Fire parameters

What fire characteristics will help address this issue?

Fire severity

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

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

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

Mosaic (area burnt within an individual planned burn)

- **Protection zones:** 90 per cent burnt.

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.

Western (drier) areas	Eastern (moister) areas
Season: Burn in the early dry seasons where overnight conditions will extinguish the fire. Daytime conditions will allow a good coverage of fire.	**Season:** Burn when conditions are dry enough to ensure a good coverage of fire. Avoid periods of increasing fire hazard in the very late dry season.
GFDI: < 11	**GFDI:** < 11
DI (KBDI): 80–100	**DI (KBDI):** 80–180
Wind speed: < 15 km/hr	**Wind speed:** < 23 km/hr

Relative humidity (RH): Burn during high relative humidity to achieve a low to moderate-severity burn. This will reduce the potential impact on infrastructure during hazard reduction burns. Cloud cover may also be of use.

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

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

What burn tactics should I consider?

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

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

Targeting rank or standover grasses through broad-scale aerial ignition with widely spaced incendiaries. In the right conditions techniques such as this will assist in impeding wildfires later in the season and meeting conservation outcomes such as retaining a level of patchiness leading to increased diversity.

Nick Smith, QPWS, Bulleringa National Park (2012).

Issue 2: Planned burning near sensitive cultural heritage sites

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

Awareness of the environment

Key indicators of Indigenous cultural heritage sites:

- Raised mounds (especially with visible shell debris) or the presence of shell debris scattered on the ground can indicate the presence of shell middens.
- Rock shelters, especially if they have rock paintings, stone tools, artefact bundles, wrapped material or bones inside.
- Engravings on trees or rock faces.
- Arrangements of stones or raised earth patterns on the ground, or artefacts scattered on the ground.
- The presence of trees that have been scarred or carved.
- Natural features which have significant cultural meaning and are associated with stories are identified.
- The presence of burial sites.

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

David Cameron, DNRM (2004).

Caves such as this may contain cultural material vulnerable to smoke impacts.

David Cameron, DNRM, Unspecified location.

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

David Cameron, DNRM, Atherton (2002).

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

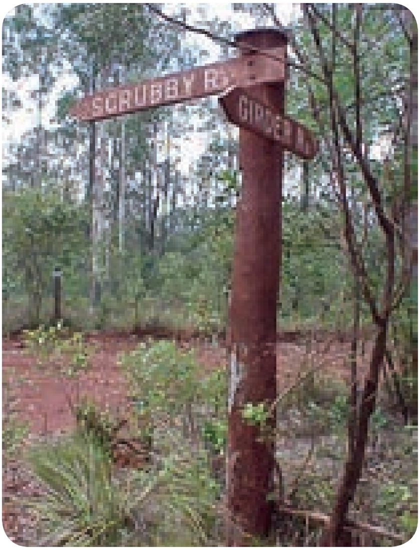
David Cameron, DNRM, Bribie Island (2005).

Key indicators of European cultural heritage sites:

- Presence of building remains, corrugated iron shacks, wooden house stumps, old fence posts, old stock yards, tombstones, wells, graves, bottle dumps, old machinery and iron debris.
- Quarries and old mine sites (sometimes deep holes covered with corrugated iron or wood).
- Forestry artefacts including marked trees (shield trees), and old machinery such as winders (timber tramways) and timber jinkers (timber lifting wagon).
- Military artefacts such as old equipment and used ammunition are found.
- Survey and trig points present.
- Historic fence-lines remain.
- Markers from early European explorers are located.

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

David Cameron, DNRM, Dogwood Creek (2005).



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

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

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

David Cameron, DNRM, various locations.

Discussion

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

What is the priority for this issue?

Priority	Priority assessment
Highest	Fuel management through the implementation of planned burns within **protection zones** to protect life, property, and conservation values.
Very high	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.

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

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

Fire parameters

What fire characteristics will help address this issue?

Fire severity

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

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

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

Landscape mosaic

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

What weather conditions should I consider?

When planning a burn it is important to be aware of weather predictions prior to and following burns so that undesirable conditions and weather changes can be avoided.

Season: Favour early season burning and moist conditions

FFDI: < 11

GFDI: < 18

DI (KBDI): 80–120

Wind speed: < 15 km/hr

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

Soil moisture: Ensure good soil moisture

What burn tactics should I consider?

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

- **Spot ignition**. Can be used effectively to alter the desired intensity of a fire particularly where there is an accumulation of available and volatile fuels next to a site of interest. Widely spaced spots are preferred in this instance as it will promote a slow moving and manageable low severity fire and limit the chance of high severity junction zones developing.
- While a low intensity backing fire is recommended, a **running fire** of a higher intensity may be required initially where there is an accumulation of surface or uncured fuels. Use with caution and be aware of environmental impacts that may result. To create higher intensity, **spot light the windward (clear) edge**.
- **Manual fuel management**. Usually, burning in appropriate conditions should be sufficient to protect cultural heritage items. However, prior to undertaking planned burns near sites of cultural significance (e.g. scar trees and rock art sites), assess the need for manual reduction of fuel. This may include the raking, clearing (e.g. rake-hoe line), trimming or leaf blowing of surface fuels away from the site to limit potential impacts from smoke, flame and heat radiation. Only undertake manual fuel management if required, otherwise it is preferable to leave the site completely undisturbed.

Natural features such as springs and waterholes can have significant meaning to Traditional Owners. A very high priority should be placed on their careful management.
QPWS, Bulleringa National Park.

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

Issue 3: Reduce overabundant saplings and seedlings

In the Gulf Plains bioregion an overabundance of *Melaleuca* spp., *Eucalyptus* spp., *Acacia* spp. and in some areas currant bush *Carissa lanceolata*, quinine *Petalostigma* spp., gutta percha *Excoecaria parvifolia*, *Gardenia vilhelmii*, or other species may reduce the health and diversity of the ground layer through competition and shading. If left unmanaged, the structure of woodlands and forests can become more closed and grasslands can become woodlands; a process known as woody thickening. As woody thickening progresses, fires become more difficult to reintroduce.

Awareness of the environment

Key indicators

- Significant numbers of young trees are beginning to emerge above ground layer plants. It is not an issue if the area affected is small or isolated or young trees are scattered.
- Overabundant young trees are in the mid stratum. The mid stratum is becoming difficult to see through.
- Grasses are becoming scattered, other ground layer plants are declining in health, diversity and abundance due to shading.

Woody thickening can occur where fires have been absent or infrequent. This Cooktown ironwood *Erythrophleum chlorostachys* has thickened in the mid-stratum and if left unmanaged will shade out grasses.

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

This gutta percha has thickened due to high grazing pressure. leading to reduced fuels for planned burning.

Bernie English, DAFF, Croydon District (2008).

Sometimes trees such as the tooth brush Grevillea can appear to have thickened. In this location it is in fact a natural canopy. Understanding the past land use and fire history of an area can assist in determining if thickening is an issue.

Lana Little, QPWS, Staaten River National Park (2009).

