PROFILE FOR ECOLOGICAL FIRE MANAGEMENT OF BADU ISLAND

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1. INTRODUCTION

This is the second of two reports prepared to address the matter of developing purposeful and systematic fire management programs for the two large adjoining islands of Moa and Badu. 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.

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).

The report for Moa Island was prepared first because it was considered that the path to achieving island wide fire-management there would be a more complex one, and that most of the principles developed for it would be applicable to Badu Island. This has proved to be so, and many of the sections of the Moa Island report that relate to the theory and preferred direction of prescribed burning have been transcribed without alteration to this report. The precise objectives presented in each report are, however, very different.

The more comprehensive report for Moa Island is due largely to the greater complexity of the island’s habitats and landscape, the greater difficulty of access for large parts of it, and not least to the fact that the recent fire history of Badu seems to indicate that it has been subject to much more systematic, regular, and widespread burning, than has Moa, where a large part of the island does not appear to have been regularly burnt.

Badu Island is a close neighbour of Moa and the two together form part of a fascinating landscape of mountains and a surrounding sea studded with islands and reefs. They sit at the heart of one of the great natural areas of the world, rimmed to the north by the lofty mountains of New Guinea, to the south by the vast wild lands of northern Cape York Peninsula, and to the east by the northern limits of the world’s greatest coral reef.

Both islands have mostly intact natural environments and sit in what has been identified as one of the most pristine parts of the world’s oceans. For this the thousands of years of stewardship of the area by the people of the Torres Strait must take much of the credit.

1.1 The Need for Fire Management

The vegetation of Badu Island, as we see it today is shared with that of Cape York Peninsula and is the end product of at least 60 million years of evolution that has seen gradual but

Photograph 1. A broad mosaic of woodlands, shrublands and wetlands on Badu Island.

continual change in its structure and species composition. That change was imposed by changing climate and changing landscape as mountains formed and were eroded, and the sea rose and fell. Ever present however, was fire, first ignited by lightning, and then by the firestick of man. Its influence would always have been dramatic as it sifted from the landscape those species which could not tolerate its varying regimes of frequency and intensity, and favoured others more tolerant. The arrival of man would have brought the most dramatic and rapid changes of all as infrequent but hot and widespread fires were replaced by frequent numerous and smaller ones. 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.

It seems certain that, in the last century or so, much that was traditional in the way fire was used on the island has largely been abandoned, and undoubtedly the island’s vegetation has changed as a result. That these changes have clearly not been dramatic would be due to the fact that most of the landscape is still subject to fire at fairly regular intervals. It seems, however, from advice provided by rangers Troy Stow and Frank Nona, that the emphasis in

burning has now shifted to late in the year, in contrast to a beginning of such activities soon after the wet season which once would have prevailed.

In spite of the changed emphasis, under the current fire regime the island's habitats are being maintained, and appear to be in what, by any comparison with similar habitats elsewhere, could be described as excellent condition. If it were possible (and while the island remains inhabited it would certainly not be) to remove the influence of fire from the island altogether, change, far more dramatic than that brought by the arrival of man, would be initiated. From what the writer has seen of the effect of withdrawal of fire for 70 years and more, over thousands of square km of eastern Cape York Peninsula, it is clear that the loss of regular fire from the islands' vegetation would, in a few decades, initiate change in most of its habitats that would be unpredictable but make it very different in structure and species composition from that at any stage when man was present. In the taller forests and woodlands on the better soils those changes would be irreversible. In total, because the speed of change would not allow what would have happened in past ages to occur, and that is the gradual adaptation of species to their changing environment, and the evolution of new species, the end result would be a significant loss of habitats and many species of plants and animals.

1.2 The Situation Elsewhere

Comparable habitats to those on Moa are found covering large areas of Cape York Peninsula. Their condition varies according to what part of the Peninsula they are found in, but most of them are in poorer condition.

