



PROFILE FOR ECOLOGICAL FIRE MANAGEMENT OF **ERUB ISLAND**

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1. INTRODUCTION

This report for Erub Island provides the third report for a Torres Strait Island aimed at developing a systematic fire program for ecological management purposes. It is intended that these programs will be the responsibility of the rangers and therefore, to guide them as much as possible, these reports go, in some detail, into the history, theory, and practice of what will be referred to as prescribed burning. Particular emphasis is placed on its traditional aspects. This report has been prepared at a preliminary level, prior to community consultation, and as such is subject to further fine tuning. Prescribed burning refers to the planned use of fire; it is not synonymous with the term “back-burning” which is sometimes used, and fuel-reduction burning is but one form of prescribed burning which is done with the much narrower aim of reducing the intensity and spread of unplanned fires (bushfires or wildfires).

Whilst the reports for the two large continental islands of Badu and Mua are specifically targeted toward the ecological maintenance of relatively undisturbed habitats, Erub presents a much different case. Habitats on Erub have been subject to considerable disturbance, largely at the hand of a range of transforming exotic weeds which have proliferated on the fertile basaltic soils. Hence the approach described within, although adopting similar fire management principles, is targeted to the much narrower and specific aim of stabilizing the landscape to prevent further degradation. Without the option of herbicide usage (as per current wishes of the island community) and a limited supply of labour, the prescribed use of fire presents the only feasible means of achieving this aim over the broad scale.

Erub Island, along with Mer (Murray) and Ugar (Stephen) are unique in a bioregional context. They are formed from basalt, the result of Pleistocene age volcanism, and are further removed from the land mass of northern Australia than any other islands in the Torres Strait group. The distinctive geology and geographic location, being dissimilar to landscapes on either Cape York Peninsula or its much nearer neighbour of Papua New Guinea serves to enhance its uniqueness. In an Australian context at least, these islands have no equivalent.

1.1 The Need for Fire Management on Erub

There is some conjecture as to whether the grassland habitats on Erub are man induced. It is almost certain however that with the arrival of man, the area of grassland occupancy through man's use of fire would have been increased and the general mosaic of vegetation on the island altered considerably. The Erub Island landscape in the 4 000 yrs following human settlement has been heavily influence by man's activities and large areas of the island have essentially been managed as a permaculture. Whilst intensive farming concentrating on areas of more favourable soil and landform significantly altered the structure and composition of many rainforest habitats, seemingly less productive grassland habitats were also managed for cultural purposes. Such purpose may have been as simple as maintaining ease of access, or

to manage a material resource. As an example, harvested fresh leaves of blady grass were used as a primary roofing material (Bully Sailor, March 2011 - pers. comm.) on Erub. Throughout traditional occupation, the only feasible means of maintaining these grassland areas would have been fire. Man effectively took charge of fire to use it in many different ways to manage and shape the landscape to serve his own requirements of safety, ease of access, and food supply. The anthropologist Rhys Jones (Jones, R. 1969) coined the term “firestick farming” to describe this process. Undoubtedly man shaped fire to serve his ends, and in the process fire shaped man as it changed the landscape and thus the way man adapted to live within it.

On Erub, a long term and seasonally consistent approach to fire management would have maintained equilibrium between grassland and rainforest habitats. Whilst repetitive hot fire events will result in the retreat of vine forest margins to all but the most topographically protected and sheltered locations, a reduction in fire frequency and intensity will generally result in encroachment of grassland areas by rainforest shrubs and trees. It is expected, as was the case on mainland Australia, that traditional fires on Erub would have been small and numerous and hot fires would have been used for specific purposes such as forest conversion. It is almost certain that, in the last century or so, much that was traditional in the way that fire was used on the island has largely been abandoned, and undoubtedly the island's vegetation has changed as a result. From the authors observations and discussions with local community members, the current fire regime consists of ad-hoc fires lit late in the season with little purpose or pattern other than opportunistic spectacle. It is probable, as is evidenced from recent satellite imagery, that the majority of the islands grassland habitats are burnt annually in a few large scale fire events that occur in the period from October to November. From satellite imagery captured in late November 2011, it is estimated that up to 90% of the islands grassland habitats had been recently burnt.

The equilibrium between grasslands, vine forest and woodland habitats is an intrinsic feature of continental island ecosystems along Queensland's entire coastline, particularly apparent in the Palm and Whitsunday Island groups and on Hinchinbrook Island in the Wet Tropics Bioregion, although perhaps to a lesser extent in the latter example. On Erub however, the regime of hot late season fires has undoubtedly shifted the balance in favour of grassland. Although both rainforest and grassland habitats have equally important landscape and ecological function, the value of the remaining good quality rainforest vestiges is increased by their relative scarcity in the current island landscape.

It is beyond doubt that wholesale removal of fire from the Erub landscape will alter island scale biodiversity values. In the absence of other degrading factors, reduction in the use of fire would undoubtedly lead to an expansion of rainforest and this may arguably be a worthwhile result. However, with the recent advent of exotic weeds, particularly lantana (*Lantana camara*) which was introduced to the eastern island ground in the mid 1900's, the

removal of fire has perhaps some catastrophic consequence. On Mer for example there has been an observed massive expansion of lantana on the grassy slopes of Gelam between 2007 (an earlier visit by the author) and 2011. The pertinence of this observation is that grassland firing was banned as a practice from the island ten years prior due to cultural concerns. The expansion of lantana on Erub is not as dramatic as has occurred on Mer, solely because Erub is still subject to regular firing. Lantana is however thickening dramatically in those areas that are not regularly burnt such as the grassy areas below the airstrip road as well as on coastal headlands that are isolated from the broader expanse of grassland. In the absence of fire and other means of control, it is feasible that within several decades, very few areas of natural grassland would remain in the island landscape, replaced with a covering of impenetrable thickets of lantana. This rapid expansion of lantana is considered the most critical ecological process affecting the island at present, and as discussed in following sections, fire has a critical role in regulating its spread. Without intervention, these grassland habitats, which have great significance as a cultural landscape as well as having specific biodiversity values will rapidly be lost.

1.2 The Value of Effective Fire Management

A fire regime is defined by the number of fires that occur over a given period and their intensity, and these things must be measured over a time period long enough to be meaningful. If a long established fire regime changes, then the habitat will begin to change in ways that disadvantage some species of plants and animals, and advantage others.

It needs to be recognised that there is much antipathy to the use of fire within the Australian population. It is found at all levels of society from the man in the street to the academic community. It is largely an urban or near urban phenomenon, but is also common in large areas of rural Australia where the use of fire is not seen to have any role in land management. This attitude ignores the now indisputable fact that fire in the hands of pre-European Aboriginal and Islander Australians played a pre-eminent role in determining the nature of the vegetation and landscape that European Australians inherited. There would appear to be no rational basis now for abandoning that ancient order for the hazardous and uncertain future of land management without fire.

Central to the distaste felt by many for the suggestion that fire should play a major role in the management of natural lands for the maintenance of biodiversity is the deeply ingrained belief that fire can only be a destructive force. It is a belief that is continually reinforced by the recurring catastrophic fires of southern Australia, with loss of homes and lives. That these fires are fuelled by huge accumulations of litter as the result of long exclusion of fire, generally escapes attention. Considering its role in shaping the Australian bush, however, fire is as natural a factor as wind and water.

In the hands of a skilful land manager, fire can be many different things, each used in different ways to achieve different results. In the hands of indigenous land managers it was, for tens of thousands of years, mostly a gentle force that shaped the land to their desire, and in turn, with time, gradually shaped their society. Indigenous land management gave to modern Australia the habitats, vegetation, and wildlife of which we are so proud, and see as the iconic features of our national identity, but have been, for more than two centuries, progressively destroying. There is, however, for most of Australia, no option of returning to that traditional management. Most of what are recognised as natural environments now have changed from those that the indigenous people once tended. They have been subjected to altered fire regimes; to logging and mining, to widespread invasion by introduced animals and plants, and destructive pressures from recreational users. In these environments the purposeful use of fire is still critical to their management, but now must often be used in ways that are remote from traditional indigenous practice. On Erub, that purpose should be applied to stabilising the landscape and preventing wholesale conversion of its remaining natural habitats to an impenetrable thicket of exotic weeds.

1.3 The Nature of Effective Fire Management

It is known from the historical record, early studies of traditional land management, and contemporary studies of surviving practices in Arnhem Land (Russell-Smith et al, 2009) that traditional fire management could be characterized by certain features. The extensive historical research of Gammage (2011) also demonstrated that these features were common to indigenous practice in all parts of Australia (including the island of Tasmania).

These features were:

- Fire was used purposefully to shape the landscape in ways that provided maximum advantage for ease of access, to facilitate the capture of game, and to protect and promote plant food resources.
- Large fires were few; numerous small fires were lit progressively during the year.
- Aboriginal people used fire to manage the fuel around them.

The fine scale of traditional fire management is rarely appreciated today. In essence it involved the use of thousands of small fires in areas which today are burnt by rare single fire events – often decades apart. The anthropologist Rhys Jones, for example, estimated that in the better populated areas of Australia, in an area of thirty square km that would have supported a band of roughly 40 people “Assuming that on average, three foraging parties of various types left camp per day, that each lit 10 bushfires and that this happened on only half of the days of the year, then within that area, no less than 5,000 bush fires would be lit each year”. He went on to state that he considered that to be a highly conservative estimate.

2. A PROPOSED APPROACH TO FIRE MANAGEMENT ON ERUB ISLAND

2.1 The Current Condition of Erub Habitats

From assessments undertaken by Stanton et al (2009) the current Erub landscape comprises 82 % natural vegetation. These are formed predominantly by native grasslands (58 %), rainforest and vine thickets (18 %), areas of natural rainforest regeneration (4 %) and mangrove forests (2 %).