Discussion

- An overabundance of saplings in the understorey may be triggered in response to:
    - a lack of, or a long absence of fire
    - heavy grazing
    - a high rainfall event or severe fire event which has exacerbated thickening (due to one of the above causes).
- Certain eucalypts can germinate en masse. In the absence of fire, seed stock can build up, which is likely to lead to a mass germination event after fire. Where this has occurred in areas where past management practices have caused thickening, it is likely that more than one fire will be required to address the issue. Post fire observations are essential to monitor the kill rate and germination of these species in order to ascertain the need for subsequent fires.
- Melaleuca and eucalypt saplings are unlikely to be killed outright by fire; rather they will be reduced to below the grassy layer and regenerate from root stock. Seedlings are more vulnerable however and given sufficient fuel may be killed by fire. If seedlings are observed and appear to be thickening a fire should be applied as soon as fuel and conditions allow, as within a very short time frame (sometimes only a single year) it may no longer be possible to kill them.
- For eucalypts and some acacias and other trees, seedling recruitment is most likely to occur during high rainfall years. In areas where fires have been maintained or grazing pressure is low, this does not usually result in a problem. However, rainfall triggered seedling recruitment may compound thickening where it already occurs. Following high rainfall events, carefully observe areas where past management practices have caused thickening and consider implementing a planned burn as soon as conditions allow.
- Woody thickening becomes much more severe where heavy stock grazing is combined with repeated early season burns or a lack of fire. Stock grazing reduces fuel loads, preventing fires of sufficient severity to manage overabundant seedlings/saplings. This is further compounded by cattle concentrating on regrowth grasses in the recently burnt areas and avoiding 'toxic' plants such as some quinine trees allowing woody species the competitive advantage. Spelling pasture for a time before and after fire may assist in this issue.
- In some areas, an abundance of some shrubs and trees are part of the natural fire ecology cycle. Implementing fire management appropriate to the fire vegetation group in which they occur is adequate to maintain these areas. Knowing the fire history of an area and individual species response to fire will help determine if thickening has become a problem.

What is the priority for this issue?

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

Fire management of young trees in a eucalypt community (December 2008). It may be that these trees resulted from flooding that occurred in early 2008.
Bernie English, DAFF, Near Mt Garnet (2008).

Assessing outcomes

Formulating objectives for burn proposals

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

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

Measurable objectives	How to be assessed	How to be reported (in fire report)
> 75 % of mid stratum saplings are reduced.	Select one or more sites or walk one or more transects (taking into account the variability of landform and likely fire intensity), estimate the percentage of overabundant saplings (above ground components) scorched.	**Achieved:** > 75 %. **Partially Achieved:** 25–75 %. **Not Achieved:** < 25 %.
Increase the size of grassland.	At a number of locations on the boundary of grasslands and woodlands establish photo monitoring points. Return to these locations to check if the grassland is expanding/ woodland retreating.	**Achieved:** Grassland expanding/woodland retreating. **Partially Achieved:** No change. **Not Achieved:** Grassland continues to retreat/woodland expand. * a number of fires over a long period may be required to eventually kill trees.

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

Fire parameters

What fire characteristics will help address this issue?

Residence time

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

Mosaic (area burnt within an individual planned burn)

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

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

- More than one planned burn will be required to manage this issue. Monitor outcomes until overabundant saplings/seedlings are controlled.
- In some cases it may be sufficient to apply fires at the lower end of the recommended fire frequency for a time to manage overabundant saplings/seedlings.

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

- **Moderate** for most situations where young trees are less than 1 metre tall. Where young trees are taller than 1 metre, a **high**-severity fire might be necessary. Use high-severity fire with caution. Avoid lower-severity fire, as this will exhaust fuel and reduce opportunities for subsequent higher-severity burns.
- A fire regime of repeated low-severity burns will exacerbate the issue.

Other considerations

- It is important to observe post fire germination, regeneration and kill rates to ascertain the need for subsequent fires. If the initial fire triggers a flush of new seedlings, follow-up planned burn as soon as enough fuel builds to create a moderate to high-severity fire.
- Once the area has recovered, the recommended regime for the fire vegetation group be resumed (refer to relevant chapter).

What weather conditions should I consider?

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

GFDI: 8–18

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

What burn tactics should I consider?

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

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

Issue 4: Reduce woody weeds

Rubber vine *Cryptostegia grandiflora*, parkinsonia *Parkinsonia aculeata*, *Vachellia farnesiana* (sometimes known as prickly mimosa or mimosa bush) and prickly acacia *Vachellia nilotica* are common within the Gulf Plains bioregion. Other woody weeds such as Chinee apple *Ziziphus mauritiana* and mesquite *Prosopis* spp. are also found but are less common. Neem *Azadirachta indica* is causing considerable concern due to the rapidity of its spread. Fire may assist in the control of some species.

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

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

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

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

Awareness of the environment

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

- Woody weeds occur in fire-adapted vegetation or fire extent can be limited in fire-sensitive vegetation.
- Grass or forbland fuels are still sufficiently continuous to carry fire despite the occurrence of woody weeds.
- Grass fuel crumbles in the hand meaning it is sufficiently cured to carry fire.
- Biocontrol agents may be present and increase the effectiveness of fire as a control method (e.g. rubber vine is infected with rubber vine rust or parkinsonia affected with parkinsonia dieback).

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

- Woody weeds occur in areas of insufficient fuel to sustain fire.
- Woody weeds occur in fire-sensitive vegetation and fire spread cannot be limited.
- There is a risk of fire outside the burn plot (e.g. spotting across a creek).
- Woody weeds are within or adjacent to fire-sensitive cultural sites or infrastructure.
- Control of woody weeds can not be achieved using fire alone. A combination of control methods is required.

Prickly acacia is of particular concern to native grasslands. If detected early, fire can be used to control the saplings and seedlings. However fire is much less effective on mature plants.
Kerensa McCallie, QPWS, 30 km east of Hughenden (2011).

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

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

Parkinsonia flowers.

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

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

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

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

Barry Nolan, QPWS, Cape Upstart (2008).

Results of successful rubber vine control in a floodplain eucalypt community. The fire was intense enough to kill mature rubber vine and smaller trees.

Carly Greig, EHP, Finucane Island National Park (2010).

Discussion

- Many species of woody weeds appear similar and care should be taken to ensure **accurate identification** before trialing any control method. Failure to do so could result in worsening the existing infestation.
- A single fire can be used to reduce or eliminate seeds, seedlings and young plants of some woody weeds where sufficient fuel is available (success rate is dependant on species). Follow-up fires may be required should some seeds survive in the seed bank or plants resprout.
- Care needs to be taken to identify infestations of new weeds, as they are much easier to control at early stages.
- Young plants/seedlings of woody weeds are more easily controlled with fire than mature plants.
- Planned burning in areas with woody weeds should always be conducted when the soil is moist to allow native species, especially grasses and forbs, the best chance of re-establishing.
- In areas where rubber vine or parkinsonia have shaded out native grasses, mechanical or chemical control may be necessary. A combination of fire and chemical control could also be useful where grasses abut an infestation. A backing fire into the woody weeds may reduce the area requiring chemical treatment or increase accessibility.

- Care should be taken using fire where fire-adapted communities abut fire-sensitive communities. Dead plant material or high severity fire could draw fire in to these communities.
- Be aware of weed hygiene issues when burning in areas with woody weeds. Fire vehicles and machinery can aid seed spread along firelines roads and tracks and should be washed down after exposure.

Parkinsonia

- Parkinsonia is broadly distributed within the bioregion with most areas affected to varying degrees. When trialing fire to control parkinsonia, record observations, as this information is useful to guide future fire management (there is still much to learn about fire and parkinsonia).
- Fire will kill seeds on or close to the ground and has been shown to reduce the viability of seeds remaining suspended on the plant.
- Where 'parkinsonia dieback' (a soil-borne fungus) is present, fire seems to promote the rapid spread of this pathogen amongst the surviving plants. Parkinsonia affected with the dieback will appear to be dying back from the tips of the branches, with dead leaves remaining attached to the plant. Brown staining within the stems and branches may also be a good indicator of die back. In well established areas of dieback, the fungus will spread through the soil infecting nearby trees. Parkinsonia plants with dieback may be more susceptible to control with fire.

