Issue 6: Reduce rubber vine

Rubber vine *Cryptostegia grandiflora* is found predominantly in the far north west of the bioregion on coastal creeks and headlands in the north and on islands. It is not restricted to disturbed vegetation and prefers a good layer of organic material in the soil. It is also restricted to areas where fires are absent or infrequent (Mackey et al. 1996). The 2008 Rubber vine containment line bisects the bioregion from east to west, just north of Airlie Beach. South-west of this line a priority management area has been declared due to the low to moderate-density infestations that occur just south of the containment lines. Rubber vine has the potential to spread throughout the bioregion.

Rubber vine has the ability to smother trees and shrubs and shade-out grasses, making fire difficult to apply. The vine is usually found in riverine areas, floodplain woodland, saltmarshes and creeks including dry creek beds. It spreads from these areas onto alluvial flats, plains and beach scrubs. It is also found in higher areas and in isolated pockets where seeds have been dispersed by wind, water or birds.

Awareness of the environment

Key indicators of where rubber vine can be managed with fire:

- Rubber vine occurs in fire-adapted vegetation or where it occurs in fire-sensitive vegetation fire severity and extent can be minimised.
- Grass or other fine fuels are still sufficiently continuous to carry fire despite the occurrence of rubber vine.
- Grass fuel crumbles in the hand meaning it is sufficiently cured.

Rubber vine occurring in marine samphire forbland. These forblands are adapted to the occasional fire. Fire may assist in reducing rubber vine.
Barry Nolan, QPWS, Cape Upstart (2007).

This sequence of images shows the successful use of fire to control young rubber vine plants. This first image was taken in October 2005. A moderate-severity fire was used to scorch smaller plants to their tips and brown the leaves of the taller plants.
Eleanor Collins, QPWS, Bowling Green Bay.

This second image, taken in March 2006 shows the results.
Eleanor Collins, QPWS, Bowling Green Bay.

Fire might be a useful tool near watercourses in which herbicide use poses an environmental risk.

John Clarkson, QPWS, Undara (2009).

Fire-killed rubber vine. Fire can be a useful technique to kill rubber vine in inaccessible or remote locations.

Barry Nolan, QPWS, Cape Upstart (2009).

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

- Rubber vine occurs in areas of insufficient fuel to sustain fire.
- Rubber vine occurs in fire-sensitive vegetation.

Rubber vine smothering native trees. Fire has been applied to kill rubber vine in the foreground but due to low fuel, has not reached some plants.

Above: Rubber vine flower.

Col Dollery.

Barry Nolan, QPWS, Cape Upstart National Park (2008).

Rubber vine seedlings. If fire were to trickle between the boulders, the low fuel load may provide insufficient residence time to kill the plants. Care should be taken in post -burn inspection.

Kerensa McCallie, QPWS, Gloucester Island (2005).

Rubber vine on beach dunes. Fire should not be applied where rubber vine occurs in fire-sensitive vegetation such as beach scrubs unless the impact of fire is limited and other control options are not available.

Kerensa McCallie, QPWS, Gloucester Island (2005).

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 in the right conditions.

Barry Nolan, QPWS, Cape Upstart (2008).

Using fire in areas where dense rubber vine has almost completely dominated the canopy may not be possible due to low fuel loads at the base of plants.

Paul Williams, Vegetation Management Science Pty Ltd, Finucane Island National Park (2010).

Discussion

- Where sufficient fuel is available, a single fire can be used to reduce or eliminate rubber vine seeds, seedlings and young plants. Follow-up fires may be required if some seeds survive in the seed bank or plants resprout.
- Rubber vine should always be burnt when the soil is moist to allow native grasses the best chance of re-establishing.
- Using fire to control rubber vine is more successful in areas where rubber vine rust occurs. Leaf-drop caused by the rust means fuel depth is greater below infected plants. If this fuel occurs adjacent to the stems it can increase residence time or (if spread more widely) it can help carry the fire through areas where it may have previously extinguished. Leaf-drop can also open-up the rubber vine canopy allowing grasses to grow.
- More mature plants require increased residence time to kill the plant. Simply scorching mature rubber vine is not sufficient to kill them.
- In areas where rubber vine has shaded-out native grasses, mechanical or chemical control may be necessary. A combination of fire and chemical control could also be useful where grasses abut an infestation. A backing fire into the rubber vine may reduce the area requiring chemical treatment or increase accessibility.
- 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. Fuel below the plant will sustain the fire once the gel has combusted which will improve the kill rate. In some areas this method has been very successful however mixed results in other areas have been reported. (See tactics below).
- Care should be taken when using fire in fire-adapted communities that abut fire-sensitive communities such as rainforest. Dead plant material or high-severity fire could draw fire in to the fire-sensitive areas.
- Be aware of weed hygiene issues when planned burning in areas with rubber vine. Fire vehicles and machinery can aid seed spread along firelines, roads and tracks and should be washed down after exposure.

What is the priority for this issue?

Priority	Priority assessment
High	Conservation burn in areas where structure and diversity are good but rubber vine plants are beginning to intrude. Ground layer plants are beginning to become sparse.
Medium	Sites much degraded but potentially recoverable with a series of fires. Plants representing the ecosystem are no longer the dominant structural element in the lower layer. It becomes difficult to find windows of opportunity to apply fire to this area.

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)
> 90 % reduction in number of rubber vine 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), 1 year after fire count the number of saplings have been killed and those which survived. **Or** If using the 'heli-torch' method, retrace the flight path in three locations and count the number of mature rubber vine plants killed.	**Achieved:** > 90 % plants killed*. **Partially Achieved:** 75–90 % plants killed*. **Not Achieved:** < 75 % plants killed*. *It is not necessarily a good outcome if you have killed most of the rubber vine plants and yet the fire was too severe.

Significant reduction in abundance of rubber vine.	**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 [Anon 2005]): • 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.

A single treatment should not be considered sufficient to have controlled the issue. Follow-up is always required.

Fire parameters

What fire characteristics will help address this issue?

Key factors

- The principal factor in successful control is residence time. Slow-moving fires kill mature rubber vine although intensity is also critical.

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

- In some cases applying the standard recommended fire frequency for the fire vegetation group in which rubber vine occurs may be sufficient to control the issue. Increasing fire frequency for a while may further assist in its control.
- Apply a follow-up burn during the following year if the observations indicate that the issue is not under control (e.g. mature plants have re-sprouted or seedlings have emerged from the seed bank). In some cases a third fire may be required to completely remove the infestation. Once resolved, re-instate the recommended fire regime for the fire vegetation group. Continue Monitoring the issue over time.