Mapping from high resolution 1999 aerial photography indicates that at that time, 80 ha or 25% of the native grasslands were subject to severe lantana infestation. The current extent of infestation is not known although anecdotal evidence suggests that it has expanded considerably, particularly below the road from the Erub township to the airport as well as in vestiges of grassland where the surrounding vegetation has prevented fire incursion. From visual inspection in 2011, grassland habitats on the north and north-western side of the island are relatively free from lantana except on the margins for rainforest patches and in gully lines. The most intensely infested habitats are in the vicinity of the airport where in some locations, native grasses have been almost totally displaced to the degree that fire will not carry. Also occurring in grassland habitats, although mostly in the vicinity of infrastructure are a number of additional weed species, the most problematic of which are praxelis (*Praxelis clematidea*), leucaena (*Leucaena leucocephala*), tropical kudzu (*Pueraria phaseoloides*) and sprawling vines such as siratro (*Macroptileum atropurpureum*) and star of Bethlehem (*Ipomoea quamoclit*).

Whilst well preserved rainforest patches remain on the island, particularly east of the airstrip, the majority of occurrences are confined to restricted vestiges in gully lines with peripheries fringed by dense thickets of lantana. The remaining rainforest patches are frequently interspersed with stands of bamboo or other exotic trees of which poinciana (*Delonix regia*) is most abundant.

2.2 The Response of Lantana to Fire

Control of lantana by fire is widely practiced as an initial broad-scale treatment due to cost effectiveness and its ability to be applied to large sections of the landscape relatively quickly. There is however little information on the response of lantana to fire. From personal observation the following information on the response of lantana to fire has been noted:

1. Fire, particularly hot fire, will generally kill seedlings and small plants.
2. Cool fires will generally not kill larger plants and plants impacted by cool fires will recover quickly.

3. Hot fires will kill young plants and above ground stems of mature plants although mature plants will tend to re-shoot from the base.
4. Repetitive hot fires, burnt two to three years apart to maximize fuel accumulation will gradually reduce the occupancy of lantana although total elimination will require long term persistence.

2.3 Options for Fire Management on Erub

The precise direction of fire management on Erub will have to depend on some measure of community consensus, with consideration given to the resources available to carry out any particular program. It must be stressed that without majority community support the pursuit of any program could be difficult. There are three possible alternatives for fire management on Erub, the likely outcomes of which are considered below:

1. ***Remove fire from the island landscape:*** This will be by far the most difficult to implement and also the most catastrophic in terms of island biodiversity. Grassland habitats where lantana is a relatively minor component, which is the majority of the grassland habitats on the island, will thicken dramatically in five years, become dense thickets within 10 – 15 years and conservatively within 30 years become impenetrable lantana thickets. Lantana will also begin appearing as scattered shrubs within grasslands not currently infested with lantana and thicken incrementally until the habitat is eventually consumed. It should be noted that this landscape scale conversion of grassland to exotic shrubland will result in no, or extremely limited expansion of the islands rainforest habitats beyond their current boundaries. From experience, rainforest recruitment through a closed lantana canopy is extremely slow and most likely will not occur at all. Whilst considered the least desirable of the three options, it will be very difficult if not impossible to enforce island wide fire bans on an island comprising highly flammable vegetation. It would only shift the fire regime to one of less frequent and mostly hotter fires that could potentially be destructive of some values, both cultural and natural, that are precious to the community.
2. ***Let the current regime prevail:*** It should be noted that whilst the current regime of late season fires is not considered optimal, it has most likely prevented much broader scale habitat loss on Erub to lantana. The annual burning cycle may not however allow accumulation of sufficient fuel to produce fires of suitable intensity to maximize lantana kill rates. Where fire does not penetrate, including some well-preserved grassland habitats on headlands, these habitats will also be eventually lost. Rainforest margins will continue to be repetitively scorched by hot fires limiting any chance of forest expansion, and any areas of native regrowth that should possibly be left to recruit and establish naturally will eventually be killed. The burning of large portions of the islands grassland habitat in a few wide reaching events within a

narrow time frame is also a poor outcome for general biodiversity. Such regimes tend to decrease the complexity of grassland habitats, entirely destroy shelter for fauna species that rely on grasslands, and expose extensive areas of bare soil to erosion during monsoon rainfall events.

3. ***Manage fire for specific landscape outcomes:*** It should be stated up front that it will not be possible to eradicate lantana from Erub using fire alone. The total eradication would require, in conjunction with an extensive input of labour, the use of herbicide to target lantana in those areas where fire will not carry. It can however be used to; prevent expansion of the current infestation extent; target areas where lantana infestation is particularly thick with fires of an appropriate intensity and timing; promote preferential expansion of rainforest and natural regrowth habitats, and improve the islands overall ecological function. Within a period of several years, it will be possible to see significant improvement in the ecological health of the island, including a reduction in the extent and intensity of lantana infestation, through an appropriately implemented fire regime.



Photograph 1. Relatively intact native grassland habitats looking from the radio tower to the north west. Lantana presents as the bright green fringe surrounding the rainforest habitats (photo April 2011).



Photograph 2. Late season fire scarring on Erub, mid-November (2007).

2.4 Principles for Effective Fire Management

There are two important principles that are central to actions recommended in the plan that follows. They are the principle of patch or mosaic burning, and the principle of a step by step approach to full implementation of the plan.

1) Fundamental Approach to Fire

Patch or Mosaic Burning: Central to all recommended actions is the concept of patch or mosaic burning. Patch burning requires the introduction of numerous cool fires into the landscape in the place of a few large hot ones as is currently the case on Erub. It relies on commencing burning early in the season, at the point at which fires will first carry extending these fires throughout the remainder of the year as ground cover dries and burning conditions gradually improve.

A mosaic burning system, progressively and appropriately applied during the year, requires few firebreaks, is relatively inexpensive to apply, and has maximum benefits in relation to diversity of habitats and species of plants and animals. It also takes into account as no other system can, the requirements of hundreds, or even thousands of species such as insects, fungi, and invertebrates in general that are involved in breaking down the litter layer and assisting nutrient recycling, and that are the main supporters of health in an ecosystem. It

does this by creating across the landscape an intense mosaic of areas representing different fire return intervals, different seasons of burning, and different intensity of burn that provides maximum opportunity for the maintenance of habitats and the survival of all species of plant and animal.

Storm burning: This is a useful technique to apply in any areas where a thick understory has developed as a result of long absence of fire, or because heavy grazing has destroyed the ground cover allowing shrubs and trees to escape competition from grasses, and has also removed the fuel that would allow fires to destroy the understory. Storm burning changes the competitive balance between trees and shrubs, and grass, in favour of the grass. This is because it is carried out after the first storms of the wet season when there is adequate soil moisture to promote rapid growth of grass which then suppresses regenerating shrubs and small trees.

Burning on a declining hazard: This is particularly relevant to late season fires although should be adopted as a general policy where prescribed burning is implemented. Lighting fires before midday should only be practiced early in the season or in any other circumstances where it is difficult to get fires to carry. At other times burning should be carried out at times of day when wind speed is not likely to increase, temperatures are dropping, and humidity is rising, i.e. a decreasing hazard. This usually means after 2.00pm. Burning during periods of strong wind should also be avoided.

2) The need for a gradual progression towards effective fire management across the whole island.

Starting without long involvement in on-the-ground fire management one cannot become an effective fire manager overnight. No matter what ideals, enthusiasm one brings to the task, no fire management plan will be successful unless those involved have an understanding of fire behaviour across the full range of habitats and conditions of the area they are responsible for, and a detailed knowledge of the areas geography.

Thus achieving the goal of effective fire management for the whole island must of necessity involve several steps. Firstly, a broad fire plan for the whole island must be developed and secondly, the development of short term goals on the way towards implementation of effective management across the whole island. Before beginning on field implementation, it is necessary that an understanding of fire behaviour and knowledge of island geography be developed amongst all personnel. It is expected that such knowledge is already present amongst relative personnel on Erub.

Beyond the steps referred to above, there are two pre-eminent requirements. There must be continual acknowledgement of the need to work within the limits of resources. There is

nothing that will lead to the collapse of any project faster, or breed greater discouragement in those involved, than having ambitions exceed capacity to deliver. On the other hand success in achieving progressive small steps develops interest and enthusiasm and a better chance of achieving the long term goals. It is also essential that those selected for involvement in the work must be clear in their mind that that is what they want to do, and have an interest in the work or feel that they can develop such an interest. It is also very important that those involved in the work have a good chance of long-term tenure in it. There is no point in developing expertise in ranger staff only to lose it and have to start again with someone else. In such a scenario the overall project would never be capable of getting beyond the first steps. It needs hardly to be said, of course, that without stable long-term funding effective fire management of the island cannot succeed.

Before beginning, majority community support should be sought and obtained and this will be up to the abilities of the ranger staff. Clearly, ranger staff cannot work in an environment where any mistake brings with it the chance that the project might be shut down, or there is such lack of concern for their efforts that firebugs through lack of condemnation by the community feel free to abort the most sincere efforts of the rangers.

The essence of the advice above is that fire management on the island should begin in a small way with progressive increase in responsibility as knowledge and confidence is built up in ranger staff. In this way the limits to function imposed by shortage of resources at any point should become clear long before they are tested, and the morale and interest of staff should not be seriously challenged. In line with these suggestions, it would be best to start with clearly defined but limited objectives. These matters will be further addressed below.

3. PRINCIPLES FOR ESTABLISHMENT OF EFFECTIVE FIRE MANAGEMENT ON ERUB.

Drawing together the information provided in previous sections of the report, it is now possible to provide an outline of what a fire management program would look like that was designed:

1. To arrest the advancement of lantana into grassland habitats on the island.
2. Limit the scorch and retreat of rainforest boundaries, plus damage caused to sensitive species, by extreme fire events.
3. Promote maximum biodiversity.