Rubber vine

- Fire is known to be very successful in killing rubber vine. Therefore fire should be considered part of rubber vine control. But in fire-sensitive areas use fire with care and limit fire spread (it may not be possible to use fire in these areas depending on fuel availability and likely impacts on fire-sensitive species, and chemical control may be a better option).
- Rubber vine is not restricted to disturbed vegetation and prefers a good layer of organic material in the soil. It is restricted to areas where fires are absent or infrequent (Mackey et al. 1996).
- A 'heli-torch' can be used to control rubber vine in fire-sensitive communities, inaccessible areas or where chemical use is not viable. The flammable petroleum based gel is applied directly to the plant then ignited. In some areas this method has been very successful but mixed results in other areas have been reported. See tactics below.
- Using fire to control rubber vine is more successful in areas where rubber vine rust occurs. While rarely killing mature plants, leaf-drop caused by the rust increases fuel depth below infected plants and opens the canopy allowing grasses to grow. If this fuel occurs adjacent to the stems it can increase residence time or carry the fire through areas where it may previously have extinguished, which may increase the effectiveness of fire as a method of control.

Prickly acacia

- Prickly acacia seedlings are known to be fire killed however mature plants are particularly fire resistant. Where top kill has occurred they tend to resprout from the base. Early detection of an infestation is the key to successful management as seedlings and saplings are much more susceptible to fire.

Mimosa bush or prickly mimosa

- Fire may not be a useful control method for this species as it resprout's from the base, however little published studies are available. Anecdotal observations suggest repeated fire may keep this species low in the ground layer and prevent dense infestations. Record observations of this species response to fire. *Vachellia farnesiana* is found within the bioregion but little information is available on its distribution. Records from the herbarium indicate it's occurrence within the southern gulf. Anecdotal evidence suggests it is also common on flats in the north-west.

Mesquite

- Fire can be used to control mesquite, is most effective on the tree-form of mesquite *Prosopis pallida*, but can also be used in the control of some shrub-form species. It is more effective at low and medium densities where sufficient fuel remains for fire to carry, or in areas that have first been chain-pulled and allowed to dry out.
- Fire can also assist in depleting the soil seed bank by killing seeds to a depth of 2 cm; however seedlings from undamaged seeds may appear after the following wet season and follow-up control may be required.
- Fires need to be of a high severity. DNRM (2003) found that late dry season fires in mesquite with a high fuel load remaining have been effective.

What is the priority for this issue?

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

Like other woody weeds chinee apple, seedlings are susceptible to fire but mature plants may quickly regrow.

Kerensa McCallie, QPWS, Chillagoe (2012).

Assessing outcomes

Formulating objectives for burn proposals

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

Choose from below as appropriate:

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

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

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

Monitoring the issue over time

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

Photo monitoring points are established on Finucane Island National Park to monitor the reduction in rubber vine.

Rubber vine can be dense in areas on Bulleringa National Park. Notice the scrambling nature of the rubber vine as it reaches into the tree. Without control it will smother the tree, eventually killing it.

QPWS, Bulleringa National Park (2010).

Fire parameters

What fire characteristics will help address this issue?

Key factors

- The principal factor in successful control is residence time. Slow-moving fire is required to kill mature trees although severity can also be important (to scorch plants). This is species dependant.
- Seeds, seedlings and saplings of most woody weeds are the life stages most vulnerable to fire. Planned burning should be conducted as soon as possible once an infestation is detected to increase its effectiveness.

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

- In some cases, applying the recommended fire frequency for the fire vegetation group in which woody weeds occur may be sufficient to control the issue.
- Apply a follow up burn if the observations indicate that the issue is not under control (e.g. mature plants have re-sprouted or seedlings emerged from the seed bank). In some cases further fires may be required to completely remove the infestation. Once resolved, re-instate the recommended fire regime for the fire vegetation group. Continue monitoring the issue over time.

Fire severity

- A **moderate** to **high** severity fire may be required to ensure the canopy is scorched may result in a better kill rate for some species.
- **Low** to **moderate**. In other species best results have been achieved utilising a slow moving backing fire with good residence time at the base of the plant, in combination with high soil moisture. Fire severity should generally remain within the recommendations for the fire vegetation group in which the woody weed occurs.

What weather conditions should I consider?

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

Season: Early to mid dry and occasionally late dry

GFDI: < 20

DI (KBDI): 80–180

Wind speed: < 23 km/hr Variable depending on objective and density of the infestation (denser infestation may require some fanning by wind so that the fire will carry).

Other considerations: In some western areas, greater woody weed control has been achieved using low humidity and high temperatures (e.g. 20 per cent humidity and 30°C). In the southern gulf successful burns targeting rubber vine have been conducted at 30–40°C and 40–60 per cent humidity, following rain.

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.

- **Storm burning**. Burns undertaken in the storm season around the time of the first rains. Containment of storm burns relies on impending rain, natural breaks or earlier-season burning having established areas of lower fuel sufficient to impede the passage of later fires.
- A **running fire** of a higher severity may be required to carry fire through areas of low fuel or dense thickets or increase scorch of trees.
- **As part of a control program**. In areas where dense woody weeds shade out grasses limiting fuel available for fire, initial herbicide treatment or mechanical methods could be used. Care should be taken when applying fire to dead rubber vine plants which remain hanging in the canopy as they may act as elevated fuels.
- **A low to moderate severity backing fire.** Where woody weeds are scattered in the understorey, a slow moving, low to moderate-severity backing fire with good soil moisture (and presence of sufficient surface fuels), ensures a greater residence time at ground level and has proven to be successful in killing seeds, seedlings, young and some mature plants.
- **Aerial incendiary with a 'heli-torch'** may help control the issue. This involves aerial incendiary using gelled gasoline to ignite the plants directly in fire sensitive areas. In riparian areas the surrounding vegetation needs to be moist to wet to ensure the fire doesn't spread. A balance will need to be met between ensuring the surrounding vegetation is moist enough that it will not ignite while the woody weeds are dry enough to burn. In fire adapted communities with dense infestations other techniques such as 'central lighting' could possibly be used with caution. Etheridge Shire Council (2011) has details of this and other successfully used tactics for the management of rubber vine.

Issue 5: Manage high-biomass grasses

Exotic grasses are capable of outcompeting native species to form dominant stands. High-biomass grasses of concern in the Gulf Plains are gamba grass *Andropogon gayanus*, buffel grass *Cenchrus ciliaris* and grader grass *Themeda quadrivalvis*. The latter two are currently present. Gamba grass, already well established in Cape York, is climatically suited to the Gulf Plains and a serious concern. Other high-biomass grasses considered emerging weeds are olive hymenachne *Hymenachne amplexicaulis* cv. *Olive*, para *Urochloa mutica*, Guinea *Megathyrsus maximus* and thatch grass *Hyparrhenia rufa*. These grasses have the ability to increase fuel loads, fire intensity, spotting and flame height which leads to increased fire severity and spread. This results in greater tree death and loss of habitat features with flow on effects to species. Exotic grasses can carry fire into fire-sensitive vegetation resulting in considerable damage.

While fire may not be a recommended management tool for some grass species, it can be effective as part of a control program. It is important to know which grass you are dealing with and what its fire response is prior to burning. They tend to occur as a result of disturbance and spread along firelines, roads, water courses and utility easements.

Awareness of the environment

Key indicators

- The presence of high-biomass grasses, usually occurring in a dense infestation.
- Presence of single species dominated stands.
- Generally taller than native species.
- Lots of mass and/or dead material.

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

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

A close up of the flowering head and clump mass of buffel grass.
Paul Williams, Vegetation Management Science Pty Ltd, Normanton (2011).