Fire severity

- **Low** to **moderate**. Best results have been achieved using 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 rubber vine occurs.

What weather conditions should I consider?

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

Season: Different approaches are possible including burning early in the year with good soil moisture or alternatively, progressive burning to secure a late season burn under dry conditions or storm burning.

GFDI: < 11

DI (KBDI): 80–160

Wind speed: < 23 km/hr. Variable depending on the objectives and the density of the rubber vine infestation (denser infestations may require wind for the fire to carry).

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

What burn tactics should I consider?

Tactics will be site-specific and different burn tactics may need to be employed at the same location (e.g. due to topographical variation). 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**. Burn during the storm season after the first rains. A minimum of 50 mm of cumulative rainfall is recommended (with consideration to its spread). Individual falls should be around 15 millimetres. The containment of storm burns relies on the earlier season burns that established defendable boundaries (and have lower fuel levels).
- A **running fire** of a higher severity may be required to carry the fire through areas of low fuel.
- **A low to moderate-severity backing fire.** Where rubber vine is 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. Greater residence time at ground level and has proven to be successful in killing seeds, seedlings, young and some mature rubber vine plants.
- **As part of a control program.** In areas where dense rubber vine shades-out grasses (and limits the fuel available for a fire), initial herbicide treatment could be used. Care should be taken when applying fire to the dead rubber vine plants that remain hanging in the canopy as they may act as elevated fuels.

  Rubber vine rust as a biological control rarely kills mature plants however it may increase the effectiveness of burning operations.
- **Aerial incendiary using a heli-torch**. In areas where rubber vine has invaded communities where fire is either not required or desired (such as those that are fire-sensitive) applying fire using a heli-torch may help control the issue. A heli-torch involves applying gelled gasoline to the rubber vine, directly igniting the immediate area. The surrounding vegetation needs to be moist or conditions sufficiently mild to ensure the fire does not carry outside the area of the infestation or plant. A balance needs to be met between ensuring the surrounding vegetation is moist enough that it will not ignite and ensuring the rubber vine is dry enough that it will burn (refer to Figures 1 and 2).

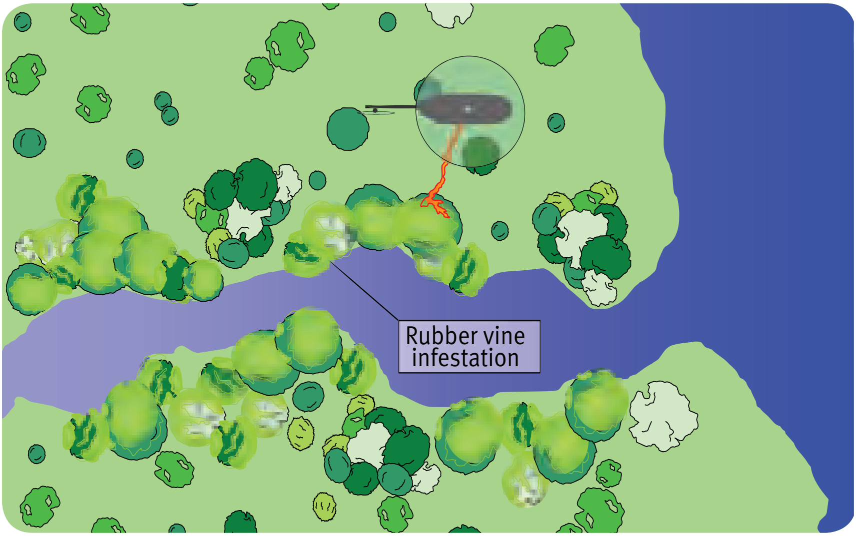


Figure 1: Fire should be applied to the plants allowing sufficient time to ignite the rubber vine and the surrounding infested areas.

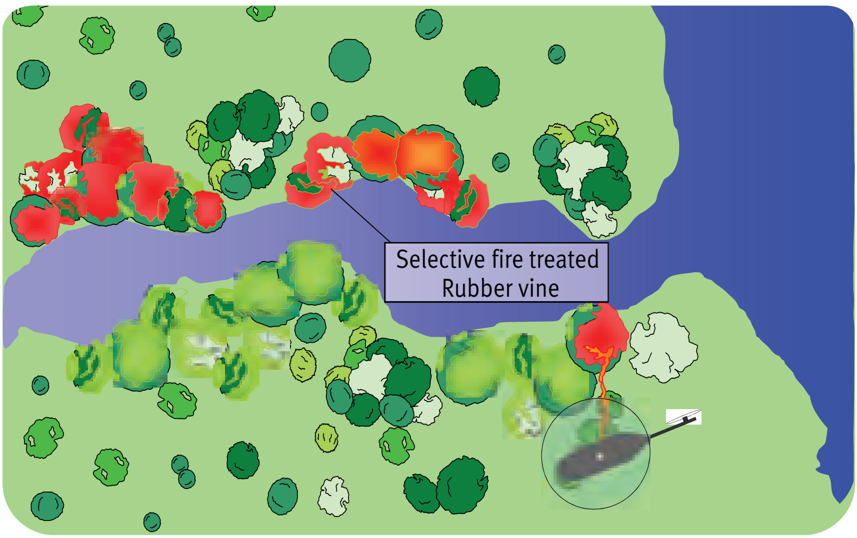


Figure 2: Individual rubber vine plants can be targeted meaning little to no damage occurs to fire sensitive communities in the right conditions.

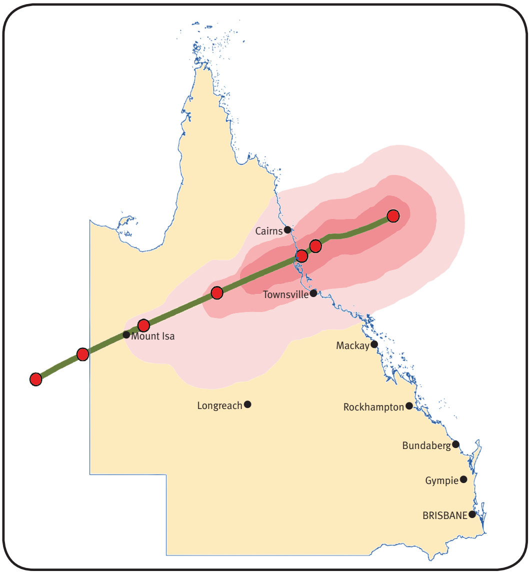
Issue 7: Post cyclone planned burning

In the event of a severe tropical cyclone (Category three or higher), 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. In the event of a Category four or higher cyclone, understorey vegetation is also damaged increasing elevated fuels. A high level of fallen tree damage can also be expected, increasing heavy fuel loads and impeding fire line access.

