Chapter 6: Cypress and bull oak communities

Cypress and bull oak communities occur on a variety of landforms within the Brigalow Belt bioregion, predominately on plains and undulating hills. White cypress pine *Callitris glaucophylla* is the most common species and is widespread particularly throughout the south, and is also an economic (silviculture) resource. The structure of cypress stands varies, depending upon landscape features, the community's exposure to forestry practices and fire. Cypress stands may occur as open forests with associated eucalypts, as fragmented clumps (containing mature and young trees) or as a dense ('locked') stands of very large numbers of regenerating trees with few mature trees. Cypress and bull oak also occur as canopy or understorey trees within other fire vegetation groups. One of Australia's most threatened butterflies, the endangered bull oak jewel butterfly *Hypochrysops piceatus*, is reliant upon dense leaf litter and mature bull oaks as a host tree for the ant species *Anonychomyrma* spp., which attend the butterfly larvae (Lundie-Jenkins and Payne 2000). Maintaining bull oak forests and minimising excessive fire impacts are critical to the survival of the species.

Fire management issues

Depending upon management objectives, fire management will include fire exclusion, fuel load management or the maintenance of a more open cypress and/or bull oak community with fire. While cypress pine is a fire-sensitive species, low-severity fire plays a role in maintaining other elements of the community, especially in more open stands. Historically, fire was excluded in cypress production areas, particularly within areas subject to intensive silvicultural management (Taylor and Swift 2003). Absence of fire has promoted the formation of immature 'locked' stands, and has left cypress resources vulnerable to wildfire impacts. Planned burning to protect core cypress resources either directly (through fuel management burns within the site) or indirectly (by conducting burns within the surrounding area) is important to limit loss of production timber. Where cypress pine forests are removed from production and included within protected area estate there will be a need for the land manager to reassess fire management objectives and arrangements.

It is important to be aware of the presence of invasive grasses. These can greatly increase fire severity and draw fire into these communities, resulting in fires of a greater frequency and/or intensity.

Issues:

1. White cypress pine production forests.
2. Maintain open cypress pine forests.
3. Transition production stands to open forest.
4. Manage invasive grasses.

Extent within bioregion: 1 435 480 ha, 4 per cent; **Regional ecosystems:** Refer to Appendix 1 for complete list.

Examples of this FVG: Barakula State Forest, 95 114 ha; Kumbarilla State Forest, 55 512 ha; Yuleba State Forest, 55 178 ha; Western Creek State Forest, 53 746 ha; Oakvale State Forest, 40 196 ha; Whetstone State Forest, 29 298 ha; Pluto Timber Reserve 27 778 ha; Boondandilla State Forest, 23 935 ha; Yelarbon State Forest, 21 766 ha; Carnarvon National Park, 21 582 ha; Bringalily State Forest, 18 493 ha; Dunmore State Forest, 12 040 ha; Sunnyside State Forest, 11 970 ha; Hallett State Forest, 9 226 ha; Booroondoo State Forest, 7 549 ha; Koolbellup State Forest, 7 505 ha; Attica State Forest, 6 612 ha; Belington Hut State Forest, 6 480 ha; Braemar State Forest, 5 853 ha; Doonkuna State Forest, 5 777 ha; Chesterton Range National Park, 5 443 ha; Forrest State Forest, 5 046 ha; Ula Ula State Forest, 4 580 ha; Allies Creek State Forest, 4 461 ha; Kinkora State Forest, 4 329 ha; Combabula State Forest, 4 267 ha; Calrossie State Forest, 3 895 ha; Bendidee State Forest, 3838 ha; Bulli State Forest, 3 751 ha; Squire State Forest, 3 393 ha; Borania State Forest, 3 286 ha; Orkadilla State Forest, 2 892 ha; McLeay State Forest, 2 887 ha; Hillside State Forest, 2 500 ha; Currajong State Forest, 2 405 ha; Brucedale State Forest, 2 307 ha; Dawson Range State Forest, 2 107 ha; Woodduck State Forest, 2 002 ha; Kerimbilla State Forest 1, 1 926 ha; Kettle State Forest, 1 872 ha.

Issue 1: White cypress pine production forests

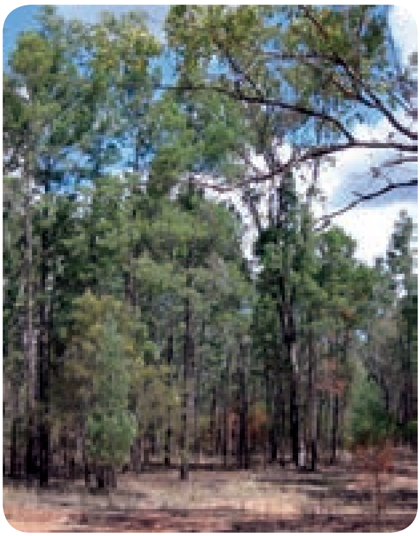
Use fire in adjoining areas to protect white cypress pine production forests.

Awareness of the environment

Indicators of a white cypress pine forest where fire exclusion is necessary:

- The area is zoned by the Queensland Department of Agriculture, Fisheries and Forestry (DAFF) as a Production Forest.
- The leaf litter is predominately made up of thick and compacted cypress pine litter.
- More than 75 per cent of the canopy is dominated by cypress pine.
- There are often no signs of fire history at the site (e.g. charring of trees).
- Logs and limbs and a build up of coarse or heavy fuels are present on the ground.
- The site lacks or has sparse understorey plants.

A high quality cypress pine production forest. There is a full healthy crown of cypress and on average a good spacing between trees.
Stephen Berlin, DAFF (2007).



An average cypress pine production forest. Note the mixed canopy, greater number of young cypress and reduced spacing between trees.
Stephen Berlin, DAFF (2006).

An open cypress production forest. There is no evidence of charring on young cypress trees. There are some understorey plants but these are sparse.
Stephen Berlin, DAFF (2006).

Compacted leaf litter and heavy fuels build-up can be found in some production forests.
Stephen Berlin DAFF (2004).

Discussion

- The protection of cypress pine production forests relies on appropriately managing surrounding areas with mosaic burning, and implementing low to moderate severity planned burns undertaken in suitable conditions, aimed at reducing fuel loads. The adjacent areas could be cypress pine forests of lower economic quality, or other fire-adapted communities.
- Cypress is often killed by fire and regenerates from canopy stored seed. It is particularly vulnerable where there has been flame residence time at the base of the tree and complete charring or 'collaring' of the bark.
- The increased usage of state forests for the rapidly expanding coal seam gas industry has implications for fire management in these areas. Cleared production pads and extensive road networks limit the coverage of planned burns. There is also an increased presence of employees on the ground associated with the coal seam gas company. It is important to consult with representatives responsible for the company's activities when a burn is being planned.

What is the priority for this issue?

Priority	Priority assessment
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.

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)
Reduce overall fuel hazard to low. **Or** Reduce fuel load to < 5 tonnes/ha.	**After the burn:** 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 fuel load has been reduced to less than five tonnes/ha. **Not Achieved:** Fuel hazard has not been reduced to low **Or** fuel load is greater than five tonnes/ha.
< 5 % of the white cypress pine production area is scorched.	**After the burn:** Visual estimation of percentage of area burn – from one or more vantage points, or from the air. **Or** **After the burn:** Walk through the site or representative sections (e.g. a 100m long section of the margin in three locations) and estimate the percentage of area is scorched.	**Achieved:** Less than five per cent of the area is scorched. **Partially Achieved:** 5–15 % of the area is scorched. **Not Achieved:** > 15 % of area is scorched.

Fuel reduced sufficiently such that there are no corridors of fuel to promote passage of a wildfire across the area.	**After the burn:** Boundaries of burn assessed sufficiently to determine whether there are or aren't unburnt corridors that extend from one side of the area to the other.	**Achieved:** No unburnt corridors extend from one side of the area to another. Passage of wildfire will be prevented or substantially slowed. **Partially Achieved:** No unburnt corridors extend from one side of the area to another but in some places the 'gap' between unburnt patches is very small such that the passage of wildfire may not be effectively prevented. **Not Achieved:** Unburnt corridors extend across the area.

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?

Fire severity

- In adjoining fire-adapted communities: In general **low** but occasionally **moderate**. Ideally aim for a fire that will self-extinguish in late afternoon and/or on the cypress community's edge.

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

- Aim to burn the surrounding areas every seven to ten years or as often as required to reduce fuel loads.

Mosaic (area burnt within an individual planned burn)

- A greater than usual coverage of fire in the target community surrounding cypress pine production forests (e.g. 70–80 per cent) is required to mitigate the impacts of unplanned fire on the area, create a buffer of low fuel loads and limit the impacts of re-ignition within the burn area.

Landscape Mosaic

- It is common to use rotational burning of some surrounding areas in an eight year cycle to create a series of buffer blocks and variation of fuel loads.

Other considerations

- Broad-scale use of fire in surrounding country under mild conditions in combination with recommended tactics (see below) throughout the year will assist in mitigating impacts of wildfires on cypress pine production forests.
- Production areas are defined by constructed fire-lines that assist to restrict fire spread and provide access. Fire-line maintenance is a key strategy.
- Following fire-line maintenance in cypress production areas, there will often be pushed up piles of debris from heavy plant such as dozers. Be aware that if fire carries into piles they will generally smoulder for long periods. Be aware that smouldering may not be immediately apparent but can cause relights or spot over's into adjoining areas.

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.

Optimal conditions for fuel reduction planned burns adjacent to cypress production forests have been identified (Taylor and Swift 2003) as per below:

Season: Traditionally, in the south of the Brigalow Belt bioregion, fuel reduction burning in cypress pine forests commences in April/May and extends to July (burns continue through to August in exceptional circumstances). Conditions are cooler during this period and the potential for fire to exceed the desired severity is limited.

FFDI: < 12

DI (KBDI): 80–120

Wind speed: Beaufort scale 1–3, (ideally 10 km/hr). Some wind is required to ensure the fire will carry through an area and avoid flame residence time at the base of cypress pines (residence time can cause collaring and tree death).