The writer's comments are made on the basis of experience in working on Cape York Peninsula with both the Queensland Department of Forestry and the Queensland National Parks and Wildlife Service, at various periods spanning almost 40 years, but mostly concentrated between 1972 and 1997. His responsibilities involved initially exploratory surveys and later land management of areas acquired as National Parks. During that period it was possible to observe the effects of the extremes of fire regimes over vast areas of countryside. Except for the situation on some National Parks fire was mostly unmanaged.

Over large areas of north-eastern Cape York Peninsula, fire had disappeared with the removal of aboriginal influence during the 1930's and 1940's. Over most of the remainder of the Peninsula, however, a wildfire regime prevailed, with individual fires burning for weeks or months during the drier and hotter part of the year. In the former situation, the wildfires burning on the western side of the Peninsula never penetrated because they came against barriers of numerous rainforest lined creeks. As a consequence fire sensitive species, such as those found in rainforest, and cypress pine, have invaded former open forests and changed them to closed forests that will no longer carry fire. Where late season hot fires prevail they are destroying hollow trees, so essential for many species of wildlife. In addition

these fires destroy most of the litter layer which protects soils from the erosive power of the first storms. Many parts of the Peninsula are also subject to pressure from grazing animals, both domestic and feral, which has altered or destroyed the ground cover vegetation in wide areas around streams and wetlands, facilitating erosion and invasion by weeds.

It is a remarkable observation that, because of a better fire regime over a long period of time, the absence of significant grazing pressure, and freedom from invasion by exotic weeds, that the diverse habitats of the insignificantly small Badu Island when compared to the vastness of Cape York Peninsula, are now some of the best examples to be found in relation to pre-European condition. The reason for this is clearly that the island has remained populated since European contact, and has not developed a grazing economy. Much of Cape York Peninsula is now what it has not been for possibly 40,000 years or more, a wilderness – a land which has lost its people, and its natural landscapes have suffered accordingly.

1.3 The Value of Effective Fire Management

It is clearly established that most Australian vegetation has evolved with fire and that the particular expression of any habitat (vegetation type) at any time, is, in the absence of disturbance such as clearing or heavy grazing, or the short term effects of cyclonic wind, determined by its fire regime. 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 recognized 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 recognized 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. This does not, however, apply to Badu Island. Here, because regular fire has been retained and the island's environment has not been significantly degraded by the factors referred to above, there is an opportunity to re-establish traditional practices. It is an opportunity shared only with the more remote parts of northern Australia, but currently being seized only in few areas in central Australia and in Arnhem Land. On Badu and Moa Islands, and a number of other islands of the Torres Strait, most particularly Badu, there is a unique opportunity to demonstrate what high quality land management in the high rainfall (+ 1,500mm/annum) section of north-eastern Australia should be, using the power, precision, and skills of traditional burning.

1.4 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 they 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 logic of the last feature is clear if one looks at it from the perspective of people who lived with fire. They camped with fire, and they carried the fire stick with them wherever they went. They could not safely tolerate conditions in which a stray spark could ignite a large and uncontrollable fire. Clearly, they could not have survived under the current conditions in the bush in most of southern Australia.

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 BADU ISLAND

The precise direction of fire management on Badu will have to depend on some measure of community consensus, and 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.

The alternatives for fire management on Badu Island are threefold:

a) To let things continue as they are;
b) To attempt, in part of the island or all of it, to permanently remove fire from the landscape;
c) To establish purposeful fire management over part or all of the island.

Dealing with each or all of these in turn:

a) It is acknowledged that the island's habitats are generally in good condition, and the question would naturally arise, if that is so, as to what purpose would trying to change things serve? That question is addressed below.

From the information provided by the rangers it appears that the island is regularly burnt by a number of people, and that there is a system to that burning. It appears to have been coordinated to the extent that there is some agreement that the burning should be done during the month of October, or at least after about the end of September.