Once dry, the changed fuel conditions 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
- fire-sensitive communities becoming vulnerable to fire encroachment during certain dry periods
- an opportunity to re-introduce fire into areas that have been transitioning to closed forest.

Strategic planned burning with high soil moisture and avoiding dry conditions; encouraging landholders to mechanically reduce fuel; avoiding ignition sources during risk periods; and reviewing scheduled planned burns to make use of moister seasonal conditions are strategies to compensate for changed fuel conditions.



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.

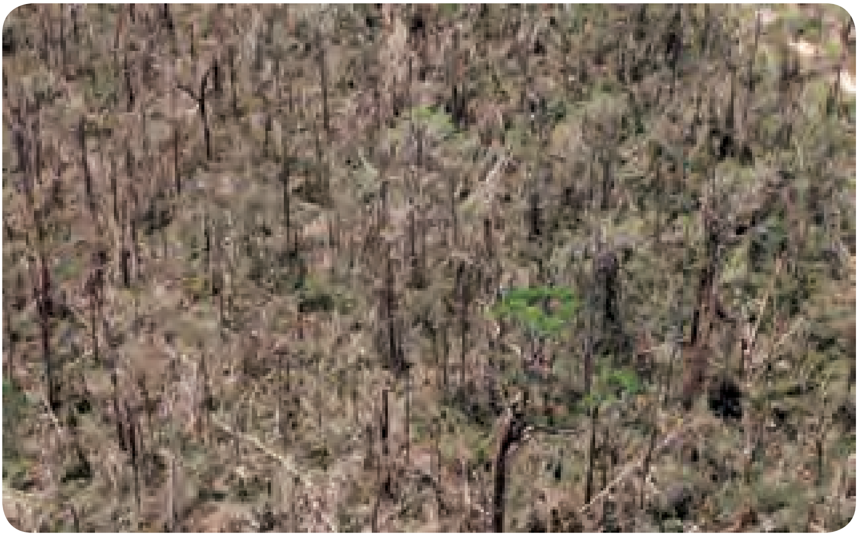
David Clark, QPWS (2011).

Awareness of the environment

Indicators of increased fuel hazard due to a severe tropical cyclone:

- there has been at least a **Category three severe tropical cyclone** (165 - 224 km/hr, very destructive winds)
- vegetation and branches stripped from open forest trees
- leaf, leaf shred, branches and limbs accumulate on the ground as significant fuel loads
- branches and fine fuel elevated above ground where they can easily aerate and become an elevated fuel hazard
- the reduction in native vegetation cover has allowed the establishment of high biomass invasive grasses (refer to Issue 3 of this chapter)
- rainforest or other fire-sensitive community extensively stripped of canopy foliage creating an open structure, with fuel accumulation on the ground or suspended; the open structure creating conditions where forest floor fuels become flammable under dry conditions.
- there has been at least a **Category four severe tropical cyclone** (225 - 279 km/hr, very destructive winds)
- in this case, understorey vegetation may also be severely damaged creating excessive vertical and ladder fuels leading to an increased fuel hazard.

Although cyclone categories have been used to indicate wind damage, be aware that the pattern of damage can be quite variable. For example, a forest might be stripped of canopy vegetation, however have no accumulated fuel, as the fuel was blown elsewhere. Similarly a forest that did not sustain wind damage (for example, the protected side of a ridge) may have received the blown fuel. Therefore post cyclone assessments on the ground and/or by air are essential. Monitoring fuel conditions in the years following a cyclone is important as fuel matures and breaks down at different rates in different locations.



Strewn fuel and fallen branches will create a high fuel hazard when dry. Dead or fallen trees will allow fires to smoulder for some time, creating re-ignition risk.
Audrey Reilly, QPWS, Cyclone Yasi, Murray Falls (2011).

Category 5 cyclonic winds can cause build-up of fine and elevated fuels over substantial areas. Suspended fuel is aerated which decreases drying time and increases combustibility.
Richard Lindeman, QPWS, Cyclone Yasi, Stephens Island, Barnard Island Group National Park (2011).

These fallen fuels have dried to a point of ignition within 2 weeks of a cyclone.
Mark Parsons, QPWS, Cyclone Yasi, Lily Creek (2011).

Be aware of changed fuel conditions next to assets and infrastructure after cyclonic wind impact.
Audrey Reilly, QPWS, Cyclone Yasi, Bingal Bay (2011).

Usually not fire prone, coastal littoral communities can accumulate sufficient fuels to carry fire following a cyclone; if there are aerated fine fuels and fire is pushed by a sea-breeze.

Mark Parsons, QPWS, Cyclone Yasi, Foreshore, Girramay National Park (2011).

A melaleuca wetland severely impacted by cyclonic winds. Be aware that fuel lying upon wetlands may carry fire where it would not usually travel. Also, this wetland now has an enormous amount of ladder fuel which will increase fire severity leading to tree death if burnt inappropriately.

Audrey Reilly, QPWS, Cyclone Yasi, Hull River (2011).

Strewn fuel and trees fallen across fire lines is one of the many issues to consider when planning fires after cyclones.

Audrey Reilly, QPWS, Cyclone Yasi, Murray Falls (2011).

Melaleuca wetland damage by Category 5 cyclonic winds. Notice that most trees have been stripped and many lie on the ground.
Audrey Reilly, QPWS, Cyclone Yasi, Hull River (2011).

Category 5 cyclonic winds impacted these ridges and peaks, causing a build up of dead and flammable material next to vine forest. Avoid fires in the late dry season as vine forest/ rainforest edges are potentially vulnerable to fire in the two years after a cyclone, if they are upslope of a run of fire.
Audrey Reilly, QPWS, Cyclone Yasi, Cardwell Range (2011).

Discussion

- After a severe tropical cyclone, people will 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 already stressed canopy.
- 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.
- 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, a low severity, are easy to control and allow disorientated and distressed fauna to find refuge areas. Also, they are less likely to further stress the canopy. The next best time to utilise moist conditions is the following storm season.
- Where ignition sources can be reliably controlled, consider avoiding fires altogether for a period. Especially where fires are likely to scorch stressed canopy.
- Despite best efforts, after a cyclone that causes extensive damage, it will not be possible to reduce fuel hazard in all the areas where it would be desirable to do so. A prioritised approach is required.
- The best way to protect property and infrastructure is emphasising the landholder's responsibility to mechanically clean up fuel. However, planned burning in moist conditions may form part fuel reduction strategies.
- 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 and increased native or high biomass 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 fire lines, and over wetlands). Site preparation, careful consideration of tactics and a different burning window may be required, using more moist and humid seasonal conditions than normal years in order to compensate for increased fuel.