Wind direction: No easterly component

Cloud: Nil. No cloud cover is of critical importance (Taylor and Swift 2003)

Relative humidity: 30–40 per cent at 11:00 am and 15–20 per cent at 3:00 pm

Temperature: 19 to 23˚C, ideally 21˚C at 12:00 noon to 1:00 pm.

What burn tactics should I consider?

- Tactics will be site-specific and different burn tactics may need to be employed at the same location (for example, 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.
- **Aerial ignition**. Gridding using aerial incendiaries from a fixed-wing aircraft allows for the efficient coverage of large, flat areas (ideal for cypress pine production areas) and can be used to effectively alter the desired intensity of a fire. Spots are spaced approximately 100 metres apart to promote a lower-severity fire and limit the chance of hot junction zones occurring.
- Lighting smoke beacons (via aerial ignition) on the perimeter of the planned burn area can help to clearly identify the area and provide some visual information on local weather conditions (e.g. wind directions). This knowledge allows the fire manager to adjust tactics to suit the prevailing conditions.
- In some instances aerial ignition may be implemented in conjunction with ground ignition to secure an edge around the area being burnt. Be aware that this tactic requires a good understanding of the flight path or 'runs' of the plane and the spacing of the aerial incendiaries as smoke from fires lit by ground crews may impair the vision of the pilot and hamper lighting efforts. Following the securing of an edge, follow up ground ignition may also be required within the area to achieve the desired fire coverage. Use of aerial photographs is recommended (stereoscopic images are particularly useful to gain an understanding of terrain) and it is good practice to plot the incendiary drop path onto a map or aerial photograph and ensure lighting crews are well aware of this prior to ignition.
- A **running** fire (closely-spaced spot ignition or strip/line ignition with the wind) is often favoured within cypress pine production areas to limit flame residence time around the bases of the cypress pines. When using this tactic it is important to be aware of the prevailing and predicted weather conditions on the day of the burn and any existing containment issues. If these are not adequately considered, a running fire of greater severity than desired may result and impact upon the cypress pine community.

Aerial ignition using a fixed wing aircraft in a cypress pine forest. Smoke plumes indicate the spacing between spots.

Stephen Berlin, DAFF (2009).

Issue 2: Maintain open cypress pine forests

Use low-severity burning to maintain open cypress pine forests

Awareness of the environment

Indicators of healthy open cypress pine forests:

- Cypress (where it occurs as an open forest) may exist as a pure stand or can be associated with other species such as smooth barked apple *Angophora leiocarpa*, ironbark, bull oak *Allocasuarina luehmannii* or Moreton Bay ash *Corymbia tessellaris*.
- Some evidence of past fires (e.g. charring on trees) is present.
- Mature cypress trees often occur in distinct age classes through a number of germination events but not as a 'locked' stand of narrow immature cypress.
- Bull oak mistletoe *Amyema linophyllum* may be present on the branches of older bull oak trees.
- The mid and lower stratums are often sparse with a mix of smaller trees and shrubs, such as *Acacia* spp. and *Dodonaea* spp. with some young canopy species present (enough to eventually replace the canopy).
- Ground-layer vegetation can vary from sparse to dense and is often dominated by grasses such as hairy panic *Panicum effusum*, kangaroo grass *Themeda triandra*. Occasional forbs may be present.
- The leaf-litter may be thick and compact, discontinuous or sparse.
- Logs and branches are scattered.
- Overall, it is easy to see through and walk through.

A healthy open cypress pine forest with a shrubby understorey. In this photo young trees and shrubs are scattered and the ground-layer is sparse.

Mark Cant, QPWS, Wondul National Park.

A healthy open cypress pine forest with a mixed understorey. There is a good mix of young trees of varying species and ages.

Mark Cant, QPWS, Barakula State Forest.

Cypress and eucalypt co-dominant forest.
V.J. Neldner, Queensland Herbarium.

The following may indicate that fire is required to maintain open cypress pine forests

- A lack of diversity with cypress starting to dominate forming dense, ‘locked’ stands of young cypress trees usually of a height between one and three metres.
- An abundance of single age cypress of one to three metres.
- Cypress pines are beginning to shade-out understorey diversity and out-compete recruiting juvenile trees.
- The lower stratum has been shaded-out and ground-layer diversity has declined and/or is sparse.
- Where grasses were once common they are becoming sparser or for clumping grass species, the clumps are poorly formed. There is an accumulation of dead material and grasses have collapsed.
- The ground layer is starting to accumulate a blanket of cypress pine leaf litter and there are some suspended fuels and an abundance of heavy fuels (e.g. fallen trees and branches).

Young cypress pines are beginning to form a locked stand and will gradually shade out the understorey. This site is still recoverable with fire.

Mark Cant, QPWS, Barakula State Forest.

Young cypress pines have formed a dense 'locked' stand and have almost completely shaded-out the understorey. It would be difficult to introduce a planned burn into this site.

Mark Cant, QPWS, Gubbermunda State Forest.

Post clearing and grazing, young cypress have formed a dense stand and have almost completely shaded-out the understorey. It would be difficult for a planned burn to carry through this site.

A.R. Bean, Queensland Herbarium.

Discussion

- Protection of open cypress pine forests relies on low severity fire in and around the community, to mitigate impacts of wildfire.
- Appropriate fire management within open cypress pine forests avoids the formation of 'locked' stands. Mature and intermediate cypress trees will survive low-severity fires however, young trees and seedlings will not (Price and Bowman 1994). Applied in this manner, fire can be used to maintain the health of the cypress pine forest.
- One of Australia's most threatened butterflies, the 'endangered' bull oak jewel butterfly *Hypochrysops piceatus*, is reliant upon mature bull oaks as a host tree (Lundie-Jenkins and Payne 2000) and a thick leaf litter for its survival. Highs severity fires may remove leaf litter (disrupting the attendee ants) and burn mature bull oaks, impacting upon the survival of the bull oak jewel butterfly.
- Bull oak is an important food tree for the glossy black cockatoo.
- Cypress is particularly vulnerable to fire where there has been flame residence time at the base of the tree and complete charring or 'collaring' of the bark (some wind is advisable to avoid this).
- Dense 'locked' cypress stands will naturally exclude fire as they create a thick blanket of pine leaf litter and act as a 'wind break' that generally will impede fire spread and hamper planned burn efforts. Despite this, under severe weather conditions, they will burn with a very high to extreme severity with significant ecological impacts, including neighbouring areas (Taylor and Swift 2003).
- Cypress pine forests are an economic resource and are often managed in cooperation with other agencies including the DAFF. As part of the Western Hardwoods Process, a number of state forests and timber reserves that have retained some conservation values (some containing significant cypress communities) are progressively being transferred to protected area estate managed by the QPWS. Other areas of core cypress pine on State Forests are still currently available for timber harvesting.
- It will often be necessary to undertake cooperative planned burns in conjunction with other agencies (e.g. DAFF) to protect core cypress pine timber production forests.

What is the priority for this issue?

Priority	Priority assessment
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)
Burn 40–60 % spatial mosaic of burnt patches.	Choose one of these options: 1. Visual estimation of percentage of vegetation burnt, from one or more vantage points or from the air. 2. Map the boundaries of burnt areas with a GPS, plot on a GIS and thereby determine the percentage of area burnt. 3. 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:** 40–60 % burnt. **Partially Achieved:** between 30–40 % and 60–80 % burnt. **Not Achieved:** < 30 % burnt or > 80 % burnt.

> 75 % of overabundant cypress < 3 m are killed.	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 scorched.	**Achieved:** > 75 % of saplings < 3 m are scorched to the tip. **Partially Achieved:** 25–75 %. **Not Achieved:** < 25 %.
> 95 % of trees with stems of 10 cm DBH (diameter breast height) retained.	Select one or more sites or walk one or more transects (taking into account the variability of landform and likely fire intensity) and estimate number of mature trees. Determine the percentage retained after fire.	**Achieved:** > 95 % retained. **Partially Achieved:** 90–95 % retained. **Not Achieved:** < 90 % retained.
> 95 % fallen logs (with a diameter ≥ 10 cm) retained.	Before and after the burn (immediately-very soon after) count the number of fallen logs crossed by one or more line transects (e.g.100 m long but length must be adequate to provide a representative sample of the area) and determine the percentage retained in each chosen location.	**Achieved:** > 95 % retained. **Partially Achieved:** 90–95 % retained. **Not Achieved:** < 90 % retained.

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

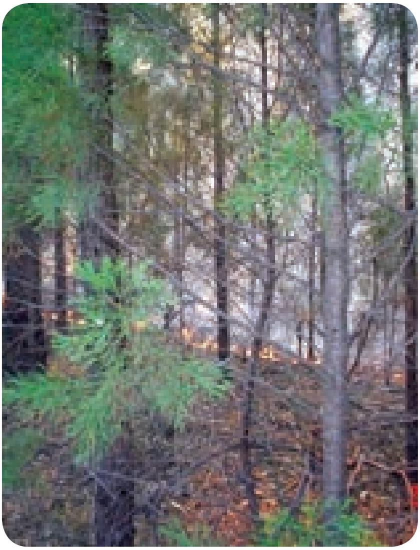
What fire characteristics will help address this issue?

Fire severity

- In general **low**, but vary with occasionally **moderate** to ensure the density of young cypress pines is managed and to reduce the likelihood of 'locked' stands forming.

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	< 0.3	< 1.5	High percentage of patchiness with minimal encroachment into cypress dominated communities. Undamaged cypress crowns. No signs of stem or bark damage.
Moderate (M)	50–200	0.3–1.0	1.5–5.0	Some patchiness, most of the surface fuels have burnt. Moderate scorch with up to 50 % of crown affected. Up to 25 % of stem circumference charred or weeping.

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



Examples of low severity fires within cypress pine forests.
Stephen Berlin, DAFF.

Post a low severity, mosaic burn in cypress forest. The fire has created a good mosaic, retained leaf litter and fallen logs and also scorched some cypress and bull oak saplings which will ensure the structure remains open.
Mark Cant, QPWS, Wondul National Park (2008).

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

- Fire frequency should primarily be determined through **on-ground assessment of vegetation health, fuel accumulation, cypress flush** 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 (i.e. recently burnt through to the maximum time frame). Consider a broad fire interval range of between six to eight years.