The condition of the habitats examined on the island by the writer indicates that the current system has managed to stabilize the majority of them against the kind of widespread change that is so evident in similar habitats over large parts of Cape York Peninsula. There is, however, evidence that some parts of the landscape are managing to escape regular fire and tree and shrub species are thickening in the understory as a result.

The current system could be improved. The main problem with it is that it is imposing a fairly uniform burning pattern over large parts of the island. This is the antithesis of what would have happened under a traditional burning regime which would have consisted of numerous relatively small fires and resulted, in contrast to the uniform patterns currently prevailing, in a mosaic of patches with varying levels of fuel accumulation. The current fire regime is not providing the variety in the landscape essential for long-term survival of all species of plant and animal that are now part of it. A particular threat to the reproductive cycle of many species would certainly arise from the confinement of most fires to the same narrow calendar time each year. It also seems likely that while accessible localities along the valleys, coastal areas, and flats are being regularly burnt, that fires have been much less frequent in the large areas of rugged hill country. An ideal fire-management program would spread regular attention to all parts of the island.

Clearly, the situation could be improved, and the maintenance of the various habitats of the island, for whatever purpose is determined, can only be guaranteed by having clear goals and acting to attain them. In brief, to let things continue as they are would be to rely on continuing good luck and thus to gamble with the future.

b) It is a fact that cannot be avoided that in the island situation, dominated by fire derived and fire prone vegetation, and with a resident population, it would be impossible to permanently exclude fire from the island or any large portion of it. All it would do would be to 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. Such attempts would also destabilize the island's habitats, which, under a new fire regime would begin to change in numerous ways, largely predictable, but varying in degree and type according to the habitat considered.

c) To take charge of the island's future by actively managing fire throughout its habitats would seem to be the most appropriate of the three options to pursue, and it would best be done by trying to re-establish traditional practices as far as they can be determined or assumed to have been. It would have the clear benefit on top of those to the island's habitats, of necessitating the development of a detailed knowledge of the island, which in turn would foster much interest in it and a greater sense of ownership among those participating.

2.1 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) Patch or Mosaic Burning

Central to all recommended actions is the concept of patch or mosaic burning. This has been touched upon in previous sections of this report but is described more fully in the following paragraphs.

In pre-aboriginal Australia lightning was the main source of ignition and individual fires would have burnt over large areas. The aborigine tamed the lightning; he had to. By managing the fuel around him he deprived lightning of its potency, and guaranteed security for himself and his food resources. He turned the landscape into a mosaic of numerous cool fires where previously few fires but large and hot ones would have raged, fed by accumulations of fuel over large areas, and ignited by the lightning of dry summer storms. The later arrival of people in the Torres Strait would have initiated the same process there and given Badu, and some other islands, the inheritance of habitats, plant species, and wildlife they have today, and which, unlike in most parts of Australia where massive change to the natural landscape has occurred, are still recognizable as that pre-European legacy.

The long-term protection of that legacy demands a return to traditional burning as the only way to guarantee its long term survival, and on Badu Island, as on so few places on mainland Australia, such a return, if that is what is wished, is still possible.

The question of fire management is often approached from the point of view of the requirements of individual species, usually high profile species rare, or representative in their life history of a large number of species within a particular habitat. This then usually leads to prescriptions concerning appropriate fire return intervals and assumes a high level of control of the way in which fire behaves in the landscape in contrast to the element of chance that is inherent in traditional burning practices. There are several problems that arise from the application of this approach. The first is that there might be dozens of species in any particular habitat, and nowhere in Australia is it likely that there have been detailed studies of the life histories of more than a few of them. In the case of Badu Island it is unlikely that any species has been appropriately studied in any depth. Secondly, to apply the knowledge of individual species requires a large measure of control over the return interval of fire and its seasonal timing in individual habitats. In most places, and certainly on Moa Island where there is a large number of habitats intimately mixed, this would not be possible without the construction of many kilometers of fire breaks, which would be very costly and immensely

destructive to the island's environment. A third consideration is that for every species that is advantaged by a particular fire regime, another could be disadvantaged, and this observation is as equally valid for animals as it is for plants.