The program would closely approach traditional management principles although would differ in some regards as traditional land managers would have never had the scourge of invasive weeds to deal with.

Whether the program was extended to all or part of the island would also depend on the available time, energy, skills and desires of the rangers plus approval of the local community. In the early years of development, the most appropriate course of action might be to designate a portion of the island as a trial which can be expanded upon as the community becomes engaged or encouraged by the initial results. An appropriate management area has been identified by Erub rangers, extending from the north-eastern tip of the island (Watato) west to the access road to the coming of the light monument at Kemus (see **Map 1**). Based on discussions with the PBC, rangers have received approval to undertake management trials in this area, including using of glyphosate herbicide to arrest lantana spread. Concentration of management activities on this local site should not however preclude application of the principles to the broader island landscape if the local community is amenable, or even wants to become involved. Hence principles described here address broad scale fire management across the island as a whole, although they can be applied at a local site level as discussed further in **Section 4**.

The initial process for broad scale management would involve:

- i. Identification of assets requiring protection of fire and establishment of appropriate fire breaks.
- ii. The identification of grassland habitat that is relatively free from lantana where early season (cool) burning could be initiated.
- iii. The identification of grassland habitats infested with lantana that would benefit from high intensity fires late in the season.
- iv. Mapping and identification of fire sensitive rainforest habitats that require protection from intense fire.
- v. Mapping of infrastructure and other cultural assets that require protection from high intensity fire.

Establishment of fire breaks around critical infrastructure: In any area where fire management is proposed, the initial task will be to remove the risk posed by heavy fuels in the rank grasslands that surround the township and infrastructure. The main infrastructure concerns for asset protection burning are the water catchment area, residential / commercial dwellings including the school and other assets such as garden areas and picnic areas. Establishment of fire breaks would involve either the slashing or spraying (using herbicide) of a 2m wide strip around the perimeter of these areas very early in the season (March to April) followed by burning of the dead grass as soon as ignition is possible to create a fire break.

Early season (cool) burns: As soon after the wet season as fire will carry (April-May in most years) burning will begin in grassland habitats that are relatively free from lantana. The most extensive areas of relatively 'clean' grassland occur on the islands north-west slopes and these may be an appropriate target. Early season burning will also concentrate along the

edges of rainforest communities that may be exposed to hot, late season fires. This is particularly the case where grassland directly abuts rainforest edges although is less crucial where there is a dense buffer of lantana on the rainforest margins. Other areas that might be targeted include areas of native regrowth if re-establishment of rainforest is an aim, and areas of heavy fuel load around infrastructure and cultural sites. Areas of heavy lantana infestation should be avoided during early season burns and left for late in the year when high intensity fire will be most beneficially employed.

The initial phase of burning aims to produce a mosaic of burnt and unburnt patches across the island or portion of the island. If a hot fire occurs late in the season, it will tend not to travel far in areas where a mosaic is established and it also ensures that large areas of soil are not exposed during any single period. The pattern of mosaic burning in grassland habitats can probably continue sporadically through to July, by which time it will be well established in the landscape.



Photograph 3. Native grassland in excellent condition with a mix of kangaroo grass (*Themeda triandra*) and blady grass (*Imperata cylindrica*). Such areas are suitable for cooler mosaic burning. A single lantana shrub is visible which can be pulled out.

It would be beneficial if prior to commencement of the program, that fire be excluded for a season from those parts of the island subject to the trial. The ability to start early burning in these areas would benefit from having a significant portion of the landscape having at least two years fuel accumulation. The nature of the ground cover in the tall grass areas is that they reach maximum fuel accumulation in 3 to 4 years after fire. They are difficult to burn in the

cool season two years running, but are quite capable of supporting undesirably hot fires late in the season in the second year after burning. After 3 years without fire, any late season fires are bound to be hot.

The ideal situation for starting early burning and establishing a significant mosaic burning pattern would be to have fired excluded from target areas for the year prior to program implementation with an aim to burn an average of one third to one half of the target habitat per year. Experience with burning in these grassland habitats has demonstrated that once a mosaic is well established with progressive patch burning then this sort of average is what is attained by a combination of chance, and some judgement on the part of the field operator. That judgement is enhanced with experience.

The timing of the burning program will vary from year to year and as with all average figures there can be some extreme variation. In some years burning will be difficult because of constant showers in most months, and consequently a high percentage of it will burn in the following year if there is not a repetition of the same weather pattern. Very early season action will be required if the following wet season ends abruptly. In such a sequence of years the variation in the percentage burnt in any one year could be as extreme as from 15% to 70%.

Late season (hot) targeted fires: Once a burning mosaic has been established across the island landscape, it will be possible to target areas of heavy fuel load without concern that the fire will travel far and risk burning large portions of the island, risking damage to both infrastructure and ecology. These will typically be areas of grassland where lantana is thickening severely that have been intentionally avoided during early season burns. As stated previously, it would be beneficial to have at least two seasons worth of fuel accumulation in these areas prior to burning to maximise impact to lantana.

It is essential that such areas be isolated from infrastructure or highly sensitive rainforest patches by a buffer of previously burnt vegetation. Physical fire breaks created by the slashing or spraying of grass can also be considered if the risk is assessed to be great.

Storm burning can also be trialed to give grass a competitive advantage, possibly limiting the regeneration of lantana through competition. This method has needs further testing on lantana and as such, it might be appropriate to undertake a trial in an area prior to applying the approach more broadly.



Photograph 4. Heavily degraded grassland with lantana scattered pervasively throughout. The area occurs in a pocket that is sheltered from all but the most deliberately lit fires and provides a suitable site location for prescriptive fire management.

4. A PROPOSED FIRE MANAGEMENT PROGRAM FOR ERUB

As identified within **Map 1**, an area has been identified as a trial management area within which landscape and weed management activities can be focused for an initial period. It is anticipated that successful control of lantana and other weeds within this area will facilitate broader support for the program within the island community and confidence that measures can be effectively applied more broadly across Erub's landscapes. The management area has the following features:

1. It is bound to the west by an established access track.
2. The area contains a complex mix of intact rainforest with dense lantana thicket on the margins.
3. There are some areas of intact grassland, mostly on the coastal headland.
Grassland in many locations is subject to intense thickening of lantana pervasively throughout the habitat. This thickening has occurred mostly in the period from 2007 (based on survey observation) to present.
4. Grassland pockets mixed with lantana that are isolated from the more expansive grassland areas and can thus be burnt intensely without fear of fire spreading widely across the island.



Activities within the initial year should focus on the trial management area whilst the broader Erub landscape is rested from fire as far as is feasibly possible. The recommended management measures in the initial year of activity are described below.



Photograph 5. Steep slopes in the trial management area where thickets of lantana are interspersed with grassland habitats. There is no firm evidence of burning within this area for several seasons.

Year 2013-2014: Trial management area: It is uncertain as to how early a start can be made to activities and details provided within describe the ideal process to be followed over an entire year. However, there are activities that can be completed regardless of how early a start can be made to the program in 2013 and such activities are indicated where possible. The activities also assume that permission has, or will be obtained to use glyphosate (herbicide) in the trial management area. If permission to use this herbicide is denied, an alternative approach that uses fire as the sole means of control will need to be considered. It should be noted that the aim of the management program in this area should be ultimately to:

1. Arrest the consumption of grassland habitats by lantana.
2. Promote the expansion of rainforest margins into grassland habitats until a relatively stable equilibrium and firm boundaries between the two habitats is established.

The ideal management approach to achieve these aims is described below with any potential deviations from the ideal noted:

1. From early in the season, a manageable area should be identified for lantana control with the use of herbicide. This may be the entirety of the trial management area if resources are sufficient to the task or more likely a smaller suitable area chosen from within the management block.
2. Over-spraying of lantana thickets should concentrate on areas where it forms a dense fringe to intact rainforest habitats and should be undertaken a minimum of a month before the first burns are affected (generally in March although can be completed prior to this). The full width of the infestation should be sprayed if possible and it may be beneficial to spray from the margins of the vine thicket outwards as well as inward from the outer margins of the lantana thicket.
3. Once lantana has died, which should take little more than a month when sprayed during the growing season of February to March, and grassland habitats are capable of carrying fire, a cool burn should be placed on the interface between the dead lantana thicket and the adjoining grassland areas. This should be completed by walking the interface continuously lighting small patch fires. The aim of the cool burn is to establish a fire break so that hot fires burnt late in the season will not penetrate the dead lantana, destroying any rainforest regrowth and potentially damaging the intact rainforest margins.
4. Should the use of herbicide not be permissible, step 3 should be undertaken in any case in an attempt to establish a buffer to reduce the detrimental impact of any hot late season fires. Hot fires in this case may kill lantana, although it is likely to regenerate rapidly in the following season. Hot fire will also destroy any regenerating rainforest shrubs so the best outcome that could be hoped for would be a prevention of continued expansion of the lantana thickets on rainforest margins.
5. Depending on the success of the early season burning program, a subsequent phase of early season burning may be required to increase or more firmly establish the buffer between grassland and rainforest habitat types. The requirement for this will be dependent largely upon season.
6. Depending on seasonal conditions, hotter late season fires should be driven through vestiges of degraded grassland that retain sufficient fuel to carry fire. This should only be undertaken when early season burning has effectively established a fire break, isolating as much as possible areas of combustible grassland from dry thickets of dead lantana. Without establishment of the break, there is potential for hot fires to push into and damage the rainforest margins. These fires should be considered for the period from July through to around the end of October. Ultimately over several seasons, repetitive fires will reduce the occupancy of lantana within the grassland habitats.
7. To reinforce the effectiveness of a burning event, regenerating lantana shrubs can be selectively sprayed prior to re-establishment of dense grass cover.