- If it is not possible to use moister seasonal conditions and yet it is still important to reduce fuel, careful consideration of ignition tactics will be required. Backing fires away from risk areas, down slope and/or against the wind can be considered. Afternoon and evening conditions can also be considered.
- In some locations cyclones may provide a rare opportunity to reintroduce fire into open forests and woodlands which are in the late stages of transition to closed forest communities through seedling/sapling and rainforest 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.
- After a severe cyclone, there will be a substantial number of fallen trees that may smoulder long after fire (especially after the second year), creating a re-ignition risk if burning in increasing fire hazard periods (mid to late dry season). Planned burning will not normally consume fallen trees, and the problem is likely to persist for years after a cyclone. Burning with moisture and in periods of stable moist conditions, or in declining fire hazard, will minimise the risk.
- During the late dry season in the two years after a cyclone, rainforest edges are vulnerable to upslope runs of fire. Lantana, high biomass grass invasion and severe cyclone events (causing a more open canopy) increases the risk of encroachment.

What is the priority for this issue?

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

Assessing outcomes

Formulating objectives for burn proposals

Every proposed burn area contains natural variations in topography, understorey, or vegetation type. It is recommended that you select at least three locations that will be good indicators for the whole burn area. At these locations, walk around or if visibility is good, look about and average the results. Return to the same location and record counts before and after the burn to support the estimations.

Choose objectives as appropriate:

Measurable objectives	How to be assessed	How to be reported (in fire report)
No canopy scorch.	There are two options: 1. From one or more vantage points, estimate extent of canopy scorched. 2. In three locations (that take account of the variability of landform within burn area), walk 300 or more metres through planned burn area estimating percentage of canopy scorched within visual field.	**Achieved:** No canopy scorch. **Partially Achieved:** 1–20 % of canopy scorched. **Not Achieved:** > 20 % of canopy scorched.
Reduce overall fuel hazard to low. **Or** Reduce fuel load to less than five tonnes/ha.	Post fire; use the Overall Fuel Hazard Guide (Hines et al. 2010b), or Step 5 of the QPWS Planned Burn Guidelines: How to Assess if Your Burn is Ready to Go, to visually assess the remaining fuel in at least three locations.	**Achieved:** Fuel hazard has been reduced to low; Or fuel load has been reduced to less than five tonnes/ha. **Not Achieved:** Fuel hazard has not been reduced to low Or fuel load is greater than five tonnes/ha.

Fire patchiness of 70–100 % burnt.	There are three options: 1. From one or more vantage points, estimate aerial extent of ground burnt. 2. In three locations (that take account of the variability of landform within burn area), walk 300 or more metres through planned burn area estimating percentage of ground burnt within visual field. 3. Walk into one or more gully heads, and down one or more ridges and estimate percentage of ground burnt within visual field.	**Achieved:** Mosaic or patchiness of >70 %. **Partially Achieved:** Mosaic or patchiness of 50–70 %, the extent and rate of spread of any subsequent wildfire would still be limited. **Not Achieved:** Mosaic or patchiness of <50 %. High proportion of patchiness, unburnt corridors extend across the area (the extent and rate of spread of any subsequent wildfire would not be limited).

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

Monitoring the issue over time

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

Fire parameters

What fire characteristics will help address this issue?

Fire severity

- **Low** and occasionally **moderate**. Slow moving trickling fires preferred. Be aware that in the two years after a cyclone, burning in dryer months might create higher than anticipated fire severity.

Fire frequency / interval

- After a cyclone, it may be imperative to reduce fine fuels to reduce risk.

Patchiness (mosaic of individual burns)

- Mosaic or patchiness of > 70 per cent to reduce litter fuels.

Other consideration

- Planned burning in moist conditions is only one of the ways to reduce risk after a cyclone. Mechanical fuel reduction and avoiding ignition sources during risk periods are also important strategies.
- Fires should not scorch the canopy of trees which have been cyclone damaged. Be aware that this may be more difficult following cyclones due to higher fuel loads and considerable care should be taken.

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.

Recent rain: Burn soon after rain events as this increases the controllability of fire where excessive fuels have accumulated. Use the drying tables available in the QPWS Planned Burn Guidelines: How to Assess if Your Burn is Ready to Go, to estimate how soon the site will be ready to carry fire after rain (but take account of the fact there are suspended aerated fuels that might dry sooner). Moist conditions will recur in the following storm burning season (November to January).

Humidity: > 50 per cent humidity will create conditions where fire will trickle. This helps to create a low-severity fire with sufficient residence time to consume fuel.

Wind speed: < 15 km/hr (higher for storm burning)

FFDI: ‹ 11

Season: Aim for **summer** til **autumn**. Also, storm burns during **December** til **January**.

What burn tactics should I consider?

Tactics will be site-specific and different burn tactics may need to be employed at the same site (e.g. due to topographical variation). During your burn regularly review and adjust tactics as required to achieve the burn objectives. What is offered below is not prescriptive, rather a toolkit of suggested tactics.

- **Progressive burning** is very useful after a cyclone when combined with careful observations of fire behaviour, as this will indicate when conditions are becoming too dry for easy control of fires.
- **Commence lighting on the leeward (smoky) edge** to contain the fire and promote a low intensity backing fire.
- **A low intensity backing fire.** A slow moving, low intensity backing fire will generally result in a better consumption of surface 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.
- **Spot ignition**. Can be used to alter the desired intensity of a fire particularly where there is a high accumulation of available and volatile fuels. Increased spacing between spots will result in a lower severity fire. The spacing of the spots should be varied throughout the burn to take into consideration changes in weather conditions, topography, fuel loads etc.
- **Afternoon ignition**. This is particularly useful where suitable conditions are not available during the day. This will assist in promoting a low-severity fire that may trickle along the edge of non-target communities and generally self-extinguish due to milder conditions overnight.
- **Limit fire encroachment into non-target communities.** Where the non-target community is present in low lying areas (e.g. riparian systems), utilise the surrounding topography to create a low-severity backing fire that travels down slope towards the non-target community. If conditions are unsuitable (the non-target community has been damaged by cyclone and is upslope) use appropriate lighting patterns combined with active suppression along the margin of the non-target community to promote a low severity backing fire that burns away from the non-target community (refer to Chapter 9, Issue 5).