A more useful approach to protection of individual species is to manage to maintain in healthy condition the habitat that supports them. It is far simpler to establish plots to monitor trends in habitat condition and population numbers of target species than it is to elucidate the life histories of a number of species.

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.

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, and impatience to begin with one brings to the task no fire management plan, no matter how prescriptive and detailed, can achieve its aim without those involved having 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 its geography.

Thus achieving the goal of effective fire management for the whole island must of necessity involve several steps. First, the development of a broad plan for the whole island, secondly the development of short term goals on the way towards achieving implementation of effective management of the whole island, and, before beginning on field implementation, the development of an understanding of fire behaviour and knowledge of the island among those taking part if these things are not already there.

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 but the process for achieving that, if it is possible, is a subject that the writer of this report is not qualified to address. 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. GUIDING PRINCIPLES FOR PROGRESSION TO THE ESTABLISHMENT OF EFFECTIVE FIRE MANAGEMENT OF THE ISLAND AS ONE UNIT.

An approach to ecological fire management for Moa Island, presented in conjunction with this one, proposed a cautious approach to full implementation of a plan that treated the whole island as one unit. It involved confining operations over three years to a process of training, and gaining knowledge, and confining field operations to clearly defined parts of the island which in total, represented only a small proportion of it, yet nevertheless contained very much of the island's habitat complexity, and more than a proportionate share of the practical issues that would arise from its overall management. That approach was designed to build competence and confidence in ranger staff while testing the limits of what they could achieve with the resources available to them.

Those principles have guided the production of this plan for Badu Island which, however, takes a different pathway to that for Moa Island in recommending a shorter and less complex

route to full fire management across the island's habitats. This arose from significant differences between the two islands in a number of different ways.

First, there is the history of recent burning. As far as could be determined from the limited time available for inspection of both islands it was concluded that more people had been involved in burning on Badu, and in a more regular and systematic way than was occurring on Moa. On both islands most of the habitats accessible from the tracks had been recently burnt, but it seems likely from the nature of the topography of both islands that large areas would have missed burning in those fires. Secondly, Moa is a much larger island, with poorer access even to the large areas of gentle topography, and the physical task of ground operations is commensurately larger, as is the task of familiarization with its habitats. Adding to that the complexities of managing the large area of fire prone hills surrounding St Pauls, and the existence of two settlements, and the more gradual approach recommended for Moa Island is justified.

3.1 The Ultimate Goal

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 to promote long-term stability in its natural habitats, and would promote maximum biodiversity. It would closely approach but not achieve traditional management because of the essential difference that it would never have enough people on the ground to carry it out, and would no longer be guided by the precise timing and customs handed down from generation to generation. It should, however, in the present situation be the best that can be achieved.

It would have the following features:

i. It would adopt mosaic burning practices in all habitats that will carry fire with the timing of ignitions and their intensity varying according to fuel types.

ii. As soon after the wet season as fire will carry (April-May in most years) burning will begin in those habitats where fuel accumulates most rapidly and there is the greatest potential for fire scorch in sensitive habitats. These areas are the grasslands, and forests and woodlands with a tall grass understory.

    The ability to start early burning in these areas depends on having a large percentage of it with at least two years fuel accumulation. Without that there is a risk that the initiation of a program to break up fuel across these areas might have to be delayed so late in the year that fires in them will spread far into parts of those areas with more sparse ground cover. This would risk the desirable orderly progression of burning across the landscape and run the risk that fires in the first target area might cover a wider area than desirable.

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, therefore, be to have burnt an average of one third to one half of the target habitat per year. Experience with burning in these communities 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.