Year 2014 to 2015: Methods employed during the initial year in the trial management area should be evaluated to determine areas where improvements to the program can be made. It will be particularly important to reinforce any weed control undertaken with the use of herbicide although any areas that were subject to hot fires will need to be rested for a season, allowing fuel levels to accumulate to levels that will support sufficiently intense late season fires. Hence it may be necessary to extend the management principles developed during the first year to another portion of the trial management area.

It would also be beneficial, with resting of the island landscape for a season, to consider expansion of the program to the management of habitats in the broader Erub landscape. Discussion in this regard is provided below. Habitats on Erub are highly sensitive to changes in fire regime and structural changes in vegetation will be noticeable in years rather than decades as might be expected on the larger continental islands of Mua and Badu. The impact that invasive species are having on Erub's habitats also requires that a fire program be more prescriptive, focused to a large degree on specific issues. The fire behaviour categories for vegetation communities on Erub is described below:

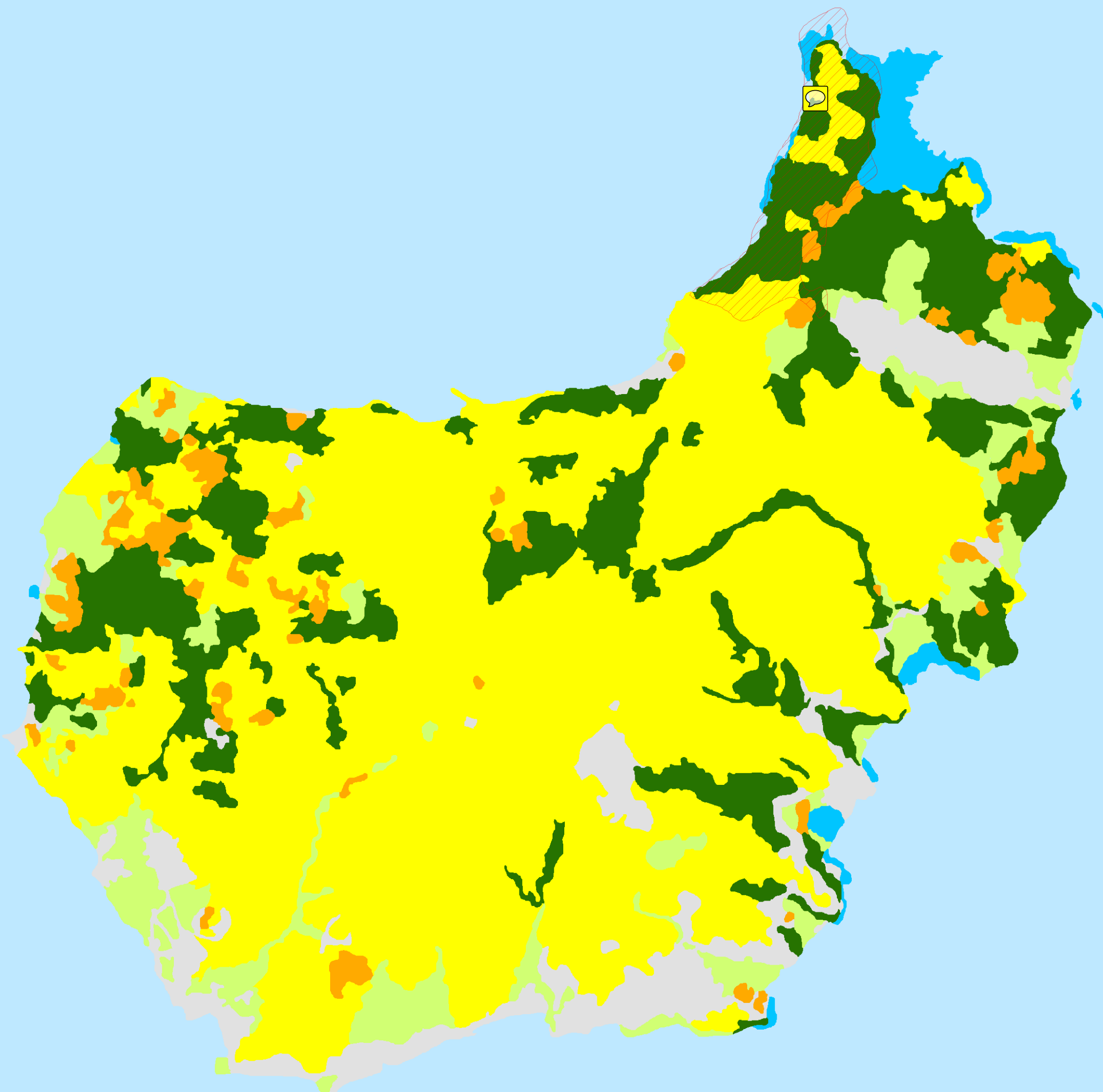
1. **Category 1 – fire sensitive non-flammable vegetation:** This includes all rainforest and advanced rainforest regrowth vegetation. These areas generally will not combust although extremely hot fire events may penetrate habitat margins, killing trees and resulting in a reduction in the habitat extent and condition.
2. **Category 2 – highly flammable vegetation:** Incorporates all grassland habitats including those affected by lantana and other types of shrubby invasion. These habitats are considered highly flammable and should be targeted as per guidelines detailed in **Section 3**.
3. **Category 3 – highly flammable vegetation – exotics:** Category 3 vegetation represents the bamboo thickets that are interspersed throughout rainforest habitats on the island. Bamboo will burn explosively with hot fires which will generally kill the plant. Hence fire should be excluded from those thickets that are considered culturally significant, particularly late in the year where risk to rainforest habitats is great.
4. **Category 4 – low to moderate flammability vegetation:** Category 4 vegetation includes mixed garden areas and exotic trees such as mango and poinciana, generally mixed with bamboo and grasses. The flammability is variable, dependent largely on the extent of grass and bamboo in the habitat. Fire should be excluded from those areas that are culturally significant.

5. **Category 5 – non-flammable vegetation:** Category 5 represents vegetation communities that will not burn under any circumstance. On Darnley, such vegetation is restricted to mangrove communities.
6. **Category 6 – infrastructure and surrounds:** Includes all clearings which may include housing and other infrastructure. Such areas should be the subject of early season asset protection burning where this is deemed necessary.

A fundamental aim of the island scale fire management program should be to instigate a shift in the current regime of a few hot late season fires which burn much of the islands flammable vegetation within a narrow window to one in which cooler, more numerous fires are burnt across a range of seasons. Begin planning for the fire season by identifying areas where cool burning within **Category 2** vegetation can be applied effectively. This would include the more expansive areas of grassland on the north west and central portions of the island where lantana occupancy is minimal. It would be beneficial to establish cool patchwork burns in these areas as minimum measure as these will limit the potential for uncontrolled wildfires to burn extensively across the island in a single destructive event. It would also be useful for longer term planning for subsequent fire seasons to identify:

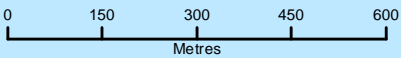
- a) Infrastructure that may be at risk during hot fire events.
- b) Other items that may be of particular importance to the community that require protection from fire. This may include cultural sites or important stands of bamboo.
- c) Sensitive rainforest or rainforest regrowth (**Category 1** vegetation) requiring protection, particularly those areas which are fringed by flammable grassland vegetation. These areas are indicated in **Map 2** although may require some refinement based on updated field information. The spatial distribution of rainforest habitat appears to have changed markedly in the period following 1999, the capture date of aerial photography used in the Torres Strait mapping project (Stanton et al, 2009).
- d) Identification of other areas where prescriptive measures tested and applied in the trial management area could be effectively employed at the broader island scale.

Map 2. Fire behaviour categories on Darnley Island



Legend

- Trial Management Area
- Category 1, Fire sensitive - non-flammable vegetation
- Category 2, Highly flammable vegetation
- Category 3, Highly flammable vegetation - exotics
- Category 4, Low to moderate flammability
- Category 5, Non-flammable vegetation
- Category 6, Non-flammable -infrastructure



Year 2015 and beyond: The long term direction of the program will depend to a large degree on the success of the program in the management trial area; the capacity of the Erub rangers to extend the techniques more widely at an island scale; and to a large degree upon acceptance of the trial program as beneficial to the island by the Erub community. As a priority, management of the trial area should continue up to and beyond the point where success can be demonstrated. Only then should more extensive application of these techniques be applied to the island at a broader scale. The program for ongoing management of the islands habitat is detailed briefly below:

February to April: Preparatory works should be undertaken adjacent to 'at risk' habitats and infrastructure that may be threatened by fire. This would include:

1. The cutting, slashing or poisoning of a fire break of 5 to 10 m wide in all flammable vegetation adjacent to threatened infrastructure. Early season burning should then focus on adjacent areas as soon as a fire will carry.
2. Spraying of lantana adjacent to sensitive vegetation types providing this is permissible.

April to end June: Early season burning should commence under the following guidance:

1. Patchwork burning should be undertaken in flammable vegetation that abuts rainforest as soon as fire will carry with ignition as close to the rainforest margins as soon as is feasibly possible. Alternatively where applicable, burning should be undertaken adjacent to the outer boundaries of areas of dead lantana. The primary aim of this burning is to reduce fuel so the late season fires will either not carry to the margins of the rainforest, or at least be of low intensity when they do.
2. Areas of advanced native regrowth vegetation which are relatively free from lantana can also be targeted for early season burning. The aim of this burning is to reduce fuel with fires of low intensity so that more advanced rainforest trees and shrubs are not killed. These areas will be protected from hot fires burnt late in the season through reduced fuel loads. With ongoing attention, these habitats will develop characteristics of more advanced rainforest habitats. Suitable areas have not been adequately identified in existing vegetation mapping.
3. Burning of grassland habitat that is relatively free from lantana should commence, targeting those areas that were not burnt in the preceding season. Starting early in the season, these burns should comprise numerous small fires that will produce burn patches rarely more than a hectare. The burning aims to produce a mosaic of burnt and unburnt patches that break up fuel loads and prevent late season fires burning extensive portions of the island landscape in a

single event. Not all grassland habitats will be capable of burning early in the season depending on fire history, aspect and composition and it may be mid-season (June to July) before all grassland habitats are capable of igniting. As a general guide, although this will vary from year to year, early season fire events should aim to burn 30 % of the islands flammable vegetation.