- **Strip ignition to draw** fire away from non-target community edge. Using more than one line of ignition can create convective updrafts which draw fires together and away from non-target areas. It is important to have safe refuges when undertaking this type of burning. For example for lighting along a track the person furthest from the track should walk parallel to the track and at least 20 m ahead of the person lighting nearer the track. This reduces the chance of the 'outer' person becoming cut off from the refuge area (the track).
- **Wet lines, blower lines (to clear strewn material) and/or rake-hoe lines** may have to be established along the edge of non-target areas. It is time consuming to establish wet lines, blower lines or rake-hoe lines especially where the boundary is extensive and where there has been considerable fallen timber, so use this tactic only where the prevailing weather conditions or the above tactics are not suitable to limit fire encroachment into non-target areas.

Issue 8: Manage exotic pine wildings

Pine wildings *Pinus* spp., invade areas of protected estate adjacent to forestry pine plantations. If they are not managed, pine wildings can displace native species and pine needles can smother lower-layer plants. When pine wildings become overabundant they provide conditions that are conducive to the promotion of weeds such as molasses grass and lantana.

Awareness of the environment

Key indicators of invasion or potential invasion:

- The vegetation community is adjacent to a pine plantation.
- Young pine wildings are beginning to emerge above the ground-layer plants.
- Pine wildlings are present and ground-layer plants are reduced in abundance and health. Grasses where present are scattered, poorly-formed and are collapsing.
- There is an accumulation of pine needles.

Pine wildings are beginning to emerge above the grassy layer.
Kerensa McCallie, QPWS, Byfield State Forest (2011).

Discussion

- Pine wildings less than one metre in height are relatively easy to manage and most fires will kill the saplings providing there is sufficient fuel around the stem base. Wildings that are one to three metres high are more difficult to manage and specific tactics may be required such as a high-severity fire or a running fire—these scorch the tip of the wilding.
- Repeated low-severity fires will promote pine wildings—the initial fire promotes a flush of seedlings and following fires are not hot enough to kill the growing seedlings (as the fire does not scorch to the tip of the plant).
- High-severity fires can reduce the quality of pine trees and make them unsuitable for products which require good quality timber. Care should be taken when burning areas adjacent to pine plantations to avoid fires impacting them.
- Pine trees grow approximately one metre per year for the first 10 years. Once they reach approximately 10 metres in height they tend to decrease their vertical growth rate but the trunk continues to increase its girth.
- Pine seeds are primarily wind dispersed (species dependant) and can be found up to five kilometres from the parent plant. These are often isolated individuals. However the majority of seedlings will fall within 500 metres of the plantation and regular reinfestation means ongoing management is crucial.
- While responsibility for wildling management lies with QPWS on protected estate, Forestry Plantations Queensland (FPQ) policy and guidelines 'Management of exotic pine wildings originating from Forestry Plantations Queensland plantations' may provide additional guidance in managing the issue.

Why are wildings overabundant?

Pine wildings in the understorey may occur:

- in areas adjacent to pine plantations
- in response to a fire event with no subsequent fire to thin the resulting flush of tree seedlings. If a fire triggers a flush of wildings, it will be necessary to plan a subsequent burn

Pine wildings may be promoted by:

- repeated low-severity, early season fires
- the prolonged absence of fire

Potential impacts of overabundant wildings:

- Overabundant wildings may result in a lower diversity of plants within the understorey. This occurs due to suppression from pine needles and the displacement of native species.

As pine trees grown, they can be difficult to manage as applying fire that is severe enough to kill them may have undesirable consequences. In these circumstances mechanical or chemical control (or a combination of these techniques) and fire may be necessary.

Kerensa McCallie, QPWS, Byfield State Forest (2011).

Few native species are able to establish where pine trees have shaded-out the ground layer. The light provided by felled trees in combination with fire will allow native species a competitive advantage.

Graeme Bulley, QPWS, Bribie Island (2008).

What is the priority for this issue?

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

Assessing outcomes

Formulating objectives for burn proposals

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

Measurable objectives	How to be assessed	How to be reported (in fire report)
> 75 % of pine wildings less than two metres are scorched to the tip.	Select one or more sites or walk one or more transects (taking into account the variability of landform and likely fire intensity), count the number of overabundant saplings (above ground components) scorched, and those that weren't.	**Achieved:** > 75 %. **Partially Achieved:** 50-75 %. **Not Achieved:** < 50 %.

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

Monitoring the issue over time

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

Fire parameters

What fire characteristics will help address this issue?

Fire severity

- **Moderate** to **high**. Aim for scorch height that is sufficient to scorch to the tip of the pine wildings.

Fire severity class	Fire intensity (during the fire)		Fire severity (post-fire)	
	Fire intensity (kWm^{-1})	Average flame height (m)	Average scorch height (m)	Description (loss of biomass)
Moderate (M)	150–500	0.5–1.5	2.5–7.5	Moderate patchiness. Some scorched litter remains. About half the humus layer and grass stubble remain. Most habitat trees and fallen logs retained. Some scorch of elevated fuels. Little or no canopy scorch.
High (H)	500–1000	1.5–3.0	7.5–15.0	Some patchiness. Some humus remains. Some habitat trees and fallen logs affected. At least some canopy scorch in moderate less than 20 metre height canopy, mid stratum burnt completely (or nearly so).

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

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

- See the interval recommended for the fire vegetation group.
- Avoid repeated low-intensity fires as this can promote the germination and persistence of pine wildings.

Mosaic (area burnt within an individual planned burn)

- > 80 per cent of area dominated by understorey trees burnt.

Repeated fires

- It is likely that more than one planned burn will be required to manage this issue. If the initial fire does not occur before mature pines seed, a flush of wildings may occur. In this case a follow-up planned burn within two years with **Moderate** to **High** severity fire may help address the issue.

What weather conditions should I consider?

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

Season: The season should be appropriate for the fire vegetation group. If fires can not be planned to co-inside with the cycle, burning before seed drop in spring.

FFDI: As per fire vegetation group.

Wind speed: As per fire vegetation group.

The flame height in this fire was sufficiently high to scorch the tips of the smaller pines in the foreground (and has killed them). Unfortunately the larger trees behind have not been killed and mechanical control may be required.

Graeme Bulley, QPWS, Centre Swamp, Bribie Island (2005).

Pine invasions can occur well away from the source plantation. This large tree (centre) was probably the parent plant and over successive years of seeding has formed its own monoculture of pines—displacing native vegetation.

Graeme Bulley, QPWS, North of Poverty Creek, Bribie Island (2005).