It should be noted, however, that with all average figures there can be some extreme variation away from the mean. 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%.

iii. Once on the ground efforts in the grasslands and grassy forests and woodlands with a tall grass ground cover have indicated that fires will carry, it would be useful to supplement the efforts of ranger staff by the use of a helicopter to drop incendiaries throughout them, and particularly targeting the margins of rainforest. The intensity of ignition will have to depend on the judgement of ranger staff involved and once again their ability to do that effectively will grow with experience. In most years suitable conditions for this work should arise in the months of May to early June.

iv. Once burning in areas with a heavy grass cover is well advanced in its coverage of the ground (once again only the judgement of experienced rangers can determine this point) then attention should turn to those woodlands and forest areas of moderate to sparse ground cover. In these areas burning should start with widely spaced on the ground ignition in areas that can be easily accessed on foot or along roads and tracks. If the results of this are considered to be poor then consideration should be given to using a helicopter for further ignition in these areas. The appropriate timing for that operation in most years would be from June to mid August. Because these areas accumulate fuel relatively slowly and are not subject to rapid change in the absence of fire, the intensity of ignition patterns should not be as high as in those areas with a tall grass cover. These areas of moderate to sparse

ground cover contain a variety of communities with significant variation in the way in which fire behaves within them and generalizations as to the percentage of the area that should be covered by fire in any one year are not useful. More useful would be an analysis of the area covered by individual fires. If one, or only a few fires, burnt more than half the total area in any one year, that would be a clear indication of a need to review, and if necessary, revise practices in the following years.

Photograph 2. An early season test fire lit in heavy grass cover on the edge of rainforest. It self-extinguished soon after the photo was taken on 26 April 2012.

v. The swamp forests are relatively small in size and widely spread. Even though they hold water for part or all of the year they continue to build up fuel above the waterline from fallen leaves (particularly pandanus leaves) and from dying leaves of sedges, ferns and grasses. Unlike the grasslands and grassy forests which quickly attain a maximum level of fuel accumulation where the rate of accumulation is balanced by rates of decay, these swamp forests appear to be capable of continuing to accumulate fuel for many years and can of support very hot fires even while they hold water.

Hot fires are unlikely to threaten the survival of these communities but where peat layers have developed in their surface soils they can be in danger during extreme drought events if the peat completely dries out. There is no management regime that can completely guarantee security for these areas but a high level of it can be attained by effectively managing fuel in surrounding areas, and by burning them periodically to avoid heavy accumulations of fuel.

Photograph 3. Heavy ground cover consisting of grasses, ferns, and vines in a melaleuca dominated swamp forest, an estimated two years since the last fire. Clearing a small patch of this (in the foreground) revealed a soil surface layer which consisted of decomposing grasses and leaf litter above a wet layer of fibrous peat.

Because of variations in the nature of the swamp forests in relation to the ground cover (or lack of it) within them, and the type of litter fall, decisions on whether or not, and when to burn them in any year can only be made after ground inspection. Even those prone to develop the most heavy accumulations of fuel can be safely allowed to go 4 years or more without fire, provided they are burnt at a time when there is water near or above the ground surface.

Knowledge of where these swamp forests are located, and inspection of them at no more than 3 year intervals is required (see **Map 1**, **Section 4**).

vi. Shrubland communities, and communities of rock pavements pose some peculiar problems for management which varies with geographical location and often defy precise prescription. Within this category are communities which will only burn after many years of accumulation of fuel, and then with ferocity, and other areas which because of a rocky ground surface will not burn under most circumstances. There are also areas which carry enough ground cover to support regular light fires. When they are mixed together, the problem is compounded.

Because shrubland communities change only slowly with time since burning there is little point in persisting with attempts to burn them under conditions in which fires will only trickle through them. More often than not they will only burn fiercely or not at all,

and in the welchiodendron dominated shrublands it is likely that large areas of them will not burn.