Discussion

- Be on the look out for newly forming stands and be especially vigilant in disturbed areas, particularly those where disturbance is ongoing (e.g. roadsides) and areas adjacent to or down stream from existing high biomass grass infestations (Melzer and Porter 2002). Control is often easier if their presence is detected and addressed early before it has become established.
- In many cases, it is desirable to avoid burning high biomass invasive grasses due to the likely increase in fire severity and the potential to promote them; however the risk of wildfire later producing an even higher severity fire must be considered. In some situations, burning high biomass grasses under mild conditions with planned fire is more desirable than allowing them to burn with wildfire.
- Prior to undertaking planned burns in areas where high biomass grasses occur become familiar with the response of the grass to fire (e.g. if it is promoted or killed) and other factors such as fire severity type and weather conditions which may favour and further its spread.
- High biomass and other invasive grasses cause the progressive loss of fire sensitive communities and also increase the risk of wildfires (particularly during dry conditions) carrying into the canopy of the community and causing the loss of mature trees. This contributes to the gradual decline and fragmentation of the extent and/or loss of a population, of fire sensitive communities. Be aware that a combination of dense invasive grasses (not just high biomass grasses in mostly monospecific stands) is also potentially damaging to fire sensitive communities.
- There is a relationship between fire timing, frequency and severity and the ability of these grasses to invade which is still poorly understood. You are encouraged to record observations regarding these species' response to fire and record them in ParkInfo or report the information to Biosecurity Queensland.
- Be aware of weed hygiene issues when planned burning in areas with high biomass grasses. Fire vehicles and machinery can aid seed spread along firelines and should be washed down after exposure.
- Once an area has been impacted by invasive grasses (in particular within fire sensitive communities) the aim of the land manager often becomes one of fuel management. This may involve implementing mild or 'cool' fires both within the site and in surrounding areas by implementing appropriate tactics to burn away from the non-target community and limit edge effects on the margin. Other techniques which may be effective include slashing, spraying with herbicide and in some instances grazing (Melzer and Porter 2002; Butler and Fairfax 2003).

Buffel grass *Cenchrus ciliaris*

- Buffel grass is a long-lived perennial invasive grass (individual tussocks may live up to 15–20 years), that has become widespread in the Gulf Plains. It may be slow to establish but will spread quickly after favourable seasonal conditions (e.g. consecutive years of above average summer rainfall) (Miller et al. 2010).
- The regenerative traits of Buffel grass means that it has a competitive advantage over native grasses which are shorter lived and rely on conditions suitable for germination (e.g. good soil moisture). Buffel grass has the ability to carry a fire at much shorter intervals than native grasses (Miller et al. 2010). It cures later in the dry season thus promoting late season wildfires.
- Fire alone is not known to be an effective tool to manage buffel grass. A 'positive feedback' loop has been described for the relationship between buffel grass and hot fires (Butler and Fairfax 2003), in which buffel increases fuel loads and thus damage to remnant vegetation, at the same time creating a disturbance which favours its spread. The same phenomenon has been observed to occur with increased grazing pressure (Eyre et al. 2009). Buffel grass is further promoted by fire as seeds germinate more quickly when sown on burnt ground. Grass seeds sown on unburnt ground can take up to two years to germinate.
- The use of fire to control buffel grass is often debated. While not a direct control measure, fire may assist in facilitating other control methods such as spraying or grazing. Be aware that follow up spraying of the affected site will need to be continued for some time as buffel grass will usually germinate en masse after fire and rain. Any fire applied to buffel should be of a **low** severity. Using night time burns where moisture is high may assist in achieving a low severity burn.
- Where buffel grass occurs within or adjacent to fire sensitive communities, it poses a threat by altering fuel dynamics (connectivity, biomass and height).
- At the end of the growing season, buffel grass is more susceptible to fire as it stores reserves at that time. Late summer fires may reduce its ability to compete with native species over time (Chamberlain 2003).
- The curing rate for buffel grass differs from that of native tussock grasses and tends to remain greener for longer periods of time. Careful consideration should be given to burning adjacent areas when there is good soil moisture and when buffel grass is green and unlikely to carry a fire. This may provide the opportunity to conduct plan burns at differing times of the year (e.g. earlier or later in the season).

Grader grass

- Grader grass has been recorded in the northern gulf plains adjacent to the coast north of about Normanton and within the Gilbert and Walsh River catchments (but does occur elsewhere). Be aware of new infestations which can quickly take hold and ensure they are dealt with as a matter of priority.
- Grader grass is a weed of disturbance. Soil disturbance (e.g. road grading) can expose seed allowing favourable conditions for establishment and spread.
- Fire is not considered to be an effective tool to manage grader grass. Unless the fire can be implemented prior to annual seed set in late February/March, the burning will open up the ground layer and encourage seed germination. If fire can not be avoided in areas of grader grass, the fire frequency should be limited to > five years.
- Seedlings which germinate following fire should be sprayed with herbicide.

Para grass

- Found in wetter areas such as sedgelands and springs.
- Fire can be used with partial success for the management of para grass where it occurs in swamps and drainage lines. Fire kills a small proportion of para grass plants and by temporarily removes the large bulk of para grass biomass. Fire is more effective where the para grass is within ephemeral swales which have dried out (limited windows of opportunity in the late season). Burning has been found to be more effective if used in combination with post-fire chemical control of sucker shoots.

Guinea and thatch grass

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

Buffel grass can recover quickly after fire and outcompete native grasses.
Justine Douglas, QPWS, Boodjamulla (Lawn Hill) National Park (2012).

A buffel grass infestation in a gidgee *Acacia cambagei* woodland. The presence of buffel grass will increase fire intensity and flame height, contributing to tree death.
Paul Williams, Vegetation Management Science Pty Ltd, Cloncurry area (2012).

Grader grass forming a monospecific stand amongst native grasses is easy to spot due to its height and distinctive reddish colour when in fruit.

Mike Ahmet, QPWS, Blackbraes National Park (2008).

Guinea grass is much taller than most native grass species and greatly increases fire severity when burnt.

Kerensa McCallie, QPWS, Jubilee Pocket (2012).

What is the priority for this issue?

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

Assessing outcomes

Formulating objectives for burn proposals

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

Choose from below as appropriate:

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

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

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

Monitoring the issue over time

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

When using fire to reduce the density of invasive grasses, it is important to continue to monitor the site to ensure it is not promoted and to ensure invasive grasses do not recover their original density.

Fire parameters

Varies depending on species, refer to the discussion above.

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.

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

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

Non-target fire vegetation groups include spring, vine thicket, acacia, mangrove and some dune communities. These communities are sometimes self-protecting if fire is used under appropriately mild conditions and/or due to factors such as moisture or internal micro-climates and low fuel loads. But where these communities are vulnerable, the tactics presented here such as burning away from them, can enhance their protection. Their vulnerability to fire is increased if successive years of high rainfall have promoted fuels, or where fire-promoting weeds or cyclone damage occurs.

Awareness of the environment

Indicators of fire encroachment risk:

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

Springs are particularly vulnerable to even low severity fire when peat is dry. Ensure standing water is present or peat is waterlogged. Refer to Chapter 5: Springs, for guidelines to avoid peat fire.

Rod Fensham, Queensland Herbarium, Currajong.

Discussion

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

What is the priority for this issue?

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

Assessing outcomes

Formulating objectives for burn proposals

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

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

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

Fire parameters

What fire characteristics will help address this issue?

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

Fire severity

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

Mosaic (area burnt within an individual planned burn)

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

Landscape mosaic

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

What weather conditions should I consider?

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

FFDI: Refer to the relevant fire vegetation group

DI (KBDI): Refer to the relevant fire vegetation group

Wind speed: < 15 km/hr

Soil moisture: Refer to the relevant fire vegetation group.

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.