4. Grassland habitats that are subject to considerable thickening of lantana should be avoided during early season burns although a burning mosaic should be established in adjacent flammable habitats.

September to November: Dependent on the climate and seasonal conditions, it may be necessary to extend the early season burns through to August to establish a suitable burning mosaic, particularly in areas adjacent to sensitive vegetation or infrastructure. The following general guidelines should be applied to the late season burning regime:

1. Grassland habitats infested with dense lantana should be inspected to determine suitability for late season burning. Depending upon visual inspection, it may be recommended that burning not commence until the following season to allow fuel levels to accumulate. They should also be inspected to determine if firing risks any unnecessary impact to sensitive vegetation or infrastructure and it may be necessary to slash fire breaks where considerable risk is identified.
2. In areas of heavy infestation, it is most appropriate to burn under extreme conditions when fire will have maximum impact on lantana. This should only occur when mosaic burning has reduced fuel loads in adjacent areas and any additional fire breaks that may be required have been constructed.
3. Firing should follow principles of burning during periods of decreasing hazard (after 2 pm) and when wind is not severe.

In general, intense late season fires should account for approximately 10% of the total burning undertaken in any year. Areas not burnt should be targeted during subsequent years as governed by fuel loads and priority. Intense fires should not be attempted in the same location on subsequent years to allow fuel levels to accumulate.

At a basic level, the program should however focus on building a mosaic of burnt and unburnt country with burning commencing as soon as possible after the wet season. As the program develops, ultimately Erub's grassland habitats will not be burnt on consecutive years and expansion of lantana throughout grassland habitats on Erub will stabilise. It is also anticipated that the density of lantana in those areas subject to targeted hot fire events will begin to decrease after several cycles, although most rapidly if herbicide is used as an additional control in conjunction with fire.

5. REFERENCES

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6. APPENDIX

A1. FIRE MANAGEMENT FRAMEWORK

The essential feature of the fire management framework is that it is based on the premise that the diversity and patterns of distribution of the island's habitats are the result of the purposeful use of fire by man over perhaps thousands of years, and therefore the maintenance of these features depends, at the most basic level on the continuing presence of fire. Whilst the precise nature of traditional management cannot be determined in the absence of its practitioners, its main features are known, and the island's fire management should be guided by them. It should endeavour to create a patchwork of numerous small burnt areas by using progressive ignition throughout the year whenever conditions are suitable. It should ensure that most fires are of mild to moderate intensity, and provide the conditions under which wildfires will tend to self-extinguish before they can cover large areas. Fire management should also be prescriptive to the extent that it specifically targets those habitats that are infested with exotic weeds with the ultimate aim of stabilising the landscape and preventing continued expansion of weed occupancy.

During, or soon after the wet season, priority will be given to securing the any infrastructure by slashing, mowing and burning of fire breaks. Herbicide will also be used if permissible to kill lantana on the margins of sensitive rainforest vegetation. As soon after the wet season as fires will carry, patch burning will be carried out on the ground in those grasslands that are relatively clean (free from lantana), paying particular attention to rainforest margins. This pattern of patch burning can continue for several months until a mosaic of burnt and unburnt grassland is established in the landscape. Grassland areas with severe infestation of lantana should be excluded from the early season burning regime as cool fires may promote continued expansion of the weed. The patchwork burning undertaken early in the year should aim to reduce fuel loads across the landscape, protecting sensitive vegetation from severe late season fire events.

Late season fire events should target those habitats that are severely infested by lantana. It should however be completed in the knowledge that fuel levels across the landscape have been methodically reduced by preceding patchwork burning and that intense fires will not spread broadly across the landscape, threatening ecological diversity and amenities.

A2. FIRE MANAGEMENT STRATEGY

A2-1. General introduction to the approach to fire management

The fire management program should aim to:

- Ensure as the highest priority the protection of life and property.
- Establish an approximation of traditional burning practices by burning throughout the year, when conditions are suitable, to establish a mosaic pattern representing burns at different times of the year, and at different intensities and return intervals.
- Replace any existing fire patterns dominated by relatively few large fires with smaller more numerous ones.
- Provide the conditions under which fires can self-extinguish.
- Protect the edges of rainforests and vine thickets from scorch.
- Arrest the spread of lantana and other weeds in Erub habitats with the ultimate aim of reducing lantana occupancy in the landscape.

A2-2. Ecological description of the island

Location and Landscape: Erub Island, located 205 km ENE of Thursday Island is the largest island in the Eastern Island Group. Along with the associated islands of Mer (Murray) and Ugar (Stephens), Erub is formed by basaltic lava, the result of Pleistocene age (1.5 ma) volcanism which has resulted in the development of red, fertile soils. The island has a land area of 565 ha and rises to 150 m AHD at its highest point near the islands radio tower. There are no permanent watercourses on the island although a number of ephemeral streams and gully lines are present which flow only during heavy rainfall events.

The main settlement is located on the south-western side of the island with scattered dwellings occurring on the islands southern coastline.

Climate: Erub, as for other Torres Strait Islands is influenced by the summer monsoon (wet season) between December and March during which moisture laden north and north-westerly winds prevail. South-easterly trade winds dominate for much of the remaining months with transitional periods between April to May, and October to November. February is typically the wettest month producing on average precipitation of 243 mm out of an annual average of 1 287 mm. This can be compared to Dauan which is the driest recording station in the Torres Strait at 1082 mm and Badu the wettest at 1983 mm. There is however considerable rainfall variability on both annual and decadal cycles. Due to its location, and the regulating effect of the ocean, moderate temperatures are experienced throughout much of the year and the broader Torres Strait experiences a mean annual temperature of 27° with minimal range from 25° to 28°.

Vegetation: The island landscape is dominated by a mosaic of grassland and rainforest communities mixed with former garden areas, bamboo groves and mangrove habitats in sheltered enclaves on the island coastline. Grassland habitats contribute 58 % of the islands total area although the condition of these is variable, many infested with lantana amongst other exotic species. Rainforest habitats form 20 % of the islands vegetation which mostly occur as restricted fragments on gully heads which persist due to topographic protection from fire. The best developed rainforest habitat is located on the eastern side of the islands airstrip and appears largely undisturbed. Other communities are interspersed with groves of exotic bamboo. A map of vegetation on Erub is provide in **Map A**.

A2-3. The history of fire in the island's landscape

There is some conjecture as to whether the grassland habitats on Erub are man induced although it is almost certain that with the arrival of man, grassland occupancy on the island through man's use of fire would have been increased and the general mosaic of vegetation on the island altered considerably. It is not known when traditional burning was abandoned and there is no documentation of fire history since then. From information provided by rangers and recent satellite imagery, it is apparent that almost all flammable vegetation burns in a number of closely spaced events that occur between October and November. Whilst the late season fire regime is not ideal for biodiversity management, it has contributed to the control of lantana in the landscape and large areas of native grassland, particularly on the islands northern fall, remain relatively free from the weed.

A2-4. Specific requirements for asset protection

Specific factors that require consideration during prescribed burning are detailed in Table **A2-4** overleaf. The table is intended as a guide to information that is required and it is expected that additional detail will be added as the fire program develops.