This area was clear felled of pines in 2000. Eleven years later trees are having shading impacts on the ground layer and native species diversity has reduced below the regrowth. Without management intervention this area will continue to redevelop into a pine forest.

Graeme Bulley, QPWS, Westaways Creek, Bribie Island (2011).

This fire is of sufficient severity to scorch the smaller pines (centre) but not those to the right of the image.

Frank Mills, QPWS, Mount Atherton (2010).

Regeneration of pine invaded areas may be a two step process; after mechanical removal of mature pines, fire is applied to remove ground fuel, pine saplings and promote regeneration of native species.

Graeme Bully, QPWS, Near Centre Swamp, Bribie Island (2010).

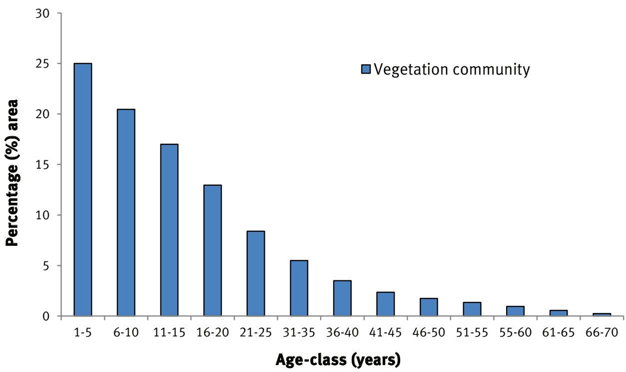
What burn tactics should I consider?

Tactics will be site-specific and different burn tactics may need to be employed at the same location (e.g. due to topographical variation). 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 often sufficient to address this issue, it is dependant upon the height of the wildings. A **running fire** of a higher-severity may be required to increase the scorch height (to ensure the tips of the wildings are scorched).
- **Line or strip ignition** is used to create a fire of higher-severity or to help fire carry through moist or inconsistent fuels. A second line of fire parallel to the initial strip can increase fire severity between the two lines, as the fires draw together.
- **A backing fire with good residence time.** A slow-moving backing fire (lit against the wind on the smoky edge or lit from upslope) will generally result in a more complete coverage of an area and ensures the fire has a greater amount of residence time. This tactic will also ensure fire intensity and rate of spread are kept to a minimum. Greater residence time is also useful for killing wildings one to two metres high.
- **Combining mechanical control with planned burning** can be a useful tactic where fuel loads are insufficient for fires to carry or to cause scorch to the tip of the pines. Three to six months prior to burning, fell as many trees as possible, making the cut below the lowest branch (this ensures the pines will not regrow). Using a bobcat-mounted slasher can assist in felling dense infestations or infestations over a large area.

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.

<table>
<tr><th>Terminology</th><th>Definition</th></tr>
<tr><td>Clarification over the terms

‘fire vegetation group’ and ‘fire management zone’.</td><td>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.

<table>
<tr><th>Fire management zone</th><th>Fire management sub-zone or Fire vegetation group</th></tr>
<tr><td rowspan="2">Conservation</td><td>FVG1</td></tr>
<tr><td>FVG2</td></tr>
<tr><td rowspan="2">Protection</td><td>P1</td></tr>
<tr><td>P2</td></tr>
<tr><td rowspan="2">Wildfire mitigation, etc</td><td>W1</td></tr>
<tr><td>W2</td></tr>
</table>
</td></tr>
<tr><td>Fire perimeter</td><td>The outer containment boundary in which fire is being applied.</td></tr>
<tr><td>Fire regime</td><td>The recommended use of fire for a particular vegetation type or area including the frequency, intensity, extent, severity, type and season of burning.</td></tr>
<tr><td>Fire regime group (FRG)</td><td>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.</td></tr>
</table>

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 the Central Queensland Coast bioregion	Percentage
Eucalypt forest and woodland	645 472	44
Tall open forest	32 025	2
Grasslands and sedgelands	8 138	1
Heath and shrubland	16 799	1
Melaleuca communities	40 269	3
Dune communities	25 556	2
Rainforest	191 540	13
Mangroves and saltmarsh	57 618	4
Plantations	7 904	1
Sand	75	0
Water	5 059	0
Non-remnant	427 027	29
Other bioregions	2 872	0
TOTAL	**1 460 354**	**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 forest and woodland**	Eucalypt forest and woodland	E	8.12.5c, 8.12.12d, 8.12.27a, 8.12.27b, 8.3.8, 8.5.5, 8.11.5b, 8.11.5a, 8.11.6, 8.11.8b, 8.12.5a, 8.12.14c, 8.12.14d, 8.12.25, 8.12.31b, 8.12.32, 8.3.5, 8.3.6c, 8.3.6a, 8.3.13d, 8.5.1b, 8.5.1a, 8.5.3b, 8.5.3a, 8.9.1, 8.10.1b, 8.10.1a, 8.11.1, 8.11.3c, 8.11.3b, 8.11.3a, 8.11.4, 8.12.5b, 8.12.6b, 8.12.6a, 8.12.7c, 8.12.7a, 8.12.7b, 8.12.9, 8.12.12a, 8.12.12b, 8.12.20a, 8.12.20c, 8.12.22, 8.12.23, 8.12.26, 8.3.13c.
			Eucalypt forest – poorer soils	Ec	8.11.8a, 8.11.12b, 8.11.12a, 8.12.14a, 8.12.14b.
2	1	**Tall open forest**	Rose gum open forest	R	8.12.31a.
			Red mahogany, yellow stringybark and/or *E. portuensis* closed-forest to low open-forest	A	8.12.4.
			E. montivaga open forest	M	8.12.8.

Chapter	Issues	Fire vegetation group	Fire regime group	Map label (if required)	**Regional ecosystems** (Sattler and Williams 1999; Queensland Herbarium 2011a; 2011b).
3	1	Grasslands and sedgelands	Grasslands	G	8.3.12, 8.12.13, 8.12.13a, 8.12.13b.
	2		Grasslands (poorer soils)	Gp	8.10.1d, 8.11.9.
	2		Sedgelands	S	8.3.4, 8.3.14, 8.2.9.
4	1	Heath and shrubland	Coastal heath	Hc	8.11.10, 8.12.29, 8.12.29a, 8.12.29b, 8.2.3a, 8.2.3d, 8.2.4a, 8.2.4b, 8.2.7b.
			Montane heath	Hm	8.11.7, 8.12.10a, 8.12.10b, 8.12.29c.
5	1	Melaleuca communities	Melaleuca forest and woodland	Mw	8.2.13b, 8.3.2, 8.3.11, 8.5.2a, 8.5.2c, 8.5.6, 8.5.7.
	3		Melaleuca gallery forests	Mg	8.3.3a, 8.3.3b, 8.3.15.
	3		Melaleuca swamps	Ms	8.2.11, 8.2.4c, 8.2.7a, 8.2.7e, 8.3.13a, 8.3.13b.