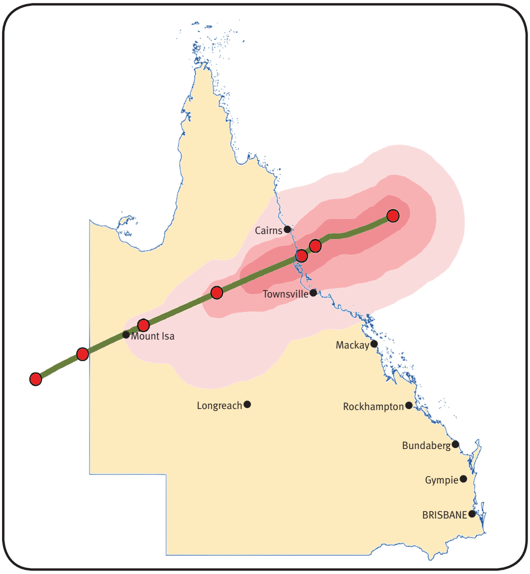
- **Broad-scale fire management.** Refer to tactics in Chapter 1 'Eucalypt communities' for specific guidelines on establishing and maintaining a mosaic across large areas.
- **Test burn** of interface to ensure non-target areas do not burn.
- **Do not create a running fire.** Use low intensity perimeter burns from the edge of low lying communities to protect margins when burning in adjacent communities.
- **Commence lighting on the leeward (smoky) edge** of the non-target fire vegetation group to promote a low intensity backing fire. Depending on available fuels and the prevailing wind on the day this may require either spot or strip lighting or a combination of both.
- **Afternoon ignition**—planned burning in areas adjacent to non-target communities undertaken late in the afternoon. This will assist with promoting a low severity fire that may trickle along the edge of these communities and generally self-extinguish due to milder conditions overnight or higher moisture differentials.
- **Limit fire encroachment into non-target communities.** Where the non-target community is present in low lying areas e.g. riparian system, use the surrounding topography to create a low intensity backing fire that travels down slope towards the non-target community. If conditions are unsuitable (e.g. the non-target community is too dry to ensure fire will self-extinguish on its boundary or it is upslope of a potential run of fire) use appropriate lighting patterns along the margin of the non-target community. This will promote a low-intensity backing fire that burns away from the non-target community.

Issue 7: Cyclones and severe storms

In the event of a severe tropical cyclone (Category 3 or higher) or severe storm event, the canopy of trees and shrubs may be stripped, accumulating on or suspended above the ground as leaves, fine leaf shred and branches. Snapped limbs can be left hanging in the canopy creating ladder fuel. Many fallen trees can also be expected, increasing heavy fuel loads, impeding fire line access or allowing fires to carry across areas which previously acted as fire breaks. In the Gulf Plains, cyclones and severe storms may increase fire severity in some ecosystem types, particularly heavily wooded forests and woodlands and vegetation communities on hilltops and ridges.

The changed fuel conditions following a cyclone or severe storm may lead to:

- the potential for extensive or high severity wildfires
- an increased fuel hazard near to assets and infrastructure
- altered fire behaviour during planned burning operations in the two years following a cyclone
- the need to restore canopy health prior to further stress (e.g. avoid canopy scorch)
- fire-sensitive communities becoming vulnerable to fire encroachment during certain dry periods
- opportunity to re-introduce fire into areas that have been transitioning to closed forest
- an inability to conduct planned burns or reduced wildfires in some areas due to absent/silted fuels for a time.



Illustrating the extensive region of wind damage caused by tropical cyclone Yasi which devastated the Cassowary Coast in February 2011. Note the destructive winds area continued well into the Einasleigh Uplands bioregion.

David Clark, QPWS (2011).

The impacts of cyclone Yasi (February 2011) were felt hundreds of kilometres inland with extensive damage to vegetation as indicated above.

Justine Douglas, QPWS, Blackbraes National Park (2011).

Fires could burn into the tree canopy by way of the broken tree branches that are hanging down.
Leasie Felderhof, Firescape Pty Ltd, Blackbraes National Park (2011).

Open woodland damage by cyclonic winds. A low intensity burn (five months post cyclone) at Blackbraes National Park with heavy timber remaining after the burn.
Leasie Felderhof, Firescape Pty Ltd, Blackbraes National Park (2011).

Discussion

- After a severe tropical cyclone, people may not naturally think about planned burning. However, without a fuel reduction strategy, there is a risk of extensive wildfires in the following dry season and a risk of fires that will impact on an already stressed canopy (refer to Chapter 8, Issue 1, for fire management guidelines).
- The canopy of trees damaged by severe cyclones is particularly susceptible to further impacts (such as canopy scorch), and may lead to tree death. Until the health of the canopy is restored, fires which may impact them should be avoided.
- In heavily timbered areas, the wildfire hazard following cyclonic events is likely to be higher than open country where wider spacing reduces the chances of an intense fire front developing (Felderhof and Poon 2011). There are fallen trees and branches in open country, but the wider spacing reduces the chances of an intense fire front developing.
- The low, flat topography of much of the Gulf Plains make the bioregion susceptible to prolonged flooding. Understory vegetation can be killed by silt deposition or a lack of light and oxygen (Noble and Murphy 1975). While fire guidelines following prolonged flooding are unavailable, it is thought that ceasing or limiting planned burning, at least for a while, to enable recovery of the understory vegetation would be prudent. In any case, should the ground fuel be absent following flooding, fires will be impossible for some period after the event. In addition storm surges during cyclones can inundate vegetation communities that are not salt tolerant. Storm surges can breach dunes and rush up waterways and may result in the death of plants less tolerant of salt. In areas, the combined impact of wind and salt water incursion may increase the heavy fuel load and result in greater wildfire risk.
- The best time to act on post-cyclone fuel reduction is soon after rain. Moist and humid conditions create slow moving, trickling fires with good residence time. Such fires have good fuel consumption, are of low severity, easy to control and allow disorientated and distressed fauna to find refuge areas. Also, they are less likely to stress canopy. The next best time to utilise moist conditions is the following storm season.
- Early, low intensity burns may not ‘clean up the country’ and it will take a number of years for the fallen timber to be removed. These burns are necessary however to reduce the spread of late season wildfires in some areas. A trade-off is required between fires of low intensity to reduce fuel to protect against wildfire and more intense fires to remove woody debris (Felderhof and Poon 2011).

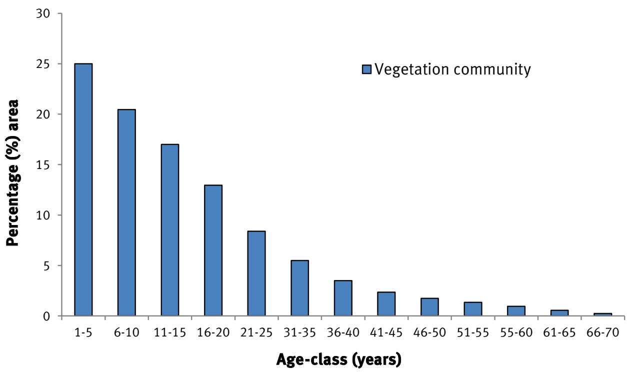
- Expectations of how fire behaves in a normal year must be reconsidered post cyclone or even after a severe storm. It is likely programmed fire management can continue, but only after re-assessment of planned burn areas. Be aware that increased finer fuels, native or invasive grass cover, suspended and aerated fuel, open canopies and continuous fuel will change the way fire behaves. Fire will be more severe and may carry where it would not normally (e.g. over gullies, over streams, over firelines, and over wetlands). Conversely, fires may be of a lower severity or unable to carry the expected distance due to a lack of understory fuels in areas which have suffered prolonged flooding.
- In some locations cyclones may provide a rare opportunity to reintroduce fire into grasslands or open forests and woodlands which are in the late stages of transition to closed forest communities through shrub or tree invasion. Species found in eucalypt forest and woodland in particular need abundant light and bare soil to establish. Temporarily reducing the understory through planned burning may allow seedlings of canopy trees such as eucalypts to establish and thus halt or slow the transitioning process.
- Strategic planned burning with high soil moisture, avoiding burning in dry conditions and reviewing scheduled planned burns to make use of moister seasonal conditions are strategies to compensate for changed fuel conditions.