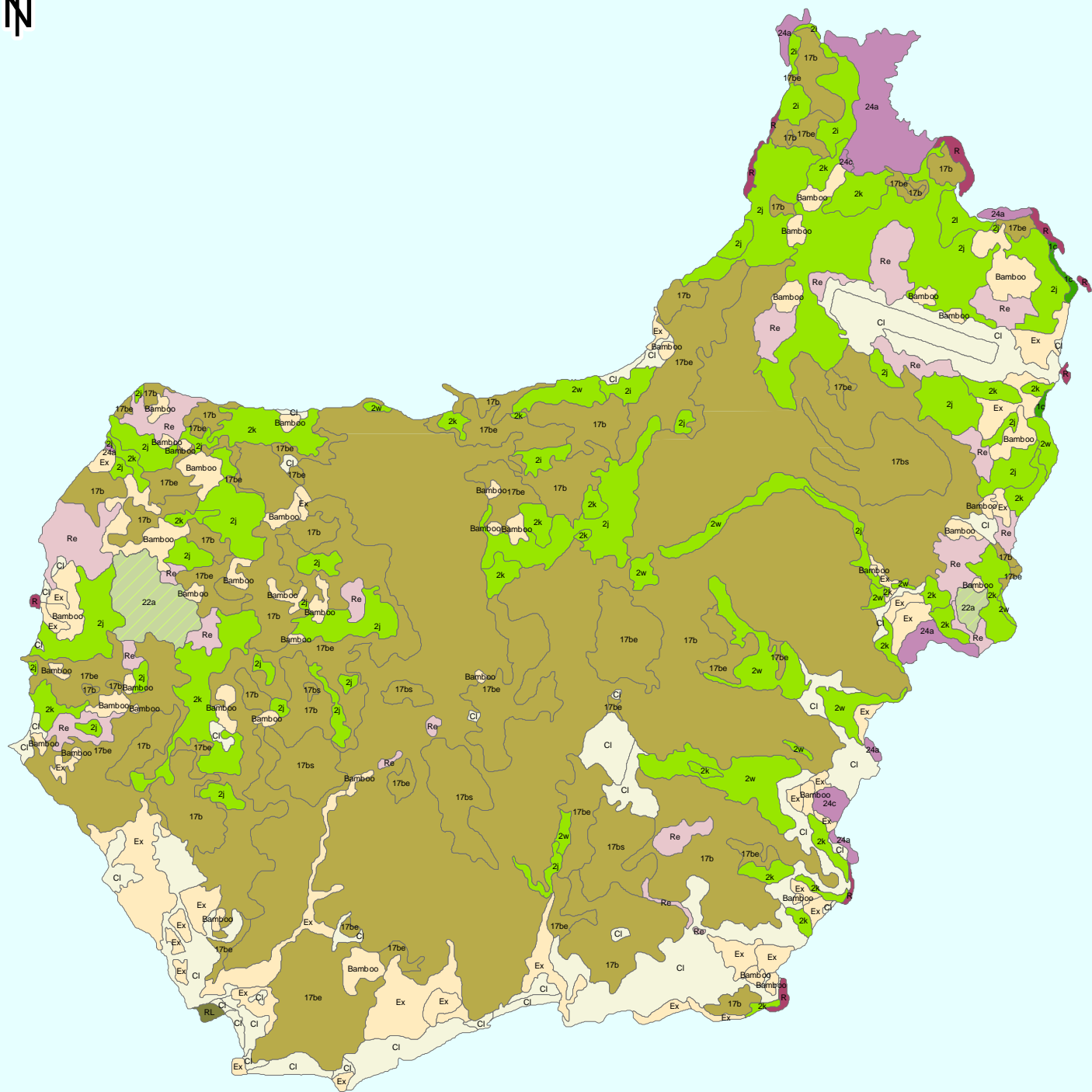


Figure Vegetation Communities and Broad Vegetation Groups of Darnley Island

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Date 26/10/2012	A4
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Evergreen vine forest and vine thicket

1c, Evergreen notophyll vine thicket (windsheared) + *Manilkara kauki* + *Celtis philippensis* + *Terminalia muelleri* + *Diospyros maritima* + *Thespesia populnioides* + *Drypetes deplanchei*. Coastal dunes.

Deciduous/Semi deciduous vine forest and vine thicket

2i, Semi deciduous notophyll vine thicket + *Berrya javanica* + *Cupaniopsis anacardioides* + *Bombax ceiba* var. *leiocarpum* + *Diospyros hebecarpa* + *Mimusops elengii* + *Melicope peninsularis*. Basalt escarpments.

2j, Semi-deciduous notophyll vine forest + *Bombax ceiba* var. *leiocarpum* + *Diospyros hebecarpa* +/- *Alectryon repandodentatus* + *Cupaniopsis anacardioides* + *Alstonia spectabilis* +/- *Melicope peninsularis*. Basalt hills.

2k, Deciduous vine forest + *Gyrocarpus americanus* + *Bombax ceiba* var. *leiocarpum* + *Antiaris toxicaria* var. *macrophylla* + *Canarium australianum* + *Cathormion umbellatum* subsp. *moniliforme* + *Garuga floribunda* var. *floribunda* +/- *Adenanthera pavonina* +/- *Maranthes corymbosa*. Basalt footslopes.

2l, Semi-deciduous notophyll vine forest + *Bombax ceiba* var. *leiocarpum* + *Gyrocarpus americanus* + *Garuga floribunda* var. *floribunda* + *Manilkara kauki* + *Diospyros maritima* + *Celtis philippensis*. Coastal dune.

2w, Deciduous vine thicket + *Garuga floribunda* var. *floribunda* + *Gyrocarpus americana* + *Bombax ceiba* var. *leiocarpum* +/- *Antiaris toxicaria* var. *macrophylla*. Escarpments on basalt and scoria cones.

Grasslands and grassland complexes

17b, *Themeda* sp. +/- *Imperata cylindrica* +/- *Mnesithea rottboellioides* grassland. Basalt hillslopes

17be, *Themeda* sp. +/- *Imperata cylindrica* +/- *Mnesithea rottboellioides* grassland (Lantana degraded). Basalt hillslopes

17bs, *Themeda* sp. +/- *Imperata cylindrica* +/- *Mnesithea rottboellioides* grassland (severe erosion). Basalt hillslopes

Anthropogenically altered (secondary) vine forest an

22a, Tall palm (*Cocos nucifera*) woodland and open forest with *mesophyll/notophyll* vine forest sub-canopy of *Myristica insipida* and *Lepidopetalum fructoglabrum*. Basalt terraces

Mangrove forest, woodland and shrubland complexes

24a, Mangrove closed and open forest, woodland and shrubland complexes (24d/24c – 80/20).

24c, *Avicennia marina* subsp. *eucalyptifolia* open to closed forest. Saline alluvial soils.

Rock

R, Rock

Exotic species

Ex, Communities dominated by exotic species

Bamboo, Bamboo thicket

Reclaimed land

RL, Reclaimed land

Regrowth

Re, Regrowth

Cleared

Cl, Cleared

Legend- Vegetation Communities and Broad Vegetation Darnley Island

Client Torres Strait Regional Authority

Scale

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Date 26/10/2012

A3

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Table A2-4. Preliminary list of assets, specific issues and requirements and contact information.

Asset	Issues	Specific Requirements	Stakeholders (to be listed)	Contact
Erub township area	Need to determine the risk flammable vegetation poses to dwellings and other infrastructure.	A program of hazard reduction burning is required to manage the risk that hot wildfire poses to dwellings.	Erub Council	
			Erub Community	
			Island Rangers	
			Rural Fires – Fire warden	
			PBC??	
Airport – including potential smoke problems	Fire poses no direct threat to the airstrip although smoke from fires has potential implications for aircraft transit.	Smaller, more frequent fires will provide lower smoke hazard than higher intensity events.	Erub Council	
			Erub Community	
			Island Rangers	
			Rural Fires – Fire warden	
			Commercial airline operations	
Powerline, generators and radio tower	The location of generators and powerlines requires consideration. Generators and powerline easements are located along major access roads and up an easement to the water storage facility. Radio tower requires asset protection	Hazard requires management around facilities including slashing of grass around generators, power poles and radio towers.	Ergon Energy??	
			Erub Council	
			Island Rangers	
			Telstra?	

Asset	Issues	Specific Requirements	Stakeholders (to be listed)	Contact
	and flammable vegetation on its margins should be the focus of early season fuel emplacement of fire breaks and fuel reduction burns.			
Water supply infrastructure	The risk that fires pose to water supply infrastructure needs to be assessed. There is a relatively well established fire break around the catchment area although maintenance may benefit from some early season burns on the perimeter to reduce thick ash fall associated with late season fires.		Erub Council	
			Island Rangers	
Cultural assets (requiring further documentation)	Cultural assets and the risk fire poses to them requires further consideration and documentation.	Fuel loads around cultural sites to be managed through slashing and early season burning of flammable vegetation.	Island Rangers	
			PBC	
Other infrastructure – bridges, signage etc.	The susceptibility of other infrastructure to fire damage needs to be established and considered in the fire program.	Mapping the location of fire sensitive infrastructure is required and considered in the burning program.	Erub Council	
			Erub Community	
			Island Rangers	

A2-5. Fire management requirements for weeds

There are a number of herbaceous environmental weeds that may benefit from targeted burning if this is followed up by chemical spraying as green shoots re-emerge. Such infestations mostly occur in disturbed lands around settlements and on access tracks and include a number of herbs and scrambling vine species such as siratro (*Macroptilium atropurpureum*), phasey bean (*Macroptilium lathryioides*) and star of Bethlehem (*Ipomoea quomoclit*) and tropical kudzu (*Pueraria phaseoloides*). Such areas should be identified and an approach to burning and subsequent herbicide treatment considered on a case by case basis.

Praxelis (*Praxelis clematidea*) has established in some locations on the island. Praxelis is particularly problematic as it regenerates rapidly after fire and may be favoured by moderate to hot fire regimes in those locations where it is currently established. The chemical spraying of regenerating plants following fire may be a viable control method.

A2-6. Management requirements for cultural sites.

A list of cultural sites is to be compiled with any specific requirement for fire management issues to be detailed.

Table A2 – 6. Management requirements for cultural sites (example - to be compiled).

Cultural Site	Location (GPS)	Specific Fire Issues/ Treatment

A2-7. Management requirements for vegetation communities.

Recommended fire regimes and treatments for vegetation communities on Erub Island are provided in **Table A2 – 7**.

Table A2 – 7. Fire behavior and recommended treatment for vegetation communities on Erub Island.

Fire Category	BVG	Vegetation Community	Description	Fire Behaviour/ Recommendations
Category 1	Semi-deciduous vine thicket (fire sensitive non-flammable vegetation) Also includes anthropogenically altered rainforest.	1c	Evergreen notophyll vine thicket (windsheared) + <i>Manilkara kauki</i> + <i>Celtis philippensis</i> + <i>Terminalia muelleri</i> + <i>Diospyros maritima</i> + <i>Thespesia populneiodes</i> + <i>Drypetes deplanchei</i> .	Hot fires will degrade rainforest, particularly where they combust adjacent grassland habitats. Preventative cool burns on the margins of rainforest habitats. Fire protection burning on margins should be initiated as early in the season as fire will carry.
		2i	Semi deciduous notophyll vine thicket + <i>Berrya javanica</i> + <i>Cupaniopsis anacardioides</i> + <i>Bombax ceiba</i> var. <i>leiocarpum</i> + <i>Diospyros hebecarpa</i> + <i>Mimusops elengi</i> + <i>Melicope peninsularis</i> .	
		2j	Semi-deciduous notophyll vine forest + <i>Bombax ceiba</i> var. <i>leiocarpum</i> + <i>Diospyros hebecarpa</i> +/- <i>Alectryon repandodontatus</i> + <i>Cupaniopsis anacardioides</i> + <i>Alstonia spectabilis</i> +/- <i>Melicope peninsularis</i> .	
		2k	Deciduous vine forest + <i>Gyrocarpus americanus</i> + <i>Bombax ceiba</i> var. <i>leiocarpum</i> + <i>Antiaris toxicaria</i> var. <i>macrophylla</i> + <i>Canarium australianum</i> + <i>Cathormion umbellatum</i> subsp. <i>monoliforme</i> + <i>Garuga floribunda</i> var. <i>floribunda</i> +/- <i>Adenanthera pavonina</i> +/- <i>Maranthes corymbosa</i> .	
		2l	Semi-deciduous notophyll vine forest + <i>Bombax ceiba</i> var. <i>leiocarpum</i> + <i>Gyrocarpus americanus</i> + <i>Garuga floribunda</i> var. <i>floribunda</i> + <i>Manilkara kauki</i> + <i>Diospyros maritima</i> + <i>Celtis philippensis</i> .	