The shrubland communities dominated by *Asteromyrtus brassii*, on old dunes and some rocky foothills, will continue to accumulate fuel loads for a decade or more, and as that happens the time at which they will easily ignite and burn hotly will gradually shift from late season to cooler times of the year. There is a risk to surrounding communities if they are burnt late in the year. If a late burn is decided upon it will have to be planned a year in advance so that burning of those surrounding communities can begin early in the year.

vii. Affecting most of the matters referred to above are some issues, practices, and principles which are important enough to draw together at this point so that their significance is not lost by being diffused throughout the report.

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 regrowing shrubs and small trees.

The presence of significant numbers of grazing animals (horses and cattle): These could be very destructive of soil and habitat values if they concentrate on small patches burnt early in the season. In large enough numbers they would diminish the ability to carry out the fire management programs recommended in this report.

Fires lit by hunters: No attempt was made to determine how the proposals of this report would affect their practices, and whether or not this could be an issue affecting the whole program.

Burning on a declining hazard: 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.

4. A PROPOSED FIRE MANAGEMENT PROGRAM FOR BADU ISLAND

It is acknowledged that the natural habitats of Badu Island are mostly in very good condition, particularly when compared with similar habitats on Cape York Peninsula. The main reason for this is that regular fire has been maintained in much of the landscape. Whether or not the importance of that action for survival of those habitats is realized the people involved in it must be given credit for the appropriateness of their actions in the situation in which they have found themselves. Even from the perspective of the far from adequate examination of the island which has led to the production of this document, however, it is clear that fire management of the island could be improved.

In the habitat management profile (3d Environmental 2012) for the island emanating from comprehensive field work and production of a major report entitled Vegetation Communities and Regional Ecosystems of the Torres Strait Island,, D. Stanton and D. Fell (2009) make reference to observing places on Badu Island where vegetation thickening is occurring as a result of lack of fire. Of specific concern was the habitat of the plant *Costus poteriae* which is listed “Endangered” under Queensland and federal legislation, and its favoured habitat is along the margin of swamp forests. The implication of these observations is that fire management needs to be much more prescriptive, and extended more meticulously across the landscape.

The information that most, if not all burning was confined to late in the year, focusing on the month of October, leads to the inevitable conclusion that it is not ideal for biodiversity management. The ideal situation for that is spelt out in PART II of this report. There is a need to extend burning more widely during the year, focusing particularly on the early dry season.

While fire may be missing some important parts of the landscape there is also a likelihood that it has been or has the potential to be, damaging to others. Some of the dune complexes, involving mosaics of vine thickets, woodlands, shrublands and grasslands were reported as degraded by fire, in the habitat management profile, and one examined near Argan in a recent inspection was certainly in poor condition. Others examined, however, were noted to be in good condition, but the potential for problems was there with any changes in land management and access in particular. Some indication of potential problems in the swamp forests and areas on their margin was also noted with fire-killed trees prominent in one location.

4.1 Proposed Program for Year 1 - 2012

There is a high potential for fire to damage or destroy houses and infrastructure in and around the Badu township. The danger posed by flammable swamps surrounded by long grass that

abuts backyard wooden fences, and even flammable material close to houses, is severe. Clearly, the people of Badu are familiar with fire and comfortable with such surrounds, but there must be an element of luck in the fact that there has been no disaster to date.

Establishing an island wide fire management regime as recommended in this report will not be an easy process of putting something in place where nothing existed before. It will involve the difficult task of taking an existing system and improving it with some radical shifts in extent and timing. The rangers do not have the power to impose change and will therefore have to try to obtain community support, and however that is achieved it will be easier if the community has confidence in their professional abilities. For that reason therefore, although it would add an extra burden of responsibility that their job descriptions may not have included, it would be valuable for them, before they devote too much effort to the island wide tasks, to address the urban area problems referred to above. It is suggested, therefore, that they get fully involved with any brigade set up under the Rural Fires Act, including becoming office bearers, and desirably, having one of them take up the position of Rural Fires Warden.