Open woodlands are also effected by cyclones. Ensuring fire breaks are cleared and fences are intact is important.

Paul Williams, Vegetation Management Science Pty Ltd, near Mt. Garnett post Cyclone Yasi (2011).

Glossary of fire terminology

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

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

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

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

Terminology	Definition
Clarification over the terms **'fire vegetation group'** and **'fire management zone'.**	The fire management requirements within a **conservation fire management zone** are based on the **fire vegetation groups** (FVGs)—groups of related ecosystems that share common fire management requirements. Fire regimes for FVGs are identified in the Bioregional Planned Burn Guidelines and are reflected in fire strategies. Other fire management zones (e.g. protection, wildfire mitigation, special conservation, sustainable production, rehabilitation, exclusion, and reference) will have specific management objectives that override the FVG fire regime requirements. Further, if there are a number of these other zones within a strategy they are identified as **fire management subzones** (FMSz) (e.g. P1, P2, P3, WM1, WM2, etc) each with specific fire management requirements.

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

Terminology	Definition
Fire perimeter	The outer containment boundary in which fire is being applied.
Fire regime	The recommended use of fire for a particular vegetation type or area including the frequency, intensity, extent, severity, type and season of burning.
Fire regime group (FRG)	A group of related ecosystems that share a common fire management regime including season, severity, recommended mosaic etc. These are a sub-grouping of the fire vegetation groups to provide more detail about specific fire management requirements. Fire regime groups are provided as a more detailed alternative for use with fire strategies or in mapping.

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

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

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

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

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Appendix 1: List of regional ecosystems

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

Fire vegetation group	Hectares within Gulf Plains bioregion	Percentage
Eucalypt communities	10 007 486	45
Grasslands and sedgelands	4 395 268	20
Melaleuca communities	5 344 469	24
Acacia communities	1 406 517	6
Springs and dune communities	3 333	0.01
Vine thickets	3 969	0.02
Mangrove and saltmarsh communities	551 315	2
Other areas	154 969	1
Other bioregions	356 970	2
TOTAL	**22 232 102**	**100**

Chapter	Issues	Fire vegetation group	Fire regime group	Map label (if required)	Regional ecosystems (Sattler and Williams 1999; Queensland Herbarium 2011a; 2011b).
1	1	Eucalypt communities	Eucalypt community (tussock grass dominated)		2.2.2, 2.3.19, 2.3.20, 2.3.20a, 2.3.20b, 2.3.20c, 2.3.20d, 2.3.20e, 2.3.20g, 2.3.20h, 2.3.20i, 2.3.20j, 2.10.3, 2.3.14, 2.3.18a, 2.3.21, 2.3.21a, 2.3.21b, 2.3.21c, 2.3.21d, 2.3.21e, 2.3.21f, 2.3.21g, 2.3.21x1, 2.3.21x12, 2.3.21x13, 2.3.21x2, 2.3.22, 2.3.22x11, 2.3.22x11a, 2.3.22x11b, 2.3.23, 2.3.23b, 2.3.23x1a, 2.3.23x1b, 2.3.23x1c, 2.3.25, 2.3.25b, 2.3.25c, 2.3.25x1, 2.3.25x2, 2.3.25x3, 2.3.26, 2.3.26a, 2.3.27, 2.3.35, 2.3.37, 2.3.5, 2.3.6, 2.3.6x1a, 2.3.6x1b, 2.5.1, 2.5.1a, 2.5.1b, 2.5.1c, 2.5.1d, 2.5.1x10, 2.5.1x11, 2.5.1x11b, 2.5.10, 2.5.12, 2.5.12a, 2.5.12b, 2.5.12c, 2.5.2x2, 2.5.2x3, 2.5.2x4, 2.5.3b, 2.5.4, 2.5.5, 2.5.5x11, 2.5.5x11a, 2.5.5x11b, 2.5.5x12, 2.5.5x13, 2.5.5x14a, 2.5.5x14b, 2.5.6, 2.5.6b, 2.5.6c, 2.5.6x1, 2.5.6x10a, 2.5.6x10b, 2.5.6x10c, 2.5.6x10d, 2.5.6x10e, 2.5.6x10f, 2.5.7, 2.5.8, 2.5.9, 2.5.9a, 2.5.9x50, 2.5.9x50b, 2.5.9x51, 2.9.1x90, 2.9.1x93, 2.9.2x2, 2.9.3, 2.9.3a, 2.9.7, 2.9.7x1, 2.9.7x2, 2.9.7x90, 2.3.33, 2.3.33x3, 2.3.33x4, 2.3.8, 2.3.9, 2.3.9b, 2.3.9c, 2.3.9d, 2.3.9e, 2.3.15, 2.3.17, 2.3.17a, 2.3.17b, 2.3.17c, 2.3.17d, 2.3.17e, 2.3.10, 2.3.10a, 2.3.10b, 2.3.10c, 2.3.10d, 2.3.10e, 2.3.10f, 2.3.10x11, 2.3.10x11a, 2.3.10x11b, 2.3.10x12, 2.3.10x13, 2.3.10x40, 2.3.10x41, 2.3.11, 2.3.11a, 2.3.11ax1, 2.3.11b, 2.3.11bx1, 2.3.11bx2, 2.3.11c, 2.3.11d, 2.3.11e, 2.3.11f, 2.3.11g, 2.3.11h, 2.3.11i, 2.3.11k, 2.3.11x1, 2.3.11x40. **NON RE groupings used:** C13, D32, C33, D20, D34, D35, D41, K17.
	2		Eucalypt communities (spinifex or shrub dominated)		2.10.4, 2.10.4b, 2.10.4x1, 2.10.4x2, 2.10.7, 2.11.1, 2.11.1a, 2.11.1b, 2.11.1c, 2.5.11, 2.5.11b, 2.5.11c, 2.5.11d, 2.5.13, 2.5.3, 2.5.3a, 2.7.3, 2.7.3b, 2.7.3c, 2.7.3d, 2.7.3e, 2.7.3f, 2.7.3g, 2.7.3i, 2.7.3x1, 2.7.4, 2.7.5, 2.10.1, 2.10.1a, 2.10.2, 2.10.2a, 2.10.2b, 2.10.2c, 2.10.2d, 2.10.2x1, 2.10.2x11, 2.10.2x12, 2.10.2x2, 2.12.1, 2.12.1x1, 2.8.1. **NON RE groupings used:** D23, D50, D51, G3, H23, H28, J16, J19.
2	1	Grasslands and sedgelands	Grasslands and sedgelands		2.2.2a, 2.2.2e, 2.3.3, 2.3.3a, 2.3.3ax40, 2.3.3b, 2.3.3x40, 2.3.4, 2.3.4a, 2.3.4x40, 2.3.4x41, 2.3.4x41a, 2.3.4x42, 2.3.4x43, 2.3.4x44, 2.3.4x50, 2.9.1, 2.9.1a, 2.9.1ax40, 2.9.1ax42, 2.9.1ax43, 2.9.1ax44, 2.9.1x91, 2.9.2, 2.9.3b, 2.9.3d, 2.3.32, 2.3.32x11, 2.3.16, 2.3.2, 2.3.1, 2.3.1a, 2.3.1b, 2.3.1c, 2.3.1e, 2.3.1x2a, 2.3.1x2b, 2.3.1x2c, 2.3.1x30, 2.3.1x31, 2.3.1x51, 2.3.12, 2.3.12x4, 2.3.34, 2.3.34x31, 2.3.34x32, 2.3.38. NON RE groupings used: G17.