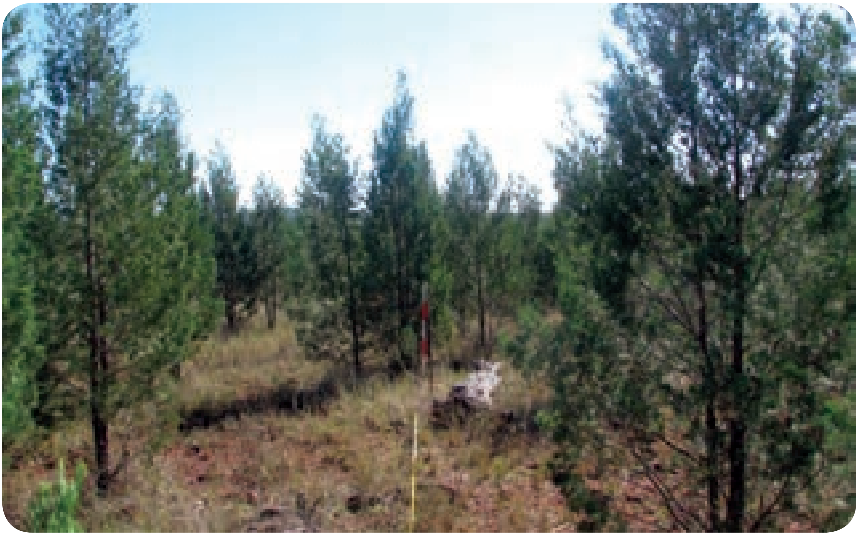
Mosaic (area burnt within an individual planned burn)

A mosaic is achieved with generally 40–60 per cent burnt within the target community.

Other considerations

- Cypress pine reaches reproductive maturity at six years. If a site has been identified as being at risk of becoming a 'locked' stand either through lack of fire or a severe fire has resulted in a flush of young trees, a fire frequency of less than six to eight years may be necessary (to reduce their number and assist in maintaining a diversity of cypress pine of varying ages).
- Long fire free intervals will ultimately lead to cypress dominance at the expense of other species, reduce the capacity to implement planned burns and result in the accumulation of high fuel loads in the area.
- The fire frequency applied in this community will be somewhat dependant upon climatic conditions, fuel availability and grazing issues.
- Broad-scale management of surrounding areas with numerous small fires under mild conditions throughout the year will assist in limiting the potential impact of wildfires on cypress pine forests.

Young cypress pines are encroaching and beginning to dominate—they will eventually shade-out the grasses. This site is still recoverable as the grass cover will still carry a fire.
Mark Cant, QPWS, Yeralbon State Forest (2005).



This photo depicts the same site four years later with no fire management. Young cypress trees have become established and grasses have become sparse. It would be difficult to recover this site due to the height of cypress pines and lack of fuel to carry a fire.
Mark Cant, QPWS Yeralbon State Forest (2009).

Post moderate severity fire in open cypress pine forest. Note the severity has resulted in enough scorch to kill some young cypress pines while others have survived.

Stephen Peck, QPWS, Alton National Park (2009).

Post high-severity fire. This fire has killed the mature cypress and bull oak trees and has resulted in the mass germination of acacia.

Bernice Sigley QPWS (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: Burn throughout the year (when good soil moisture exists). Avoid dry periods or burning during a period of increasing fire danger

FFDI: < 12

DI (KBDI): < 100, up to 120 in mild conditions

Wind speed: Beaufort scale 1–4, or < 20 km/hr

Soil moisture: Good moisture conditions in the soil will protect the bases of grasses, hollow bearing trees and fallen logs and will promote a good mosaic of burnt and unburnt patches.

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.

- **Aerial ignition** is used to create variability in fire severity (which promotes a rich landscape mosaic) and limit the scorch and severity of the fire on upper slopes. Aerial ignition using aerial incendiaries from a fixed-wing aircraft or helicopter is often used in the Brigalow Belt bioregion due to the extensive areas requiring burns. It is important to respond to opportunities to burn as they become available. Gridding with a fixed wing aircraft allows a greater coverage of large, flatter areas while helicopters provide the opportunity to directly target topographical features such as peaks, ridges and spurs to create a backing fire downhill. Aerial ignition may be implemented in conjunction with ground ignition to secure an edge around the area being burnt. Be aware that this tactic requires a good understanding of the flight path or 'runs' of the plane and the spacing of the aerial incendiaries as smoke from fires lit by ground crews may impair the vision of the pilot and hamper lighting efforts. Use of aerial photographs is recommended (stereoscopic images are particularly useful to gain an understanding of terrain) and it is good practice to plot the incendiary drop path onto a map or aerial photograph and ensure lighting crews are well aware of this prior to ignition.
- **Smoke issues.** Cypress pine litter retains a high level of moisture and often low severity planned burns will carry across it removing only approximately the first 10 millimetres off of the top layer of litter. Fires in cypress pine litter will often smoulder for long periods of time and create abundant smoke. Be aware of potential smoke impacts on urban settlements. Planned burns in adjoining areas should avoid periods when the atmosphere is stable and likely to create an inversion layer when smoke is likely to persist. Rather burns should be undertaken when the prevailing weather conditions (in particular wind direction) will direct the resulting smoke away from settled areas. Standard neighbour notification protocols should be followed. Be aware that smoke issues will also impact on apiary sites which have bees on them. Consideration should be given to these users when planning to burn as smoke and heat will impact on honey production at the time.
- **Progressive burning** can be implemented in surrounding fire-adapted communities (e.g. eucalypt forests and woodlands) where there is often a greater available fuel load under mild conditions and the fire is unlikely to carry into the cypress pine forest. Planned burns can then be implemented into the cypress pine forest at a later date under conditions that will achieve the desired severity and objective of the planned burn.

- Be aware that **fuel loads** (in particularly the presence of ground fuels) can vary greatly within cypress pine forests and need to be assessed carefully before implementing a planned burn. Although an area may appear to have sufficient fuel on casual aerial observation, it is common in cypress to have some areas where there is an accumulation of elevated fuels and lack of ground fuels. Attempting planned burns where there is a lack of ground fuel may exhaust fuels limiting later planned burn efforts.
- **Commence lighting on the leeward (smoky) edge** to create a low intensity backing fire into the burn area, or to create a containment edge for a higher severity fire ignited inside the burn area.
- **Spot lighting** can be used to effectively alter the desired intensity of a fire (particularly where there is an accumulation of elevated or volatile fuels). Spots close together will result in a line of a greater intensity (as spots merge they create hot junction zones). Spots further apart will result in a lower-intensity fire. The spacing of the spots may vary throughout the burn due to changes in weather conditions, topography and fuel loads.
- A **running fire** (closely spaced spot ignition or strip/line ignition with the wind) is often favoured within cypress pine production areas to ensure the fire carries across the available leaf litter (which is often heavily compacted in these areas) and limit flame residence time around the bases of cypress pines. When using this tactic it is important to be aware of prevailing and predicted weather conditions on the day of the burn as it may result in a running fire of a greater severity than desired and potentially impact upon cypress pine.

A spot fire from an incendiary in cypress pine forest approximately 10 minutes after being dropped. Widely spaced spots in mild conditions will promote a low severity fire such as that shown here.
Stephen Berlin DAFF (2001).

Issue 3: Transition production stands to open forest

Use fire to transition areas that were previously managed for production in order to manage them for conservation objectives.

Awareness of the environment

Indicators of previously managed production stands of white cypress pine:

- The area was previously zoned Natural Resource Management–Forest Products as a production forest.
- The leaf litter is predominately thick and compacted cypress pine litter.
- More than 75 per cent of the canopy is dominated by cypress pine.
- Often there are no signs of fire history at the site (e.g. charring of trees).
- Logs and limbs are lying on the ground and there is a general build-up of coarse or heavy fuels.
- The site lacks an understorey.

Discussion

- As management of these areas changes from one of silviculture to that of conservation, there will be a need for the land manager to determine future management objectives. Often this will be a decision to either retain monoculture stands of white cypress pines or to transition them to open stands that can be maintained more easily for conservation managed intent by using fire and other methods such as the thinning of regeneration by mechanical means.
- The harvest regime of the area preceding transition will greatly influence fire management and favoured outcomes in these areas. This is due largely to the potential removal of 50 per cent to 95 per cent of mature trees with a DBH of between 23 to 38 centimetres prior to handover to the QPWS.
- Due to the change in the vegetation structure post harvest, fuel loads at the site may be significant. Often the crowns or 'heads' of trees and other material such as bark and tree limbs will remain on the ground. This also opens the canopy allowing woody weeds such as lantana, acacias, canopy tree saplings and grasses to establish. In cypress forests, FP may conduct a 'top disposal burn' in the years following harvesting operations as the structure of the remaining material begins to change and breakdown and is more likely to result in a fire of a low severity. There is opportunity to undertake co-operative burns between FP and the QPWS to facilitate the transition.
- A dense acacia thicket may develop at harvested sites following a wildfire or a fire with an average flame height that is greater than 30 centimetres. It is important to take the opportunity to conduct planned plans (under favourable conditions with good soil moisture) at the site following a wildfire to limit the occurrence of acacia thickets and to promote grasses. If there are grasses remaining post wildfire it is often a good indication that the site is likely to recover in the long term.

What is the priority for this issue?

Priority	Priority assessment
Medium	Planned burn in areas where **ecosystem health** is **poor** but recoverable.
Very low	Ecosystem is **extremely difficult to recover**.

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)
To reduce mature cypress trees by > 50 % and create an open structure.	Choose one of these options: Visual estimation of percentage of cypress trees burnt – from one or more vantage points, or from the air. 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 trees reduced.	**Achieved:** Mature cypress trees reduced by > 50 %. **Partially Achieved:** Mature cypress trees reduced by 25–50 %. **Not Achieved:** Mature cypress trees reduced by < 25 %.
Reduce remaining heavy fuels (tree crowns, etc) post-harvest by > 50 %.	Choose one of these options: Visual estimation of percentage of heavy fuels burnt–from one or more vantage points, or from the air. 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 heavy fuels burnt.	**Achieved:** Heavy fuels reduced by > 50 %. **Partially Achieved:** Heavy fuels reduced by 25–50 %. **Not Achieved:** Heavy fuels reduced by < 25 %.