The main task is to remove the risk posed by heavy fuels in the swamps under very dry conditions. That will require a fire that will remain relatively cool while burning evenly through the swamp to remove most of the available fuel. This should be done while the soil surface is moist, or there is still some surface water, and will require at least two years accumulation of fuel. It will also require prior fuel reduction in the surrounding grasslands and woodlands.

Examination in late April 2012 revealed that there was not enough fuel in the swamps this year to provide the prescribed burning conditions. Burning should be postponed until 2013, or until there is judged to be enough fuel for a fire to carry throughout individual swamps. It will have to be postponed if there is a late fire this year resulting in even a partial burn. Little can be done to guard against unplanned ignition of the swamps, but it might help if community concern about what happened there was demonstrated by very visible preparations for next year's operations by the construction of firebreaks and trails that allowed quick access to fires shortly after they started. It would also be a valuable exercise, if resources permitted, to visit all neighbours of the swamps, to advise them of what was planned, and to encourage them to clear long grass from along fencelines and anywhere it came within at least ten metres of houses.

If funds are available for further training to follow on from that provided in 2011, it should involve a practical exercise in fuel reduction burning and a planning exercise that involved defining the works and preparation required this year, and after the 2013 wet season, for the proposed burning of the swamps in the middle of that year.

Small test burns, extinguished before leaving them, should be lit throughout the remainder of this year, in a wide variety of habitats, and under a range of seasonal conditions, to help

develop an understanding of fire behaviour. Attention should also be focused on increasing knowledge of the island's geography by driving or walking all roads and tracks, walking away from roads, and at the end of the year, a helicopter flight around the island with the dual purpose of exploring beyond the limits of the familiar and assessing what parts of the island burnt during the year. Knowledge of the fire patterns and the varying intensities of burning would be invaluable knowledge in planning burning operations in 2013.

4.2 Proposed Program for Year 2 - 2013

There are two tasks that should occupy most of the attention of rangers during this year. One is to mitigate the fire hazard in the town area by burning the swamps and adjacent areas, and the second is to begin to shift the pattern of burning across the island from late season to a throughout the year one, with emphasis on early season burns.

There should be three phases to the urban area work, first, to clean any breaks and access tracks constructed during 2012, and to finish any uncompleted ones, secondly to burn between the breaks and swamp edge, and then to burn the swamp.

Cleaning the breaks and tracks could be by slashing them as soon as the ground is dry enough after the wet season, and burning the slashed grass soon after, or by grading them. The first option is to be preferred because of the reduced risk of creating soil erosion problems. The timing of the second and third stages assumes that the grass surrounding the swamp will burn before it will. That might not be the case if, for example, a fire in late 2012 burns the grass but not the swamp. In that situation the swamp should be burnt on schedule together with any grass that will burn, secure in the knowledge that if firebreak preparation has been completed, fires in the surrounding grass will be controllable.

If funding is available, either burning the surrounding grass or the swamp should be the subject of a training exercise (or both together).

It is unlikely that the habit of regular late season burning will die easily, and without some significant shift in this pattern it will be difficult to accumulate enough fuel to make an early start to post wet-season burning possible. An important start towards initiating this desired shift, island-wide, could be made in 2013 by reducing the potency of late season fires by denying them as much as possible of the fuel over large areas. While it may not be possible to make other than a small beginning because of a scarcity of fuel, every effort should be made on the ground, as soon as fires are likely to carry (mid April to mid June depending on the season) to burn anything that can be found to burn, no matter how small the resulting patch.

On ground operations should be followed by aerial ignition, targeting the grassy forests and woodlands of the plains, valleys, and adjacent slopes. The appropriate timing for this operation cannot be defined as it depends on seasonal conditions, but on average it should be in June. This should be followed by another aerial ignition operation, after mid July, and before mid September, to spread patch fires across the range country.