Chapter	Issues	Fire vegetation group	Fire regime group	Map label (if required)	**Regional ecosystems** (Sattler and Williams 1999; Queensland Herbarium 2011a; 2011b).
3	1	**Melaleuca communities**	Melaleuca communities		2.10.6, 2.10.6x1, 2.3.24, 2.3.24a, 2.3.24b, 2.3.24x1, 2.3.24x11, 2.3.24x12, 2.3.24x12c, 2.3.24x13, 2.3.24x2, 2.3.24x2a, 2.3.28, 2.3.28a, 2.3.28b, 2.3.28c, 2.3.28d, 2.3.28e, 2.3.28f, 2.3.28g, 2.3.28x1, 2.3.28x11, 2.3.28x12, 2.3.28x13, 2.3.28x15, 2.3.28x16, 2.3.28x17a, 2.3.28x17b, 2.3.28x40, 2.3.30, 2.3.31, 2.3.36, 2.5.14, 2.5.14a, 2.5.14x1, 2.5.14x50, 2.5.14x51, 2.5.15, 2.5.15a, 2.5.15b, 2.5.15c, 2.5.15d, 2.5.15e, 2.5.15x2, 2.5.15x7, 2.3.29, 2.3.29x1, 2.3.29x2, 2.3.29x40, 2.3.29x40a, 2.3.29x40b, 2.3.29x41, 2.3.29x42, 2.5.16, 2.5.16a, 2.5.16b, 2.5.16x40, 2.7.1x3a, 2.7.1x3b, 2.7.1x3c, 2.7.1x4, 2.9.1x92, 2.9.6, 2.9.6a, 2.9.6b, 2.9.6x40.
4	1	**Acacia communities**	Acacia communities		2.2.2b, 2.2.2c, 2.2.2x1, 2.3.18, 2.3.18b, 2.3.3c, 2.10.5, 2.10.5a, 2.10.5x1, 2.10.5x2, 2.3.13, 2.3.7, 2.3.7a, 2.3.7b, 2.3.7c, 2.5.2, 2.5.2x1, 2.7.1, 2.7.1x1, 2.7.1x2, 2.7.1x2b, 2.7.2, 2.7.2a, 2.7.2b, 2.7.2c, 2.7.2d, 2.7.2x1, 2.7.2x2, 2.7.2x2a, 2.7.2x2c, 2.7.2x2d, 2.7.2x3, 2.7.2x4, 2.9.1b, 2.9.1bx40, 2.9.1cx40, 2.9.4, 2.9.4a, 2.9.4ax40, 2.9.4b, 2.9.4c, 2.9.4d, 2.9.4dx40, 2.9.4e, 2.9.4f, 2.9.4x1, 2.9.4x1a, 2.9.4x1b, 2.9.5.
5	1	**Springs and dune communities**	Springs		2.3.39, 2.10.8, 2.3.33x1, 2.3.33x2.
	1	**Springs and dune communities**	Dune communities		2.2.1, 2.2.2d, NON RE groupings used: B4.
6	1	**Vine thickets**	Vine thickets		2.2.2f, 2.9.3c.

Chapter	Issues	Fire vegetation group	Fire regime group	Map label (if required)	**Regional ecosystems** (Sattler and Williams 1999; Queensland Herbarium 2011a; 2011b).
7	1	**Mangrove and saltmarsh communities**	Mangrove		2.1.2, 2.1.3, 2.1.3b, 2.1.1, 2.3.1x1. **NON RE groupings used:** A1.
	1		Saltmarsh		2.1.4 **NON RE groupings used:** A3.

The spatial data is derived from version 6.1 of the "Survey and Mapping of 2006 Remnant Vegetation Communities and Regional Ecosystems of Queensland" layer (16 September 2011), the "Draft Pre-clearing Vegetation Communities and Regional Ecosystems" layer (20 August 2010) and the Northern Australia Tropical Savannas CRC Vegetation layer (refer to Figure 1).

Some of the regional ecosystems (RE) listed above will not be matched in the spatial data. This may be because the RE is 'not of a mappable size', the RE 'has been moved' (i.e. it has been reclassified into a new RE code), the RE exists only as a sub-dominant RE within the spatial data or the RE has not yet been mapped. In the Regional Ecosystem Description Database (REDD) system, the comments section indicates if the RE is not of a mappable size or if it has been moved. The RE's listed below do not have any matching records in version 6.1 of the Survey and Mapping of 2006 Remnant Vegetation Communities and Regional Ecosystems of Queensland spatial layer (16 September 2011) and the Draft Pre-clearing Vegetation Communities and Regional Ecosystems layer (20 August 2010). NOTE: Non-regional ecosystem (Veg 1) Queensland Herbarium codes were also used, where no regional ecosystem codes existed as of 18 January 2012.

Unmatched regional ecosystems	2.1.1, 2.3.13, 2.3.15, 2.3.19, 2.3.27, 2.3.30, 2.3.5, 2.3.8, 2.5.8, 2.8.1, 2.2.2d, 2.3.31

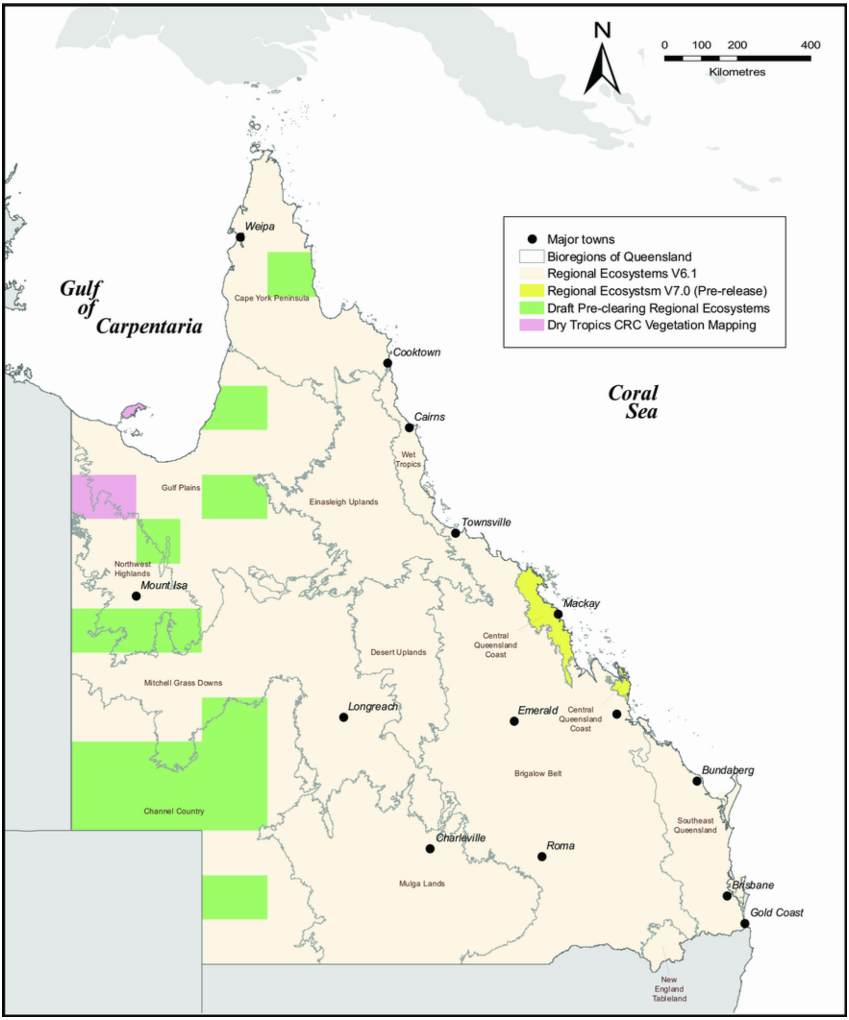

Figure 1: Map of Queensland indicating the different GIS data sources used to produce the spatial fire vegetation group mapping product.