The recruitment of native grasses is promoted post fire.	Before and after fire, select three or more sites (taking into account the variability of landform and likely fire intensity) and estimate recruitment of grasses. **Before and after the burn** (after suitable germination/ establishment conditions, and if using cover – a growing season): define the density of the recruitment using the following criteria (from Parks Victoria Protocol [Parks Victoria 1995]): • Light = Grasses have increased by 0–24 % cover. • Medium = Grasses have increased by 25–75 % cover. • Dense = Grasses have increased by > 75 %.	**Achieved:** Grass recruitment 'raises' two 'density categories' (e.g. from light before the fire to dense after the fire). **Partially Achieved:** Grass recruitment 'raises' one 'density category' (e.g. from light before the fire to medium after the fire). **Not Achieved:** No change in the density category of grasses.

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?

Fire severity

- In general **moderate**, but a number of **high** severity fires may be required initially.

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)
Moderate (M)	50–200	0.3–1.0	1.5–5.0	Some patchiness, most of the surface fuels have burnt. Moderate scorch with up to 50 % of crown affected. Up to 25 % of stem circumference charred or weeping.
High (H)	200–500	1.0–2.0	5.0–10	Ground and mid-stratum burnt. Some habitat trees and fallen trees affected. Severe scorch with 50–100 % of crown affected. Up to 50 % of stem circumference charred or weeping.

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

Post moderate-severity fire showing the removal of most surface fuels in the burnt area and some canopy scorching.
Stephen Berlin, DAFF.

To reduce the number of young trees multiple high-severity burns may be required initially (aim for a high percentage of scorching and stem charring).
Stephen Berlin, DAFF.

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

- Fire frequency will largely depend on when the fuel load has accumulated to a point in which a fire will carry. It is important to assess fuel loads in post-production sites and be operationally able to respond to opportunities to burn these sites as they arise.
- As a rehabilitation issue, it is likely that it will take a number of fires of varying severity to address this issue, after which aim to revert to the recommended frequency refer to Issue 2.

Mosaic (area burnt within an individual planned burn)

- Aim for a high percentage of burn area. The percentage of coverage may be altered to suit the objectives of the planned burn.

Other considerations

- Be aware that this is a new and developing issue and requires a commitment to monitoring the site (e.g. by using observation points) pre and post-burn. The recommended fire parameters will need to be adjusted and refined to suit the objectives and as land managers become more familiar with burning these sites.
- A high intensity burn after logging operations often will result in the heavy regrowth of wattle and associated species. Follow up fire should be programmed.

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: Throughout the year where there is good soil moisture. Avoid periods of increasing fire danger

Soil moisture: Good soil moisture is recommended to retain a high percentage of leaf litter and not to expose patches of mineral earth or sand.

FFDI: < 16

DI (KBDI): < 120

Wind speed: Beaufort scale 1–3, up to four (10–23 km/h) within the forest. If the objective is to reduce mature cypress trees than near calm conditions are preferable to ensure a good residence time at the base of trees.

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.

- **Aerial ignition** is used to create variability in fire severity (promoting a rich landscape mosaic) and limit the scorch and severity of fire on upper slopes. Aerial ignition using incendiaries from a fixed-wing aircraft or helicopter is often used in the Brigalow bioregion due to the extensive areas requiring burns. This tactic maximises resources and allows for the ability to respond to burn opportunities as they arise. Gridding with a fixed-wing aircraft allows a greater coverage of large, flat areas while helicopters provide the opportunity to directly target topographical features such as peaks, ridges and spurs (creating a backing fire downhill). In some instances this tactic may be implemented in conjunction with ground ignition to secure an edge around the area being burnt. Be aware that this tactic requires a good understanding of the flight path or 'runs' of the plane and the spacing of the aerial incendiaries as smoke from fires lit by ground crews may impair the vision of the pilot and hamper lighting efforts. Use of aerial photographs is recommended (stereoscopic images are particularly useful to gain an understanding of terrain) and it is good practice to plot the incendiary drop path onto a map or aerial photograph and ensure lighting crews are well aware of this prior to ignition.
- **Smoke issues.** Cypress pine litter retains a high level of moisture and often low-severity planned burns will only remove the top layer (approximately the first 10 millimetres). Fires in cypress pine litter can also smoulder for long periods (creating a lot of smoke)—be aware of these smoke impacts on urban settlements. Planned burns in adjoining areas should avoid periods when the atmosphere is stable as it is likely to create an inversion layer causing smoke to persist for long periods. To avoid this, undertake burns when the prevailing weather conditions (in particular wind direction) will direct the smoke away from settled areas. Standard neighbour notification protocols should be followed. Note that smoke may also impact on apiary sites—smoke and heat can impact on honey production.
- **Progressive burning** can be implemented in surrounding fire-adapted communities (e.g. eucalypt forests and woodlands). Under mild conditions the fire is unlikely to carry into the cypress pine forest. Planned burns can then be implemented into the cypress pine forest at a later date. Utilise conditions that will achieve the desired severity and objective of the planned burn.

- Be aware that **fuel loads** (in particular the presence of ground fuels) can vary greatly within cypress pine forests and need to be assessed carefully before implementing a planned burn. Although an area may appear to have sufficient fuel on casual aerial observation, it is common in cypress to have some areas where there is an accumulation of elevated fuels and lack of ground fuels. Attempting planned burns where there is a lack of ground fuel may exhaust fuels limiting later planned burn efforts. Using **grassy areas to push fire** into areas that have less available fuel may assist in carrying fire through a site that has been cleared and has a fragmented fuel structure and less likely to carry fire. Ensure there is good soil moisture at the time of burning to promote the regeneration of grasses.
- **Ground ignition**. The lighting patterns used will be dependant upon the objective of the burn and the issues to be addressed.
- **Spot lighting** can be used to effectively alter the desired intensity of a fire (particularly where there is an accumulation of elevated or volatile fuels). Spots close together will result in a line of a greater intensity (as spots merge they create hot junction zones). Spots further apart 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 and fuel loads.
- A slow moving, **low intensity backing fire** will generally result in a more complete coverage of an area and ensures the fire has a greater amount of residence time, while ensuring fire intensity and rate of spread are kept to a minimum. A greater residence time is also useful in reducing overabundant trees.
- A **running fire** (closely spaced spot ignition or strip/line ignition with the wind) is often favoured within cypress forests to ensure the fire carries across the available leaf litter (which is often heavily compacted in these areas) and limit flame residence time around the bases of cypress pines. When using this tactic it is important to be aware of prevailing and predicted weather conditions on the day of the burn as it may result in a running fire of a greater severity than desired and potentially impact upon cypress pine.
- **Commence lighting on the leeward (smoky) edge** to create a low-intensity backing fire into the burn area, or create a containment edge for a higher-severity fire ignited inside the burn area.
- **Timing burns post harvesting.** Snigging tracks are usually left in good working order following harvesting operations. Timing planned burns at this time may provide better access to areas for ground ignition.

Issue 4: Manage invasive grasses

Refer to Chapter 12 (Issue 5), regarding fire management guidelines.

It is important to be aware of the presence of invasive grasses, as they can dramatically increase fire severity and are often promoted by disturbance such as fire. Buffel grass *Cenchrus ciliaris* in particular poses a significant threat. This species alters fuel characteristics and promotes a cycle of damaging high severity fires which can result in the fragmentation and overall decline in the extent of cypress pine and casuarina open-forests and woodlands and the forming of dense 'locked' stands.

Chapter 7: Acacia dominated communities

Stretching from the New South Wales border to Townsville, acacia communities characterise the Brigalow Belt bioregion. This fire vegetation group occurs as open forests and woodlands on coastal hills, lowland flats, plains, ridgelines, escarpments and tablelands (Bailey 1984; Hodgkinson 2002). Typically they are dominated by a single acacia species as a pure stand or in association with eucalypts or casuarinas. The understorey varies and may include some softwood species, shrubs, grasses and forbs (Hodgkinson 2002). Brigalow dominated communities are covered separately in Chapter 8.

Fire management issues

In most instances fire is not applied directly to acacia dominated communities through planned burns. Instead, the 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 that encroach upon the acacia communities. This is of particular importance where invasive grasses have become established along the margin of, or have penetrated into the community (these grasses increase the severity and potential encroachment of fire into acacia communities).

Issues:

1. Burn adjacent fire-adapted communities to maintain health of acacia communities.
2. Manage invasive grasses.

Extent within bioregion: 1 647 279 ha, 5 per cent; **Regional ecosystems:** Refer to Appendix 1 for complete list.

Examples of this FVG: Carnarvon National Park, 62 580 ha; Blair Athol State Forest, 35 799 ha; Expedition (Limited Depth) National Park, 24 942 ha; Redcliffevale Station 17 095 ha; Bedourie Proposed addition to Expedition National Park, 16 746 ha; Chesterton Range National Park, 13 206 ha; Boondandilla State Forest, 11 652 ha; Mount Nicholson State Forest, 9 945 ha; Oakvale State Forest, 9 663 ha; Goodedulla National Park, 8 224 ha; Allies Creek State Forest, 7 573 ha; Amaroo State Forest, 7 011 ha; Dawson Range State Forest, 6 627 ha; Squire State Forest, 6 006 ha; Kettle State Forest, 5 955 ha; Duaringa State Forest, 5 732 ha; Fairbairn State Forest, 5 104 ha; Serocold State Forest, 4 914 ha; Junee State Forest, 4 634 ha; Belington Hut State Forest, 3 898 ha; Pluto Timber Reserve 3 547 ha; Apsley State Forest, 3 490 ha; Nandowrie State Forest, 3 400 ha.

Issue 1: Burn adjacent fire-adapted communities to maintain health of acacia communities

Maintain a varied landscape mosaic of burnt and unburnt patches in adjacent fire-adapted communities to limit the frequency and potential impacts of damaging unplanned fires encroaching into acacia dominated communities.