Chapter	Issues	Fire vegetation group	Fire regime group	Map label (if required)	**Regional ecosystems** (Sattler and Williams 1999; Queensland Herbarium 2011a; 2011b).
6	1	**Dune Communities**	Fire-adapted	Fa	8.2.13a, 8.2.12b, 8.2.12a, 8.2.7c, 8.2.8b, 8.2.8a, 8.2.8e, 8.2.8d.
	2		Fire-sensitive	Fs	8.2.1, 8.2.10, 8.2.14a, 8.2.14b, 8.2.6a, 8.2.6b, 8.2.14c.
7	1	**Rainforest**	Rainforest	R	8.3.1b, 8.3.1a, 8.3.9, 8.3.10, 8.8.1b, 8.8.1a, 8.11.2, 8.11.11, 8.12.1a, 8.12.1b, 8.12.2, 8.12.3b, 8.12.3a, 8.12.3c, 8.12.11, 8.12.11a, 8.12.11c, 8.12.16, 8.12.17a, 8.12.17b, 8.12.17c, 8.12.18, 8.12.19, 8.12.28, 8.12.30.
	1		Beach scrubs	Bs	8.2.2, 8.2.5
8	1	**Mangroves and saltmarsh**	Mangroves		8.1.1
	1		Saltmarsh	Sa	8.1.2, 8.1.3, 8.1.4, 8.1.5, 8.10.1c

Spatial data is derived from a pre-release of version 7.0 of the "Survey and Mapping of 2009 Remnant Vegetation Communities and Regional Ecosystems of Queensland" layer (16 April 2012 - pre-release of version 7.0) (refer to Figure 1).

Includes all Regional Ecosystem (RE) spatial records with a dominant RE classification associated with the Central Queensland Coast bioregion. As such some spatial records extend beyond the Central Queensland Coast bioregion boundary.

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

No REs were unmatched with the GIS spatial layer.

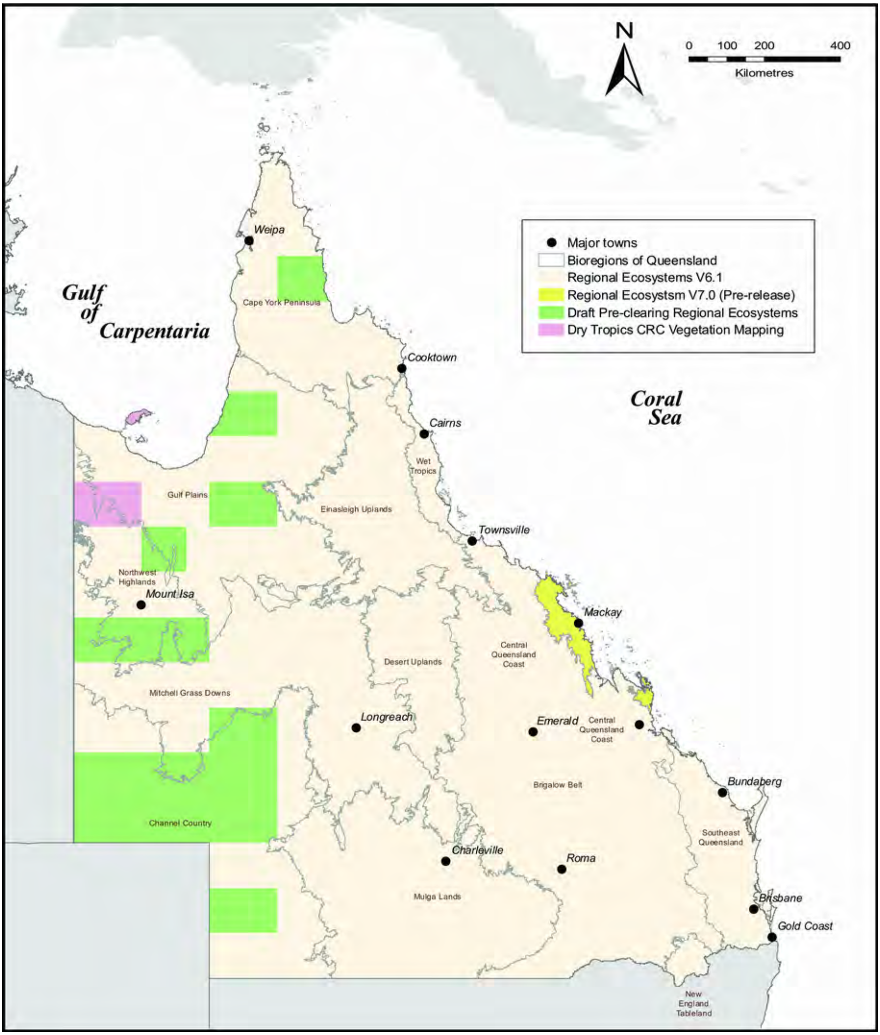

Figure 1: Map of Queensland indicating the different GIS data sources used to produce the spatial fire vegetation group mapping product.

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.

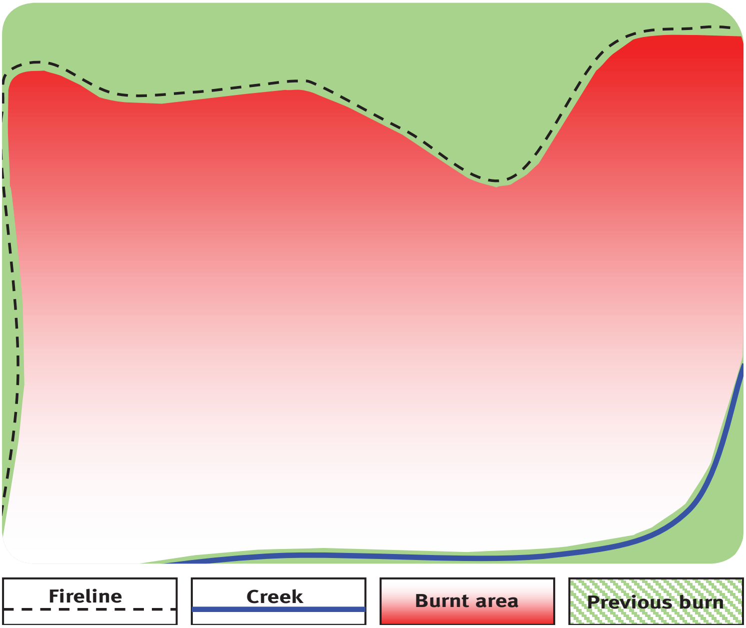

Figure 1: Example area between fireline and creek burnt in a wildfire—year 0. (Recommended fire interval for fire vegetation group is eight–12 years).