Appendix 2: Mosaic burning

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

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

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

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

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

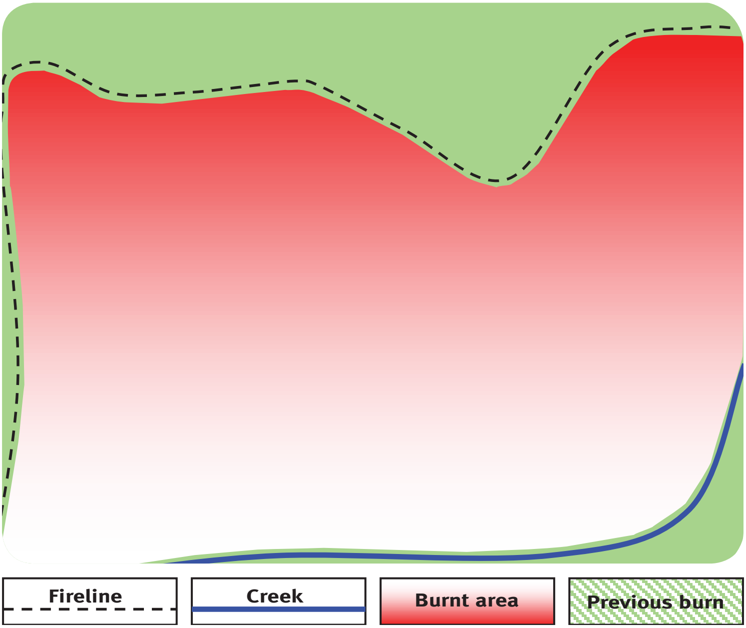

Figure 1: Example area between fireline and creek burnt in a wildfire—year 0. (Recommended fire interval for fire vegetation group is eight–12 years).

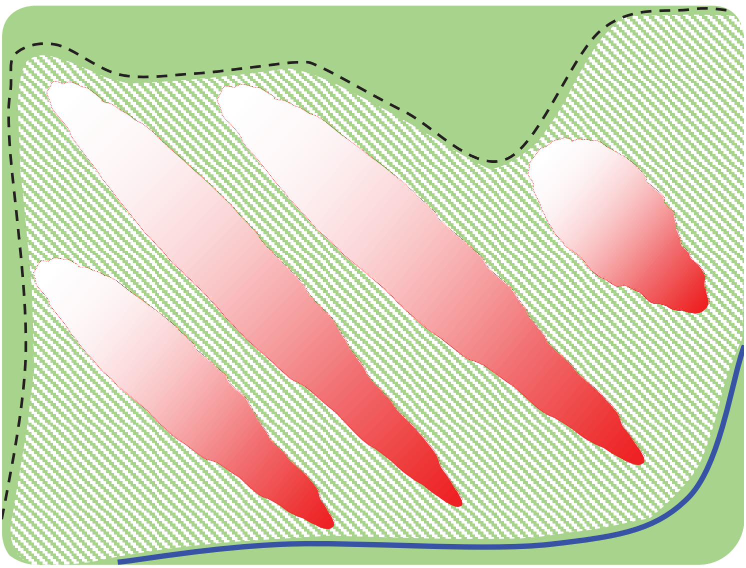

Figure 2: Planned mosaic burn—year 8.

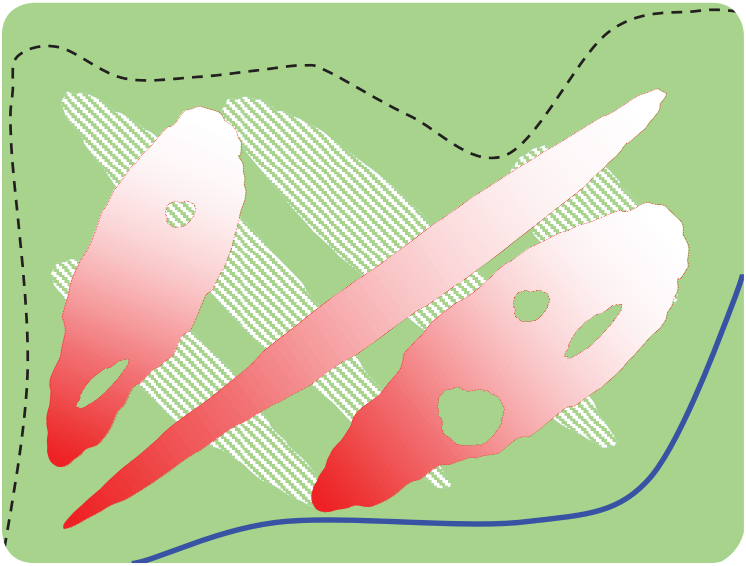

Figure 3: Planned mosaic burn—year 20.

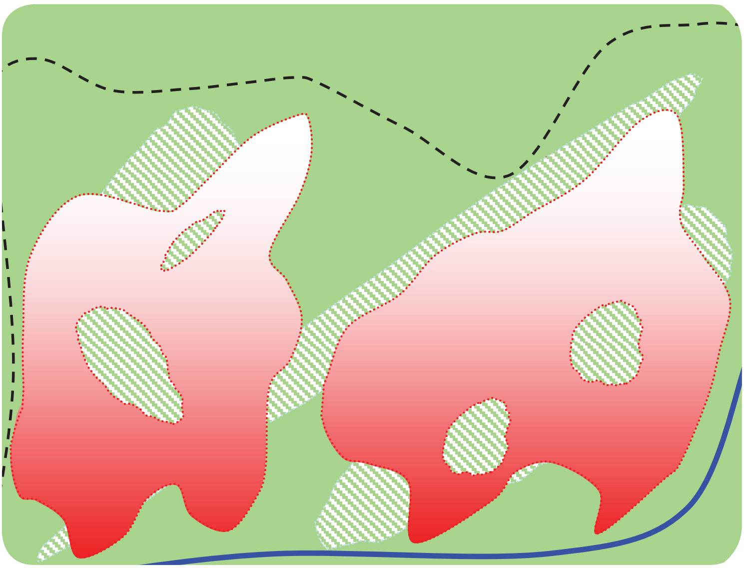

Figure 4: Planned mosaic burn—year 28.

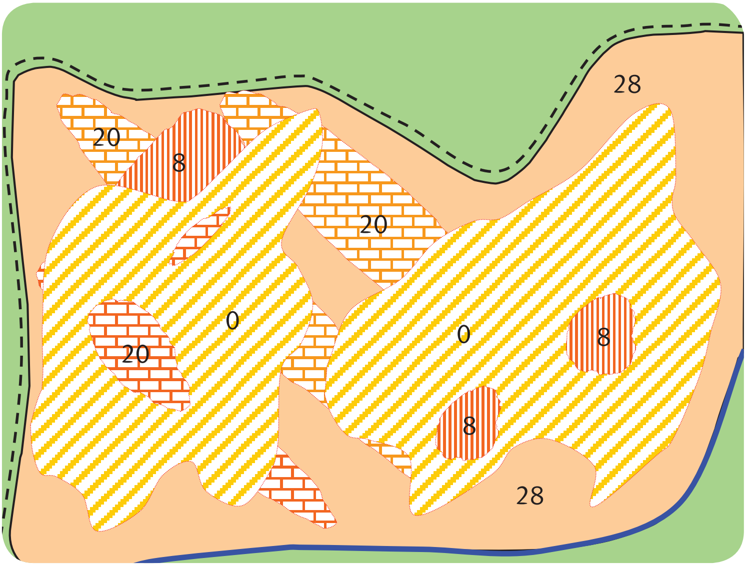

Figure 5: Fire history summary—year 28.
Wildfire and mosaic burn patterns overlaid (with years since last burnt).

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