Awareness of the environment

Key indicators of mature acacia dominated communities:

- The canopy can vary from open to closed and is dominated by a single acacia species. Eucalypts and emergent trees are occasionally present.
- The acacias are mature (i.e. are not regrowth) and on average have reached their maximum height.
- Depending upon soil type, topography, vegetation structure and season, the understorey can vary from sparse to moderately dense with grasses (e.g. *Calyptochloa gracillima and Sporobolus caroli*), herbs and forbs.
- There may be some evidence of regenerating acacias (e.g. seedlings) though these may be very sparse if present at all.
- Will usually be somewhat sheltered from fire by topographical features.
- Leaf litter and fine fuels are sparse.

Bendee and rosewood. Logs and fallen branches of various sizes are scattered on the ground in the majority of mature acacia dominated communities, providing refuge for a variety of fauna.

Rhonda Melzer, QPWS, Taunton National Park-Scientific (2005).

A Blackwood dominated community. Blackwood is easily killed by fire. It is reliant on high rainfall (rather than fire) for germination.

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

A gidgee dominated community. This species is extremely fire sensitive (killed by fire). It does not regenerate from seedlings or basal suckering post-fire.

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

A lancewood dominated community. While killed by fire, lancewood regenerates post fire via abundant seedlings which will often initially form dense clumps.

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

Rosewood is characterised by a buttressed trunk base. Good seasonal rainfall can promote a grassy understorey and a continuity of fuels. In later seasons the grasses cure and provide the opportunity for fire to carry into this community.

Rhonda Melzer, QPWS, Duaringa State Forest (2009).

Discussion

- Fire-killed acacias such as lancewood *Acacia* shirleyi, rosewood *Acacia rhodoxylon* and bendee *Acacia catenulata* are reliant upon regeneration from a viable seed bank post-fire in order for the species to persist locally. These species are hard-seeded and require a fire and good rain to promote germination. Although it is recommended to mitigate wildfire impacts by burning surrounding areas, the occasional (rare) wildfire may play a role in the persistence of this community in the landscape. It is then critical however, to exclude further fires until the acacias reach maturity and set several seed crops.
- Other acacias such as brigalow *Acacia harpophylla*, boree *Acacia tephrina*, gidgee *Acacia cambagei*, mulga *Acacia aneura*, and blackwood *Acacia argyrodendron* are long-lived and fire killed (or significantly top-killed). Fire plays no role in their germination which is very occasional and follows high rainfall years.
- Historically, fire within most acacia communities has been infrequent, estimated at between 10 to 50 years (though this differs where acacias are associated with grasslands). In general they have occurred following prolonged rainfall which has resulted in substantial grass growth creating sufficient fuel to carry fire (Hodgkinson 2002) or during extensive wildfires. Changes in land use (through clearing and use of pastoral fire) and spread of invasive grasses have resulted in fires of a greater frequency and severity causing undesirable impacts.
- Be aware that following a fire that has affected an acacia community, a more proactive fire management approach in the surrounding areas will often be required to allow the acacia regrowth sufficient time to recover and mature.
- 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 12 (Issue 5), for information regarding the management of invasive grasses.
- Fire exclusion in acacia/eucalypt mixed open forest can result in an accumulation of fuels that promote extensive, high severity single event wildfires. Patchy to low severity burns in surrounding areas that on occasion trickle into these areas is useful to reduce fuel and mitigate impacts.

What is the priority for this issue?

Priority	Priority assessment
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.

Objective: Limit fire encroachment into acacia dominated communities.

Select the following for the site:

Measurable objectives	How to be assessed	How to be reported (in fire report)
Minimal scorching or penetration of mature acacia tree edge.	**After the burn** (immediately-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-very soon after): walk the margin of the FVG or representative sections (e.g. a 100m long section of the margin in three locations) and estimate the percentage of margin scorched.	**Achieved:** Minimal scorching or penetration < 5 % of the margins scorched. **Partially Achieved:** Some scorching or penetration 5–15 % margins scorched. **Not Achieved:** >15 % of margins scorched.

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?

Fire severity

- Implement fires in adjacent fire-adapted communities as recommended for that fire vegetation group. Use good soil moisture, **patchy** to **low** severity burns, appropriate weather conditions and tactics (e.g. using landscape features such as drainage lines and rocky outcrops) so that the resulting fire will self extinguish near non-target community boundary.

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

- Implement fires in adjacent fire-adapted communities as recommended for that fire vegetation group but in such a way as to limit fire encroachment into acacia communities.
- In acacia communities with fire promoted germination, long fire intervals (often greater than 20 years) are required to enable the new generation of plants sufficient time to mature and set seed, prior to being exposed to further fires.
- Repeated fires within the same decade can result in a decline in abundance and distribution of many species of acacia (Williams et al. 2008).

Mosaic (area burnt within an individual planned burn)

- Aim for an increased mosaic (e.g. 40 per cent to 60 per cent) of burnt patches within surrounding communities to limit the severity and extent of subsequent unplanned fires.

Landscape Mosaic

- Aim to ensure acacia dominated communities remain long unburnt (and in some cases unburnt). 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).

A patch of lancewood affected by a high-severity wildfire. Note that there has been 100 per cent canopy scorch in some areas. Planned burns in surrounding areas can assist in limiting the extent and impact of wildfires on these sensitive communities.

Chris Crafter, QPWS, Boodjamulla National Park (2006).

Lancewood woodland on a rocky outcrop. Often acacia communities will be sheltered from fires due to landscape features such as bare, rocky outcrops which assist in their protection.

Rhonda Melzer, QPWS, Marlborough (2007).

Timing burns when landscape features such as melon holes retain water can assist in achieving a mosaic and limit fire encroachment into non-target communities.

Rhonda Melzer, QPWS, Nairana National Park (2006).

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.

- **Progressive burning.** Planned burns of varying size are strategically lit throughout the year in surrounding fire-adapted fire vegetation groups when conditions allow. This creates a rich mosaic of burnt and unburnt patches that can be used to establish a safe perimeter allowing further planned burns to take place. This tactic is also useful in creating a greater landscape mosaic and altering fuel loads which may assist in reducing the extent of unplanned fires. This has been used to good effect in areas such as Boodjamulla National Park where planned burns of varying size are strategically lit adjacent to lancewood patches throughout the year when conditions allow (Williams and Tran 2009).
- **Limit fire encroachment into non-target communities.** Undertaking burning in areas adjacent to acacia dominated communities under mild conditions or late afternoon will assist in creating a low severity fire that ideally will self extinguish overnight. Where the non-target community is present in low lying areas, e.g. drainage lines, utilise the surrounding topography to create a low intensity backing fire that travels down slope towards the non-target community. Use appropriate lighting patterns (e.g. spot lighting with matches) along the margin of the non-target community (refer to Figures 1 and 2, next page) to promote a low intensity backing fire that burns away from the non-target community creating a buffer zone preferably of (preferably of approximately 100 metres. In general spot lighting is the more rather than running a continuous drip torch line along the margin of the community is preferred to avoid the resulting fire being of a greater severity than desired. Once an adequate buffer has been established, additional lighting of the surrounding area can then commence if required. In both instances ensure good soil moisture is present within the non-target community.
- **Aerial ignition**. For broad-scale fixed-wing aerial ignition, use appropriate conditions so the fire can to self-extinguish near the edge of the acacia community. Aerial ignition by helicopter allows greater flexibility to directly target the edge of the acacia dominated communities. Used in areas that are particularly inaccessible, this tactic can create a backing fire that moves away from the community (especially when the community is located upslope from the fire-adapted vegetation). Be aware that burning during spring may impact upon the habits of critical pollinators.

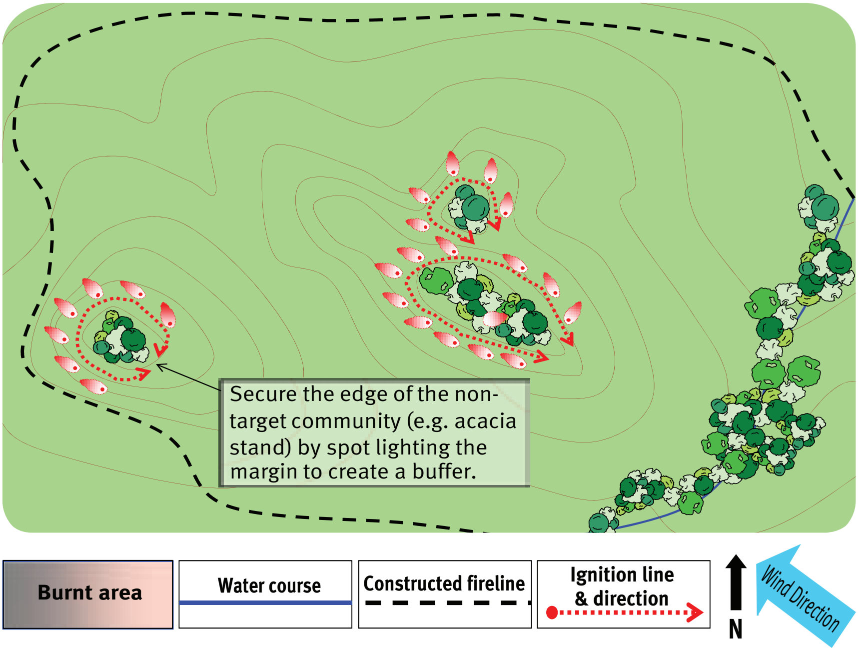


Figure 1: Creating a buffer zone surrounding a non-target community. In most instances a buffer of approximately 100 m is preferred prior to further lighting of surrounding areas.

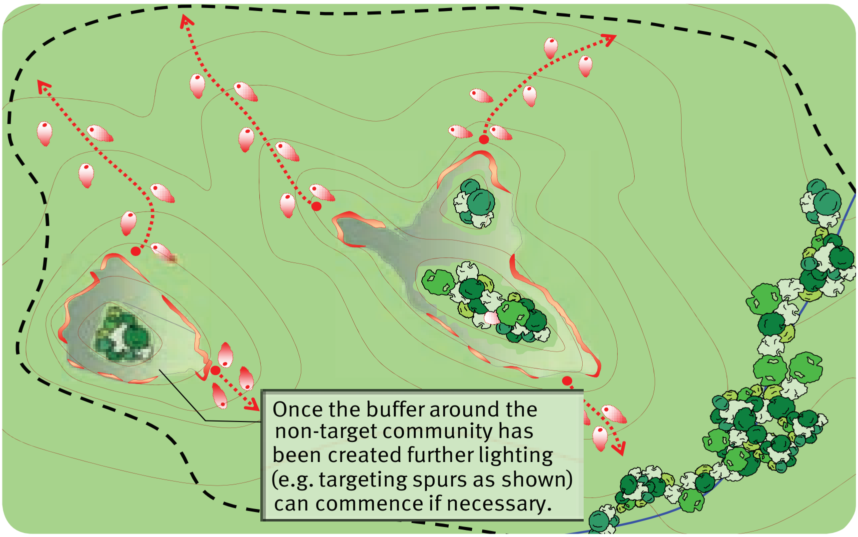


Figure 2: Once a buffer has been created further lighting in the surrounding area can commence if required. This will be determined by the objective of the burn and the desired mosaic and will not always be necessary.