Fire Category	BVG	Vegetation Community	Description	Fire Behaviour/ Recommendations
		2w	Deciduous vine thicket + <i>Garuga floribunda</i> var. <i>floribunda</i> + <i>Gyrocarpus americanus</i> + <i>Bombax ceiba</i> var. <i>leiocarpum</i> +/- <i>Antiaris toxicaria</i> var. <i>macrophylla</i> .	
		22a	Tall palm (<i>Cocos nucifera</i>) woodland and open forest with mesophyll/notophyll vine forest sub-canopy of <i>Myristica insipida</i> and <i>Lepidopetalum fructoglabrum</i> .	
2	Grassland (highly flammable vegetation)	17b	<i>Themeda triandra</i> +/- <i>Imperata cylindrica</i> +/- <i>Mnesithea rottboellioides</i> grassland.	Mosaic burning of clean (weed free) habitats commencing as early in the season as ignition will allow until, in most years July Habitats heavily infested by lantana should be burnt late in season once burning mosaic is established. The fire program should aim to not burn the same locations on consecutive years.
		17be	<i>Themeda triandra</i> +/- <i>Imperata cylindrica</i> +/- <i>Mnesithea rottboellioides</i> grassland (infested with <i>Lantana camara</i>)	
		17bs	<i>Themeda triandra</i> +/- <i>Imperata cylindrica</i> +/- <i>Mnesithea rottboellioides</i> grassland (subject to secondary shrubby thickening).	
3	Exotic species – bamboo (highly flammable vegetation)	Bamboo	Tall bamboo groves of varying height and extent.	Asset protection burning required adjacent to cultural assets.
4	Exotic forest (low to moderate flammability vegetation)	Ex	Forests of mango, poinciana mixed variably with native species and groves of bamboo.	Flammability varies dependent on the extent of bamboo and native grass that persists in the habitat. Asset protection burning required adjacent to cultural assets.
5	Mangrove forest (will not burn)	24a	Mangrove closed and open forest, woodland and shrubland complexes (24d/24c – 80/20).	No management required – will not burn
		24c	<i>Avicennia marina</i> subsp. <i>eucalyptifolia</i> open to closed forest.	

Vegetation communities 1: Rainforest habitats

Strategy: Protect these communities from fire damage by burning adjacent grassland habitats in moderate to cool conditions. Burning should commence as soon in the season as ignition allows. Ongoing protection from fire relies on development of a burning mosaic across the island to reduce fuel loads and limit spread of hot late season fires throughout the landscape. Where dense infestation of lantana occurs on the margins of these habitats, infestations should be over-sprayed with early season burns placed around outer margins once dead material has desiccated and surrounding grassland habitats will carry fire.

Vegetation communities 2: Grasslands

Strategy: Habitats that are free from lantana should be subject to patch burning commencing from as early in the season as ignition will occur, particularly focusing on rainforest margins. In a fully established mosaic, grassland ignition should not occur on consecutive years and up to 30%, (and occasionally higher) of the landscape should burn in any particular season.

Habitats that are severely infested with lantana should be excluded from the early season patch burning program although patch burning should be completed up to the margins to reduce fuel loads. Intense late season fires should be targeted in these areas with an ultimate aim of reducing the occupancy of lantana in the landscape. Burning should not be conducted on consecutive seasons to ensure fuel loads are sufficient to carry a high intensity fire.

Vegetation Communities 3: Highly flammable exotic vegetation – bamboo

Strategy: No specific fire regime required. Some areas may be of cultural significance and require asset protection burning where flammable vegetation abuts the margins.

Vegetation community 4: Exotic vegetation of low to moderate flammability

Strategy: No specific fire regime required. Some areas may be of cultural significance and require asset protection burning where flammable vegetation abuts the margins.

Vegetation communities 5: Mangroves – non flammable vegetation

Strategy: No specific fire management required. Will not burn.

A2-8. Management requirements for sensitive species.

Table A2-8 details specific requirements for sensitive flora species known to occur on Erub. It is fortunate that prescriptive fire management measures recommended for habitats (as above) provide the most appropriate means of managing populations of sensitive flora species. Similarly, fauna species will benefit significantly from a predominance of early cool season burns.

Table A2-8. Management recommendations for sensitive flora species

Species	Habitat requirements	Fire Management Requirements
<i>Alectryon repandodentatus</i> (endangered EPBC Act, NC Act)	Semi deciduous rainforest extending into regrowth habitats in disturbed locations.	Margins of rainforest habitats require protection from hot fire. Early season burning of flammable habitats (grasslands) adjacent to populations of this species will assist prevention of damage during hot late season fires. Care should be taken when over-spraying of lantana is undertaken to ensure this species is not adversely impacted.
<i>Neololeba atra</i> (near threatened NC Act)	Semi deciduous rainforest	As per <i>Alectryon repandodentatus</i>
<i>Apluda mutica</i>	Margins of vine thicket habitats, particularly on coastal headlands	There is limited information regarding the ecology of this species. Establishment of landscape scale vegetation mosaic burning is considered the most appropriate management action.

A2-9. Operational tasks

This section provides a checklist of items that are considered essential to delivery of fire management. Responsibilities for each task should be allotted each year and recorded in the annual burn plan.

Table A2-9. Operational requirements of the Erub Island burning program.

Requirement	Comments
Equipment inventory	A detailed list of equipment necessary for implementation of the burn program and checklist of items held by the Erub Island Rangers
Training	Essential training required for implementation of the fire program (further advice required; Mick Blackman). GIS mapping training to record burn locations.
Stakeholders	A list of all stakeholders including agencies, names and contact numbers (see Table A2-4).
Safety and emergency procedures	A full statement of emergency procedure is to be compiled. Advice is required from agencies such as the State Emergency Service / Mick Blackman).
Regulatory requirements	Advice from SES/ Mick Blackman is required in this regard.

A2-10. Monitoring and reporting

Specific requirements for monitoring and reporting on an annual basis are provided in **Table A2-10**.

Table A2-10. Recommended monitoring and reporting requirements

Requirement	Comments/ Responsibility
Establishment of photographic monitoring points	Specific photographic monitoring points need to be established at appropriate locations to detail the success of specific management actions. Guided by senior ranger/ ranger mentor with external expertise sought where required.
Fire mapping	The locations and extent of areas burnt during each fire season should be mapped for ongoing reference. Guided by senior ranger/ ranger mentor with external expertise sought where required.
Satellite mapping of fire scars	Satellite mapping of annual burns requires investigation. Currently under investigation.

Annual reporting	An annual report on the Erub Island fire program should be prepared at the completion of each burn season. This should provide a summary of areas burnt, timing, conditions as well as mapping of burn scars. Senior ranger guided by ranger mentor
Preparation of annual burn plan	To be completed prior to commencement of the annual burn program with consideration given to previous years activities.

A2- 11. Burn plans

Year 2013-2014: Trial management area: It is uncertain as to how early a start can be made to activities and details provided within describe the ideal process to be followed over an entire year. However, there are activities that can be completed regardless of how early a start can be made to the program in 2013 and such activities are indicated where possible. The activities also assume that permission has, or will be obtained to use glyphosate (herbicide) in the trial management area. If permission to use this herbicide is denied, an alternative approach that uses fire as the sole means of control will need to be considered. It should be noted that the aim of the management program in this area should be ultimately to:

3. Arrest the consumption of grassland habitats by lantana.
4. Promote the expansion of rainforest margins into grassland habitats until a relatively stable equilibrium and firm boundaries between the two habitats is established.

The ideal management approach to achieve these aims is described below with any potential deviations from the ideal noted:

8. From early in the season, a manageable area should be identified for lantana control with the use of herbicide. This may be the entirety of the trial management area if resources are sufficient to the task or more likely a smaller suitable area chosen from within the management block.
9. Over-spraying of lantana thickets should concentrate on areas where it forms a dense fringe to intact rainforest habitats and should be undertaken a minimum of a month before the first burns are affected (generally in March although can be completed prior to this). The full width of the infestation should be sprayed if possible and it may be beneficial to spray from the margins of the vine thicket outwards as well as inward from the outer margins of the lantana thicket.
10. Once lantana has died, which should take little more than a month when sprayed during the growing season of February to March, and grassland habitats are

capable of carrying fire, a cool burn should be placed on the interface between the dead lantana thicket and the adjoining grassland areas. This should be completed by walking the interface continuously lighting small patch fires. The aim of the cool burn is to establish a fire break so that hot fires burnt late in the season will not penetrate the dead lantana, destroying any rainforest regrowth and potentially damaging the intact rainforest margins.

