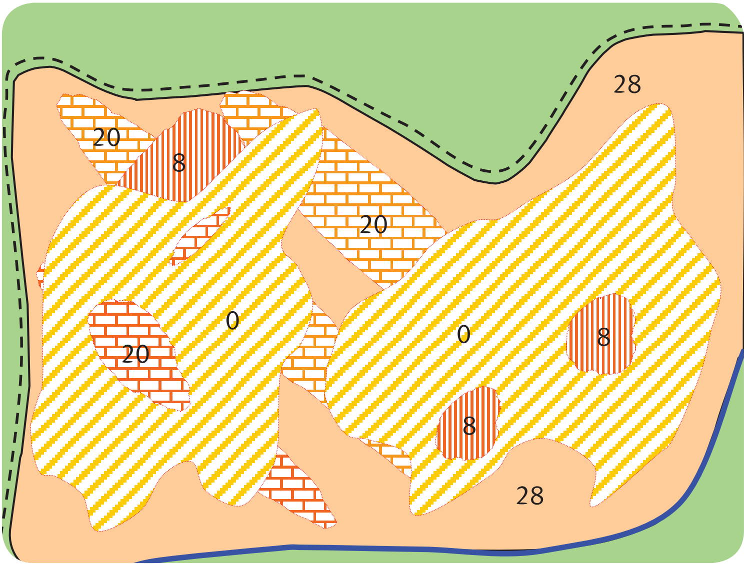


Figure 5: Fire history summary—year 28.
Wildfire and mosaic burn patterns overlaid (with years since last burnt).

13 QGOV (13 74 68)

www.nprsr.qld.gov.au