Issue 2: Manage invasive grasses

Refer to Chapter 12 (Issue 5), regarding fire management guidelines.

It is important to be aware of the presence of invasive grasses, as they can dramatically increase fire severity and are often promoted by disturbance such as fire which results in significant damaging impacts upon the vegetation community in which it has invaded. Buffel grass *Cenchrus ciliaris* in particular poses a significant threat to acacia dominated communities by altering fuel characteristics and promoting a cycle of damaging high severity fires which gradually results in the fragmentation and overall decline in the extent of acacia dominated communities.

Chapter 8: Brigalow communities

Brigalow communities are dominated by brigalow *Acacia harpophylla*. They can occur as dense stands or as open-forests with acacias, eucalypts, casuarinas and soft wood species. Brigalow has a sparse grassy, shrubby or mixed grassy/shrubby understorey and occasionally abuts softwood scrub communities. The community has a canopy of between nine and 20 metres (depending upon rainfall) and occurs on hill slopes, undulating plains and flat land; generally as tracts or patches within other fire vegetation groups. Brigalow communities were once widespread covering over seven million hectares of Queensland and making up approximately 40 per cent of the Brigalow Belt bioregion (EoE 2007). However, competition with agricultural and pastoral land uses has resulted in clearing of 90 per cent of the original brigalow communities (EoE 2007). In Queensland 16 brigalow dominated regional ecosystems are listed as **endangered** under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

Fire management issues

Brigalow does not require fire for germination and it is a relatively poor reproducer (Butler 2007). If exposed to fire, brigalow regenerates by suckering from the roots and recovery post fire can be particularly slow depending upon fire intensity and seasonal conditions (Butler 2007). Brigalow communities are sensitive to fire therefore surrounding areas should be targeted to help mitigate the risk, frequency, intensity and extent of unplanned fires impacting on brigalow. 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. These become vulnerable to fire during severe fire weather where they adjoin fire-adapted communities and 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 *Cenchrus* ciliaris and green panic *Megathyrsus maximus* var. *pubiglumis* which can then draw fire into the brigalow.

Brigalow can also occur as an open tract of forest, often in association with fire-adapted species such as eucalypts or fire-sensitive species such as casuarinas. These open areas often have a more continuous ground layer of grasses and other species that carry fire. In these areas, fire management should aim for low-intensity mosaic burning to reduce the occurrence and extent of severe fires. In the absence of fire, brigalow has also been known to encroach into neighboring fire-adapted communities. Appropriate fire management in these communities will help managing this encroachment.

Introduced invasive grasses pose the greatest threat to brigalow communities by drawing fires into these areas and increasing fire severity. Particularly vulnerable are fragmented remnants (e.g. adjacent to roadsides), patchy regrowth or where brigalow occurs in low rainfall areas. Species such as buffel grass or green panic greatly alter fuel characteristics at the site (Butler 2007) and influence the potential for frequent and damaging fires.

Issues:

1. Burn adjacent fire-adapted communities to maintain health of brigalow communities.
2. Use fire to maintain open brigalow communities using low-severity mosaic burning.
3. Manage invasive grasses.

Extent within bioregion: 1 019 659 ha, 3 per cent; **Regional ecosystems:** Refer to Appendix 1 for complete list.

Examples of this FVG: Carnarvon National Park, 23 005 ha; Culgoa Floodplain National Park, 18 816 ha; Dipperu National Park (Scientific), 6 395 ha; Southwood National Park, 5 591 ha; Nairana National Park, 5 031 ha; Wilandspey Conservation Park, 4 805 ha; Tregole National Park, 4 738 ha; Nairana National Park (Recovery), 4 691 ha; Junee State Forest, 3 841 ha; Yuleba State Forest, 3 625 ha; Palmgrove National Park (Scientific), 3 409 ha; Mazeppa National Park, 2 972 ha; Blair Athol State Forest, 2 806 ha; Taunton National Park (Scientific), 2 758 ha; Lonesome proposed National Park, 2 510 ha; Orkadilla State Forest, 2 363 ha; Chesterton Range National Park, 2 255 ha; Kettle State Forest, 2 117 ha; Expedition (Limited Depth) National Park, 1 967 ha; Epping Forest National Park (Scientific), 1 816 ha; Junee National Park, 1 582 ha; Humboldt State Forest, 1 274 ha; Nogoa River Proposed National Park, 1 222 ha; Arthurs Bluff State Forest, 1 089 ha; Blackdown Tableland National Park, 1055 ha; Boondandilla State Forest, 994 ha; Barakula State Forest, 923 ha; Withersfield State Forest, 901 ha; Narrien Range National Park, 873 ha; Erringibba National Park, 844 ha; Goodedulla National Park, 690 ha; Bendidee National Park, 679 ha.

Issue 1: Burn adjacent fire-adapted communities to maintain health of brigalow communities

Burning of adjacent areas to create a buffer of low fuel.

Awareness of the environment

Key indicators

Indicators of brigalow communities around which fire management is required to limit fire encroachment:

- The presence of a brigalow stand. Within a brigalow community the canopy height is generally uniform. Brigalow height may vary in different areas depending on rainfall and whether it is a mature or regenerating stand.
- Brigalow stands are sometimes associated with belah *Casuarina cristata*, acacias, eucalypts (eucalypts may be emergent) and softwood scrub species.
- In adjacent areas where there is a continuous cover of fine fuels such as grasses, leaf litter, sedges and forbs, fire has a greater potential to penetrate into brigalow stands.

A brigalow-dominated community. Brigalow is 'top-killed' by fire and will slowly recover by suckering from the roots post fire.

Paul Williams, Vegetation Management Science Pty Ltd (2005).

Brigalow and box community. Scattered logs and debris in this community provides valuable refuge for a variety of fauna in particular invertebrates and reptiles.
V.J. Neldner, Queensland Herbarium.

Brigalow and Blackwood community on floodplains. There are some scattered shrubs and grasses are very sparse. Fire is unlikely to carry in this community.
V.J. Neldner, Queensland Herbarium.

A brigalow and belah community. Because of the continuous ground layer of grasses, fire is likely to carry into this brigalow community particularly after high rainfall has resulted in good grass growth.

Bill McDonald, Queensland Herbarium, Lake Nuga Nuga National Park (2004).

Brigalow often occurs along the margin of softwood scrub. Maintaining fire in the surrounding fire-adapted communities will help reduce fuel loads and mitigate wildfire risk.

Bernice Sigley, QPWS (2011).

Discussion

- Mature old-age stands of brigalow are particularly important to conserve and protect from inappropriate fire encroachment because they are very rare and conserve a number of regionally endemic and threatened fauna species. Mature stands are indicated by a uniform canopy height (can be up to 20 metres) with a wide variety of habitat features such as fissures or exfoliating (peeling) bark and refuge such as litter, logs and fallen branches.
- Fauna in these areas may include the yellow-tailed black cockatoo *Calyptorhynchus funereus*, little pied bat *Chalinolobus picatus*, south-eastern long-eared bat *Nyctophilus corbeni*, rough frog *Cyclorana verrucosa*, golden-tailed gecko *Strophurus taenicauda*, Dunmall's snake *Furina dunmalli* and the brigalow scaly-foot *Paradelma orientalis*.
- Brigalow and belah forests are listed as **endangered** under the *Environment Protection and Biodiversity Conservation Act 1999* and are important habitat for the **rare** painted honeyeater *Grantiella picta* and **vulnerable** northern imperial hairstreak butterfly *Jalmenus evagorus eubulus* (QPWS nd.).
- Invertebrates such as the military slater *Australodillo bifrons* and several species of native snails are often found in old stands of brigalow and are reliant upon the microhabitats in moist places such as flood debris on drainage lines, leaf litter build up in soil cracks and around logs and stumps. These are used as cover during times of migratory procession.
- The height of brigalow stands can vary depending upon soil type and rainfall. They range from nine metres in areas with an average of around 500 millimetres per annum to up to 20 metres in higher rainfall areas that average around 750 mm per annum (Butler 2007).
- Germination of brigalow is very rare. In general it requires winter rains to promote flowering, and follow up rain for germination. A lack of brigalow seedlings does not mean that the community is of poor health. Seedlings are only likely to be observed following unseasonably high rainfall events and these may occur only three or four times a century (Butler 2007).
- Brigalow regrowth is particularly susceptible to fire and it is important to maintain a buffer of low fuel around regenerating stands to limit further degradation of the community and encroachment by neighbouring communities (Myers et al. 2004). Grazing has been useful as a means to reduce fuels while in the absence of grazing, other methods such as mechanical or chemical control, and/or fire management to reduce fuel, may be required.

Mosaic burning around brigalow to reduce fuel loads and limit the threat posed by wildfires.

Bernice Sigley, QPWS, Marengo 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.**

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.