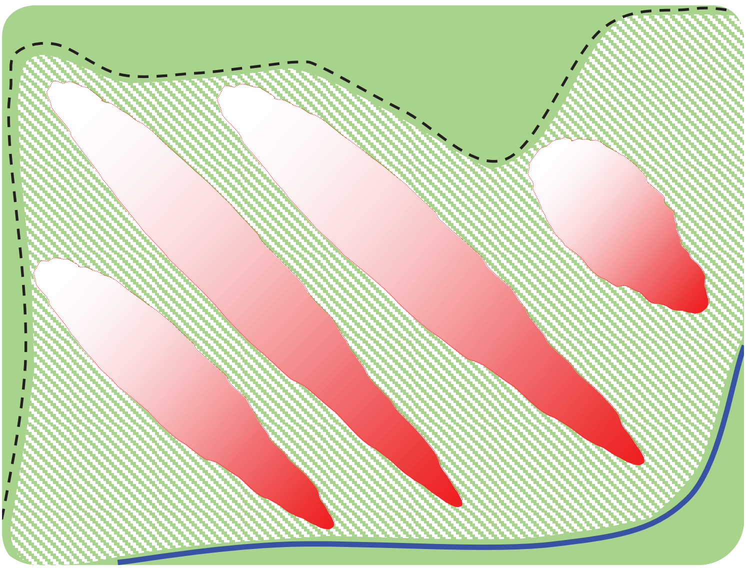

Figure 2: Planned mosaic burn—year 8.

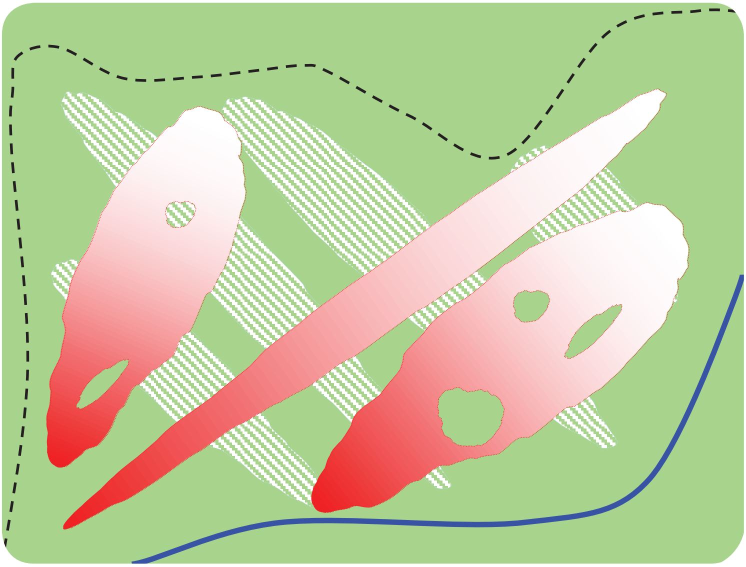

Figure 3: Planned mosaic burn—year 20.

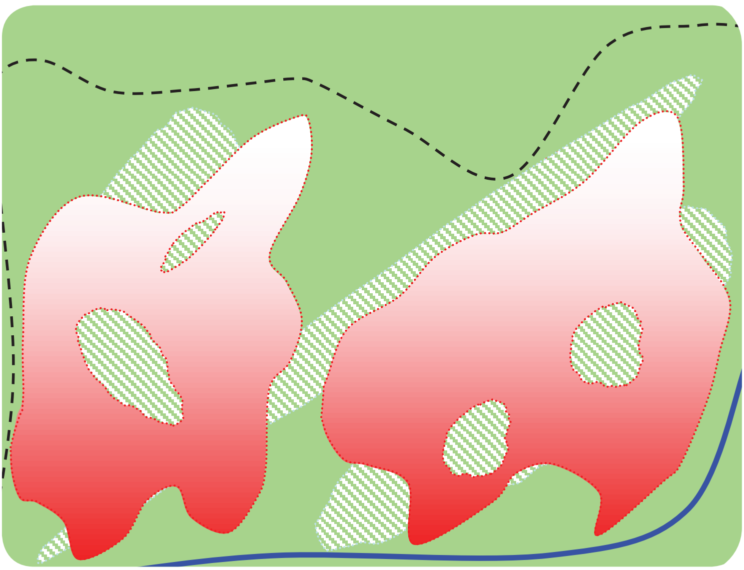

Figure 4: Planned mosaic burn—year 28.

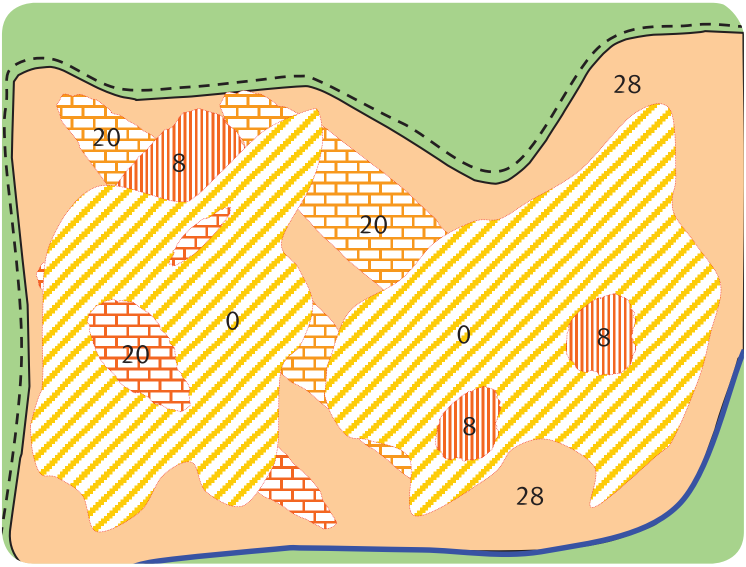

Figure 5: Fire history summary—year 28.
Wildfire and mosaic burn patterns overlaid (with years since last burnt).

Mosaic burn on Conway National Park showing approximately 40 per cent coverage across the landscape.
Kerensa McCallie, QPWS, Mt Rooper, Conway National Park (2012).

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