11. Should the use of herbicide not be permissible, step 3 should be undertaken in any case in an attempt to establish a buffer to reduce the detrimental impact of any hot late season fires. Hot fires in this case may kill lantana, although it is likely to regenerate rapidly in the following season. Hot fire will also destroy any regenerating rainforest shrubs so the best outcome that could be hoped for would be a prevention of continued expansion of the lantana thickets on rainforest margins.
12. Depending on the success of the early season burning program, a subsequent phase of early season burning may be required to increase or more firmly establish the buffer between grassland and rainforest habitat types. The requirement for this will be dependent largely upon season.
13. Depending on seasonal conditions, hotter late season fires should be driven through vestiges of degraded grassland that retain sufficient fuel to carry fire. This should only be undertaken when early season burning has effectively established a fire break, isolating as much as possible areas of combustible grassland from dry thickets of dead lantana. Without establishment of the break, there is potential for hot fires to push into and damage the rainforest margins. These fires should be considered for the period from July through to around the end of October. Ultimately over several seasons, repetitive fires will reduce the occupancy of lantana within the grassland habitats.
14. To reinforce the effectiveness of a burning event, regenerating lantana shrubs can be selectively sprayed prior to re-establishment of dense grass cover.

Year 2014 to 2015: Methods employed during the initial year in the trial management area should be evaluated to determine areas where improvements to the program can be made. It will be particularly important to reinforce any weed control undertaken with the use of herbicide although any areas that were subject to hot fires will need to be rested for a season, allowing fuel levels to accumulate to levels that will support sufficiently intense late season fires. Hence it may be necessary to extend the management principles developed during the first year to another portion of the trial management area.

It would also be beneficial, with resting of the island landscape for a season, to consider expansion of the program to the management of habitats in the broader Erub landscape. Discussion in this regard is provided below. Habitats on Erub are highly sensitive to changes

in fire regime and structural changes in vegetation will be noticeable in years rather than decades as might be expected on the larger continental islands of Mua and Badu. The impact that invasive species are having on Erub's habitats also requires that a fire program be more prescriptive, focused to a large degree on specific issues. The fire behaviour categories for vegetation communities on Erub is described below:

7. **Category 1 – fire sensitive non-flammable vegetation:** This includes all rainforest and advanced rainforest regrowth vegetation. These areas generally will not combust although extremely hot fire events may penetrate habitat margins, killing trees and resulting in a reduction in the habitat extent and condition.
8. **Category 2 – highly flammable vegetation:** Incorporates all grassland habitats including those affected by lantana and other types of shrubby invasion. These habitats are considered highly flammable and should be targeted as per guidelines detailed in **Section 3**.
9. **Category 3 – highly flammable vegetation – exotics:** Category 3 vegetation represents the bamboo thickets that are interspersed throughout rainforest habitats on the island. Bamboo will burn explosively with hot fires which will generally kill the plant. Hence fire should be excluded from those thickets that are considered culturally significant, particularly late in the year where risk to rainforest habitats is great.
10. **Category 4 – low to moderate flammability vegetation:** Category 4 vegetation includes mixed garden areas and exotic trees such as mango and poinciana, generally mixed with bamboo and grasses. The flammability is variable, dependent largely on the extent of grass and bamboo in the habitat. Fire should be excluded from those areas that are culturally significant.
11. **Category 5 – non-flammable vegetation:** Category 5 represents vegetation communities that will not burn under any circumstance. On Darnley, such vegetation is restricted to mangrove communities.
12. **Category 6 – infrastructure and surrounds:** Includes all clearings which may include housing and other infrastructure. Such areas should be the subject of early season asset protection burning where this is deemed necessary.

A fundamental aim of the island scale fire management program should be to instigate a shift in the current regime of a few hot late season fires which burn much of the islands flammable vegetation within a narrow window to one in which cooler, more numerous fires are burnt across a range of seasons. Begin planning for the fire season by identifying areas where cool burning within **Category 2** vegetation can be applied effectively. This would include the more

expansive areas of grassland on the north west and central portions of the island where lantana occupancy is minimal. It would be beneficial to establish cool patchwork burns in these areas as minimum measure as these will limit the potential for uncontrolled wildfires to burn extensively across the island in a single destructive event. It would also be useful for longer term planning for subsequent fire seasons to identify:

- e) Infrastructure that may be at risk during hot fire events.
- f) Other items that may be of particular importance to the community that require protection from fire. This may include cultural sites or important stands of bamboo.
- g) Sensitive rainforest or rainforest regrowth (**Category 1** vegetation) requiring protection, particularly those areas which are fringed by flammable grassland vegetation. These areas are indicated in **Map 2** although may require some refinement based on updated field information. The spatial distribution of rainforest habitat appears to have changed markedly in the period following 1999, the capture date of aerial photography used in the Torres Strait mapping project (Stanton et al, 2009).
- h) Identification of other areas where prescriptive measures tested and applied in the trial management area could be effectively employed at the broader island scale.

Year 2015 and beyond: The long term direction of the program will depend to a large degree on the success of the program in the management trial area; the capacity of the Erub rangers to extend the techniques more widely at an island scale; and to a large degree upon acceptance of the trial program as beneficial to the island by the Erub community. As a priority, management of the trial area should continue up to and beyond the point where success can be demonstrated. Only then should more extensive application of these techniques be applied to the island at a broader scale. The program for ongoing management of the islands habitat is detailed briefly below:

February to April: Preparatory works should be undertaken adjacent to 'at risk' habitats and infrastructure that may be threatened by fire. This would include:

1. The cutting, slashing or poisoning of a fire break of 5 to 10 m wide in all flammable vegetation adjacent to threatened infrastructure. Early season burning should then focus on adjacent areas as soon as a fire will carry.
2. Spraying of lantana adjacent to sensitive vegetation types providing this is permissible.

April to end June: Early season burning should commence under the following guidance:

1. Patchwork burning should be undertaken in flammable vegetation that abuts rainforest as soon as fire will carry with ignition as close to the rainforest margins as soon as is feasibly possible. Alternatively where applicable, burning should be undertaken adjacent to the outer boundaries of areas of dead lantana. The primary aim of this burning is to reduce fuel so the late season fires will either not carry to the margins of the rainforest, or at least be of low intensity when they do.
2. Areas of advanced native regrowth vegetation which are relatively free from lantana can also be targeted for early season burning. The aim of this burning is to reduce fuel with fires of low intensity so that more advanced rainforest trees and shrubs are not killed. These areas will be protected from hot fires burnt late in the season through reduced fuel loads. With ongoing attention, these habitats will develop characteristics of more advanced rainforest habitats. Suitable areas have not been adequately identified in existing vegetation mapping.
3. Burning of grassland habitat that is relatively free from lantana should commence, targeting those areas that were not burnt in the preceding season. Starting early in the season, these burns should comprise numerous small fires that will produce burn patches rarely more than a hectare. The burning aims to produce a mosaic of burnt and unburnt patches that break up fuel loads and prevent late season fires burning extensive portions of the island landscape in a single event. Not all grassland habitats will be capable of burning early in the season depending on fire history, aspect and composition and it may be mid-season (June to July) before all grassland habitats are capable of igniting. As a general guide, although this will vary from year to year, early season fire events should aim to burn 30 % of the islands flammable vegetation.
4. Grassland habitats that are subject to considerable thickening of lantana should be avoided during early season burns although a burning mosaic should be established in adjacent flammable habitats.

September to November: Dependent on the climate and seasonal conditions, it may be necessary to extend the early season burns through to August to establish a suitable burning mosaic, particularly in areas adjacent to sensitive vegetation or infrastructure. The following general guidelines should be applied to the late season burning regime:

1. Grassland habitats infested with dense lantana should be inspected to determine suitability for late season burning. Depending upon visual inspection, it may be recommended that burning not commence until the following season to allow fuel levels to accumulate. They should also be inspected to determine if firing risks any

unnecessary impact to sensitive vegetation or infrastructure and it may be necessary to slash fire breaks where considerable risk is identified.

2. In areas of heavy infestation, it is most appropriate to burn under extreme conditions when fire will have maximum impact on lantana. This should only occur when mosaic burning has reduced fuel loads in adjacent areas and any additional fire breaks that may be required have been constructed.
3. Firing should follow principles of burning during periods of decreasing hazard (after 2 pm) and when wind is not severe.

In general, intense late season fires should account for approximately 10% of the total burning undertaken in any year. Areas not burnt should be targeted during subsequent years as governed by fuel loads and priority. Intense fires should not be attempted in the same location on subsequent years to allow fuel levels to accumulate.

At a basic level, the program should however focus on building a mosaic of burnt and unburnt country with burning commencing as soon as possible after the wet season. As the program develops, ultimately Erub's grassland habitats will not be burnt on consecutive years and expansion of lantana throughout grassland habitats on Erub will stabilise. It is also anticipated that the density of lantana in those areas subject to targeted hot fire events will begin to decrease after several cycles, although most rapidly if herbicide is used as an additional control in conjunction with fire.

Table A2-11. Fire management program checklist (example)

Action	Responsibility	Date Achieved
<ul style="list-style-type: none"> Has equipment been checked and serviced, and will it be adequate for the planned program? 		
<ul style="list-style-type: none"> Have all necessary approvals and permits been obtained, and relevant people advised? 	Is there a fire warden? Is Council approval needed?	
<ul style="list-style-type: none"> Has communication gear been tested and a communications protocol put in place? 	Does communication gear have to be purchased? Might need to identify a consultant to advise on this.	
<ul style="list-style-type: none"> Are adequate maps available? 	Consult with 3D Environmental / TSRA GIS section on this.	

Action	Responsibility	Date Achieved
<ul style="list-style-type: none"> Are safety and emergency plans in place? 		
<ul style="list-style-type: none"> Have those involved been briefed on the requirements of the burn plan, on safety and emergency plans, and trained in the use of equipment? 		
<ul style="list-style-type: none"> Has responsibility for post burning season reporting been allocated? 		