Objective: Limit fire encroachment into brigalow communities
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)
Limit the impact of fire on fire-sensitive species known to occur within an area.	**Before the burn:** Mark the start and finish of a transect line (e.g. 50 m or 100 m long) along the margin of an area that includes fire-sensitive species that may be impacted upon by the burn. **Or** **Before the burn:** Count the actual number of fire-sensitive species in a series of quadrates perhaps 10 x 10 m in size spaced evenly along the transect; calculate the frequency of occurrence (i.e. if you assess 50 quadrates and 10 of them contain fire-sensitive species, then the frequency is 10/50 x 100 = 20 %).	**Achieved:** < 5 % of fire-sensitive species affected by fire. **Partially Achieved:** 5–10 % of fire-sensitive species affected by fire. **Not Achieved:** > 10 % of fire-sensitive species affected by fire.
Minimal scorching or penetration of mature tree edge.	**After the burn** (immediately–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–very soon after): walk the margin of the fire vegetation group or representative sections (e.g. a 100 m long section of the margin in three locations) and estimate the percentage of margin scorched.	**Achieved:** Minimal scorching or penetration < 5 % of the margins scorched. **Partially Achieved:** Some scorching or penetration 5–10 % margins scorched. **Not Achieved:** > 10 % of margins scorched.

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 be controlled.

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?

Fire severity

- Establish a buffer of low fuel loads adjacent to brigalow using a **low**-severity fire.

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

- In adjacent areas, as often as sufficient fuel exists to carry a fire.

Mosaic (area burnt within an individual planned burn)

- Aim for a greater coverage of fire than usual in the areas directly surrounding brigalow to help mitigate encroachment of unplanned fire and create a buffer of low fuel loads.

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: As conditions allow however late wet or early dry season (March to April) is preferred to ensure good soil moisture. Avoid dry periods or burning when there is an increasing fire danger as this will often result in open patches of bare ground that will allow weed encroachment.

FFDI: < 11

DI (KBDI): < 120, ideally 80–100

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

Soil moisture: Following periods of good rainfall gilgai or 'melon holes' may have free standing water. Timing planned burns with these events may assist in limiting fire encroachment into brigalow communities

Brigalow with gilgai and free standing water.
Paul Lawless Pyne, QPWS, Humboldt National Park (2003).

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.

- **Fuel reduction** methods such as slashing, spraying and grazing to create a buffer around a brigalow community may also be useful to reduce the severity and extent of fire.
- **Limit fire encroachment into non-target communities.** Undertaking burning in areas adjacent to brigalow-dominated communities under mild conditions or late afternoon will help to create a low-severity fire that will (ideally) self-extinguish overnight. Where the non-target community is present in low lying areas (e.g. drainage lines) utilise the surrounding topography to create a low-intensity backing fire that travels down-slope towards the non-target community. Use appropriate lighting patterns (e.g. spot lighting with matches) along the margin of the non-target community to promote a low-intensity backing fire that burns away from the non-target community (create a buffer zone preferably of approximately 100 metres). Rather than running a continuous drip torch line along the margin of the community, spot lighting is preferred and will avoid the resulting fire being of a greater severity than desired. In both instances ensure good soil moisture is present within the non-target community.
- **Establishment of fire exclusion or wildfire mitigation zones.** Combined, these zones give the land manager clear guidelines to conduct planned burns in the surrounding fire-prone vegetation in a way that will create a buffer of low fuel loads and minimize the risk of a fire entering or impacting upon brigalow. Be aware that identifying an area as an exclusion zone assumes all reasonable measures to exclude fire from an area of brigalow (such as regular planned burns to create a buffer from the surrounding vegetation) will be undertaken in advance and is not necessarily limited to the ‘day’ of a wildfire (e.g. you may have patches of brigalow that may be inaccessible by vehicle or are unable to be reached safely and ‘defended on the day’ if threatened by wildfire).
- **Progressive burning** has been used to good effect in areas such as Boodjamulla National Park where planned burns of varying sizes are strategically lit adjacent to lancewood patches throughout the year, when conditions allow (Williams and Tran 2009).
- **Aerial ignition** using a helicopter with aerial incendiaries can be useful to directly target the edge of brigalow communities in inaccessible areas. This tactic creates a backing fire that burns away from the community, particularly when it is upslope from fire-adapted vegetation.

Reducing fuels by slashing, weed spraying and/or grazing along firelines adjacent to brigalow communities may limit the extent and impact of wildfires on these communities.
Bill McDonald, Queensland Herbarium (2004).

A brigalow and belah community. This is a good example of where edge-lighting tactics under mild conditions could help create a buffer zone to manage fuel loads.
V.J. Neldner, Queensland Herbarium, Arcadia Valley (1982).

Issue 2: Use fire to maintain open brigalow communities using low-severity mosaic burning

Use low-severity mosaic burning to maintain open brigalow communities and to mitigate the impacts of wildfire.

Awareness of the environment

Indicators of open brigalow communities where fire management is required:

- The presence of mature brigalow in an open community. Brigalow height may vary depending on rainfall, soil type and whether it's a mature or regenerating stand.
- The presence of brigalow open-forests sometimes with associated belah acacias, cypress and eucalypts.
- The understorey may consist of native grasses or invasive grasses. Young acacias, cypress, eucalypts and softwood scrub species such as false sandalwood may be present.
- The ground layer has a cover of fine fuels such as grasses, leaf litter, sedges and forbs that can carry a fire.

A low-intensity, mosaic fire in this brigalow and mountain yapunyah community with a grassy understorey will help managing fuel loads and maximise species diversity. Be aware of buffel grass in surrounding areas.

Bill McDonald, Queensland Herbarium, Roundstone Conservation Park (2002).

Discussion

- These communities contain a high diversity of endemic species as well as a high proportion of threatened species.
- This community is heavily influenced by fire intensity. High-intensity fires often reduce the numbers of brigalow while low-intensity mosaic burning will help minimise damage to brigalow and promote diversity within the community.
- Low-intensity fires are an important tool used to maintain brigalow communities. A build-up of fuels (which is highly likely in the absence of fire), can increase the risk of high-intensity fires and can top-kill the brigalow.
- Be aware that in the long absence of fire, the brigalow canopy may close and be somewhat self-protecting from fire. Prior to undertaking planned burns in open brigalow communities, the land manager needs to be clear about how fire will shape the community, and the objectives of fire management within it.
- Young brigalow remain highly susceptible to fire until they reach maturity (after which most will survive a low-intensity burn).
- Germination of brigalow is very rare. In general it requires winter rains to promote flowering and follow up rain for germination. A lack of brigalow seedlings does not mean that the community is of poor health. Seedlings are only likely to be observed following unseasonably high rainfalls which may occur three or four times a century (Butler 2007).
- After a disturbance (e.g. fire), brigalow will produce suckers from the roots. The amount of suckers produced is dependent upon the size of the brigalow, the type of disturbance and existing environmental conditions (e.g. soil moisture at the time of the disturbance).

Brigalow regrowth with a dense grassy understorey.

Bill McDonald, Queensland Herbarium, Castlevale (2009).

What is the priority for this issue?

Priority	Priority assessment
Very high	Planned burn required to maintain areas of **special conservation significance.**

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)
Burn 25–60 % spatial mosaic of burnt patches.	Choose one of these options: • Visual estimation of percentage of vegetation burnt – from one or more vantage points, or from the air. • Map the boundaries of burnt areas with GPS, plot on GIS and thereby determine the percentage of area burnt. • 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:** 25–60 % burnt. **Partially Achieved:** between 10–25 % **Or** 60–75 % burnt. **Not Achieved:** < 10 % or > 75 % burnt.

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.
No loss of mature brigalow trees.	Before and after fire, select three or more sites of a 50 m radius (taking into account the variability of landform and likely fire intensity) and estimate percentage of mature brigalow trees retained after fire.	**Achieved:** > 95 % key habitat features retained. **Partially Achieved:** 75–95 % retained. **Not Achieved:** < 75 % retained.
A patchy or low-severity fire with average flame height less than one metre.	During the burn a visual estimation of the average flame height. Post burn the average scorch height can also be a useful indicator of flame height.	**Achieved:** Average flame height is less than one metre. **Partially Achieved:** Average flame height is one to two metres. **Not Achieved:** Average flame height is greater than two metres.

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?

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	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	Some patchiness, most of the surface and near-surface fuels have burnt. Some scorching of elevated fuels. Little or no canopy scorch.

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

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

- Ensure the fire is frequent enough to avoid fuel build-up. This will mitigate the impacts of wildfire.
- 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.

Mosaic (area burnt within an individual planned burn)

- 25–60 per cent.

Landscape Mosaic

- The highest proportion of burning in surrounding areas should be implemented in the grassy open-forests and woodlands that intermix with shrubby 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).
- Aim for a greater mosaic (e.g. 30 per cent to 60 per cent) of burnt and unburnt patches within surrounding communities to limit the severity and extent of unplanned fires.

Other considerations

- Fire frequency on existing grazing leases is influenced by the level of grazing. Overgrazing can result in the loss of ground layer vegetation, increase the thickening of the shrub layer and reduce the capacity for fire to carry.

What weather conditions should I consider?

It is important to be aware of weather conditions prior to and following burns so that undesirable conditions and weather changes can be avoided.

Season: Late wet/early dry season (March to April) or as favourable weather conditions become available throughout the year.

FFDI: < 11

DI (KBDI): < 100

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

Soil moisture: Ensure good moisture conditions to protect the bases of grasses and promote regeneration.

Other considerations: Avoid burning when there are periods of increasing fire danger to avoid re-ignition.

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 applied to aerial and ground ignition and can be used to effectively alter the desired intensity of a fire, particularly where there is an accumulation of volatile fuels. Spots closer together will result in a line of a greater intensity (as spots merge they create hot junction zones). Spots further apart 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 and fuel loads.
- **A low intensity backing fire.** A slow moving, low intensity backing fire will generally result in a more complete coverage of an area and ensures the fire has a greater amount of residence time, while ensuring fire intensity and rate of spread are kept to a minimum.

Issue 3: Manage invasive grasses

Refer to Chapter 12 (Issue 5), regarding fire management guidelines.

It is important to be aware of the presence of invasive grasses, as they can dramatically increase fire severity and are often promoted by disturbance such as fire. Buffel grass *Cenchrus ciliaris* in particular poses a significant threat to brigalow stands by altering fuel characteristics and promoting a cycle of damaging high severity fires which gradually results in the fragmentation and overall decline in the extent of these communities.

Buffel grass encroachment into brigalow. Invasive grasses pose the greatest potential threat where they adjoin brigalow communities.

Bernice Sigley, QPWS, Marengo National Park (2011).

Chapter 9: Riparian, springs, fringing and foredune communities

This fire vegetation group includes spinifex grassland and herblands on foredunes, coastal she-oak communities, microphyll vine forest (beach scrub) on sandy beach ridges, river she-oak open forest, riverine wetlands, springs and eucalypt fringing forests.

Fire management issues

Most of the species in these communities are fire sensitive. Do not intentionally burn. When burning adjacent fire-adapted communities, limit fire encroachment by burning under suitable conditions and using tactics such as burning away from the community's edge. Many of these communities are subject to weed invasion, in particular lantana and invasive grasses such as green panic and guinea grass—both of which pose a significant threat by altering the fuel loads (in-turn increasing fire risk). In some cases it may be necessary to use fire to control lantana as it is an important component of control programs by improving access and efficiency of herbicide spraying.

Springs have a biodiversity status of **endangered** and contain a number of rare and threatened species such as the **vulnerable** hairy-joint grass *Arthraxon hispidus*. Sedges can be disadvantaged by repeated fires and care should be taken when burning in areas surrounding springs where a dry peat layer has developed (particularly in degraded situations). Proactive fire management in surrounding fire-adapted areas will mitigate the impacts of unplanned fire.

Issues:

1. Limit fire encroachment into riparian, springs, fringing and foredune communities.
2. Manage lantana.
3. Avoid peat fires.

Extent within bioregion: 473 840 ha; 1 per cent; **Regional ecosystems:** Refer to Appendix 1 for complete list.

Examples of this FVG: Boxvale State Forest, 2 147 ha; Carnarvon National Park, 1 375 ha; Palmgrove National Park (Scientific), 1 106 ha; Expedition (Limited Depth) National Park, 1 071 ha; Bowling Green Bay National Park, 818 ha; Kumbarilla State Forest, 806 ha.

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

Refer to Chapter 12 (Issue 1), regarding fire management guidelines.

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 to promote structurally complex ground and mid-strata vegetation and retain mature habitat trees.

Patchy to low severity burns in surrounding areas, late wet season to early dry season (e.g. March to April), that on some occasions trickle into eucalypt fringing Queensland blue gum *Eucalyptus tereticornis* will be useful to reduce fuel loads and mitigate impacts of wildfire and in particularly the loss of habitat trees.

Coastal she-oak *Casuarina equisetifolia* is extremely fire-sensitive. When burning adjacent fire-adapted communities, care should be taken to avoid any fire penetration. A bare earth buffer can easily be scratched with a rake-hoe through casuarina needles on sand to prevent fire trickling into these communities. Storm burning (in adjacent communities) may be useful to minimise impacts on mature she-oak. Be aware that dense Singapore daisy *Sphagneticola trilobata* and infestations of high-biomass grasses can draw fire into these communities.

Coastal she-oak are easily killed by fire and are an important food tree for the red-tailed black cockatoo. When burning adjacent fire-adapted communities, care should be taken to avoid any fire penetration.

Bill McDonald, Queensland Herbarium (2008).

Microphyll vine forest on sandy beach ridges. This community is fire-sensitive and does not require fire.

Bill McDonald, Queensland Herbarium (2010).

Avoid fire into most riparian communities. Implementing planned burns in surrounding fire-adapted communities (in the recommended season using appropriate tactics) will limit the potential impacts on this community.

Paul Lawless-Pyne, QPWS, Kroombit (2011).

Grasses such as green panic have established along the margin of this dune community. This has greatly increased the fuel load and potential for fire to carry into this community.
Bill McDonald, Queensland Herbarium (2010).

Perched springs are fairly self-protecting from fire. However, ensure free-standing water is present when implementing burns in the surrounding area.
Paul Lawless-Pyne, QPWS, Homevale Dams (2010).

Issue 2: Manage lantana

Refer to Chapter 12 (Issue 6), regarding fire management guidelines.

Lantana can often invade the edge of riparian, fringing and foredune communities, increasing fuel and drawing fire into these communities. Fire in riparian areas can be a useful strategy to control lantana to aid the recovery of native vegetation.

Issue 3: Avoid peat fires

Refer to Chapter 12 (Issue 4), regarding fire management guidelines.

Springs accumulate decayed, densely-packed vegetation known as peat which can be exposed during times of drought or below-average rainfall. In the absence of good soil moisture, peat can be ignited easily and result in a peat fire. Peat fires can burn for months at a time and can have very negative impacts on the vegetation community. Peat takes many years to re-form.

Chapter 10: Rainforest and vine thicket

Rainforests including semi-evergreen vine thickets (SEVT) and microphyll vine forests are found from lowlands and plains to the uplands and tablelands of the Great Dividing Range. In the Brigalow Belt bioregion, rainforest is found within elevated refuges such as Carnarvon Gorge and Blackdown Tableland, while SEVT ecosystems usually occur as discrete or fragmented patches scattered throughout the bioregion situated within a range of other vegetation types particularly brigalow *Acacia harpophylla* forest (QPWS 2007).

Fire management issues

Typically, rainforests in the Brigalow Belt bioregion are located within areas that will not burn due to topography, an internally-moist microclimate and a lack of available fuels (Williams et al. 2006; QPWS 2007). Scorching of rainforest margins may occur during periods of drought, where they have been subjected to disturbance and/or where fire-promoted invasive species (such as high-biomass grasses and lantana) have established. SEVT share a number of factors in common with other rainforests which generally reduce the likelihood of fire impacting upon the community. Smaller isolated patches of SEVT are more susceptible to the impacts of fire than larger undisturbed stands as they have a greater exposure to edge effects including increased fuel loads and fires of greater intensity and frequency. These edge effects are generally associated with introduced grass pasture species (e.g. buffel grass or green panic) that exist in areas adjacent to the thickets, or in areas invaded by lantana (QPWS 2007). Repeated fires combined with the slow rate of regeneration characterised by vine thicket vegetation have been attributed to the rapid decline of SEVT remnants, particularly those adjacent to roadsides and the hill slope fragments in Queensland (McDonald 1996).

The main strategy is to maintain surrounding fire-adapted communities with mosaic burning to minimise the spread and severity of wildfire during very severe weather events. In certain situations, rainforests and SEVT are more vulnerable to fire (e.g. coastal littoral rainforest, dry scrubs or where damaged rainforest is upslope from a planned burn area). In these instances, it may be necessary to employ specific tactics such as burning away from rainforest edges. Occasionally, fire is used within rainforest areas for specific weed control and rehabilitation purposes.

Issues:

1. Limit fire encroachment into rainforest and semi-evergreen vine thickets.
2. Manage invasive grasses.

Extent within bioregion: 313 984 ha; 1 per cent; **Regional ecosystems:** Refer to Appendix 1 for complete list.

Examples of this FVG: Carnarvon National Park, 13 487 ha; Palmgrove National Park (Scientific), 3 664 ha; Goodedulla National Park, 3 371 ha; Expedition (Limited Depth) National Park, 3 194 ha; Sonoma State Forest, 2 881 ha; Bowling Green Bay National Park, 2 652 ha; Coominglah State Forest, 1 799 ha; Bunya Mountains National Park, 1 765 ha; Dipperu National Park (Scientific), 1 515 ha; Carminya Forest Reserve, 1 196 ha; Belington Hut State Forest, 1 084 ha; Redcliffevale Station 933 ha; Homevale Resources Reserve, 932 ha; Zamia State Forest, 856 ha; Lonesome proposed NP 720 ha; Rundle Range National Park, 719 ha; Bukkulla Conservation Park, 674 ha; Magnetic Island National Park, 669 ha; Mount O'Connell National Park, 565 ha; Allies Creek State Forest, 530 ha; Peak Range National Park, 523 ha; Homevale National Park, 517 ha; Bouldercombe Gorge Resources Reserve, 513 ha; Don River State Forest, 498 ha; Mount Hopeful Conservation Park, 497 ha; Mount Etna Caves National Park, 496 ha; Marlborough State Forest, 462 ha; Callide Timber Reserve, 452 ha; Mount Archer National Park, 431 ha; Tierawoomba State Forest, 431 ha.

Issue 1: Limit fire encroachment into rainforest and semi-evergreen vine thickets

Refer to Chapter 12 (Issue 1), regarding fire management guidelines.

Mosaic burning in surrounding fire-adapted vegetation communities will limit the potential impacts of unplanned fires on non-target communities such as rainforests and SEVT. The edges of these communities are generally self-protecting during planned burning under appropriate conditions. Sometimes however, it may be necessary to burn back from the rainforest edges.

The understorey of a typical semi-evergreen vine forest. Though there are some surface fuels, these communities are generally self-protecting and unlikely to burn if undisturbed.
Bill McDonald, Queensland Herbarium, Expedition Range (2004).

Edge-lighting tactics under mild conditions to create a low-severity fire may be useful in managing the high fuel loads adjacent to this softwood scrub community.

Bernice Sigley, QPWS (2011).

Araucarian microphyll vine forest bordered by open eucalypt forest. Manage fire in the surrounding landscape carefully to limit encroachment into fire-sensitive communities.

Rhonda Melzer, QPWS, Kroombit tops (1992).

Isolated patches of softwood scrub are vulnerable to wildfire particularly when they are upslope of fire-adapted communities.

Bernice Sigley, QPWS, Moolayember National Park (2010).

Post wildfire in a SEVT. The fire has killed most trees and shrubs and removed logs and vegetative debris. The community is now susceptible to encroachment by invasive grasses.
Mark Cant, QPWS, Bunya Mountains National Park (2009).

Where possible, hazard reduction burns in the area adjacent to softwood scrub will further protect these communities.
Bernice Sigley, QPWS, Moolayember National Park (2010).

Issue 2: Manage invasive grasses

Refer to Chapter 12 (Issue 5), regarding fire management guidelines.

It is important to be aware of the presence of invasive pasture grasses as they can dramatically increase fire severity, are often promoted by fire and may result in significant damaging impacts upon the vegetation community in which they have invaded.

The damaging impacts of the gradual encroachment of invasive grasses and increased severity and frequency of fire are shown in these two photos. The dry rainforest that would normally be sheltered on this hillside has been degraded, fragmented and almost lost due to a cycle of invasive grass encroachment and wildfires over 17 years.

Paul Williams, Vegetation Management Science Pty Ltd, Toogoora Rock (1990 and 2007).