If these operations achieve the expected result, they will provide the basis for building a mosaic of burn patterns across the landscape, and leave enough unburnt country to provide a better basis for progressive patch-burning operations in the following year. If not, there is little option but to repeat these procedures in the following year.

In the proposals above there is no emphasis, as these should be in a fully evolved patch burning program, on adopting procedures, such as burning at a time of day (mid afternoon) when temperatures are falling and humidity rising, avoiding burning in strong winds, or ceasing when fires begin to burn during the night. This is because the main task is to spread fire across a wide area of the landscape being targeted before post September fires begin. In the range country, the motivation to break up the fuel is the same as for the lower elevation country, but the situation is quite different. It is likely that much of it has not burnt for some years. In a rough broken landscape, such as these ranges, with boulders and a generally rocky surface, and numerous patches of closed forest, most spot ignited fires will not carry far. The only way to spread fire across the landscape will be to hope that some fires will continue to burn over a number of days, trickling around the landscape. This will inevitably lead to great variations in the intensity of the fire according to the time of day during which it was burning, the weather, and whether or not it was burning up or downslope. That, however, is the historic nature of fire in such country.

4.3 Proposed Program for Year 3 – 2014 and Following Years

A program for year 3 can, at this stage, only be tentative. It will depend very much on the experience of the preceding years, and how closely its goals can be reached. There are unpredictable circumstances relating to how successful a start can be made on changing burning patterns and establishing a mosaic pattern of burning on which to build. Also to be tested at all stages is the question of whether or not resources available are adequate for the task. For these reasons, therefore, fine detail has been avoided, and this report confines itself to outlining the direction of an ideal program to occupy the year 2014, and repetitively from there on, while emphasizing its essential features. Whatever precise direction is pursued for 2014, however, should be shaped by the experiences of the operations in 2013, and all annual programs from there on should evolve from the experience of preceding years.

The sequence of events in an ideal operation for 2014 and following years, at a basic level should be:

a) To continue a program of ensuring the safety of the town area by keeping fire breaks and tracks open, and burning whenever there is two years accumulation of fuel – if the weather allows it. Additionally, rangers should ensure that their operations cannot cause damage to huts or other infrastructure away from the town area;

b) To begin burning as soon as possible after the wet season, with on the ground operations to spread spot fires through readily accessible sections of the grassy woodlands and forests and grasslands (see map). Priority attention should be given to grasslands and those areas with a ground cover of tall grasses.

   In most years these operations should occupy the period mid April to the middle of June.

c) As soon as on the ground operations are judged to have a satisfactory level of coverage, aerial ignition should be carried out across all communities of the plains and valleys and extending to the forests and woodlands of the foothills. In most years it should be possible to complete this operation before the end of June.

d) In the months of August and September, the precise timing to be determined by seasonal weather conditions in one operation, aerial ignition in the range country should be carried out.

There are some areas which will need special management attention that transcends the demands of the routine operations described above, but can be accommodated within them. All of them will require the precise attention that can only be given by on the ground operations and it might be beyond the physical and time resources of the rangers to deal with them on top of the demands of the routine operations. If that proves to be the case then resources should be re-allocated at the expense of the routine on the ground operations, and aerial ignition should be extended to two separate operations to cover much of the period that would otherwise be devoted to on the ground ignition.

The areas needing special attention, as shown in **Map 1**, are listed below with additional information provided in **Appendix A2-7. Map 2** shows recommended fire actions based on vegetation type.

1. **Communities of coastal dunes, including vine forests and thickets (beach scrubs in popular terminology –shown as 1a), low open forests and woodlands, and shrublands which contain many broadleaved species including favoured**

fruit trees, and complexes of grasslands, herblands, woodlands, and vine thickets: These areas have the common feature of fire sensitive species and communities intermixed with areas which will carry fire. The major occurrences of vine forests and thickets have been defined by single mapping units rather than as part of a complex. Being fire exclusive they are not under the same degree of threat that smaller thickets and individual species in complex mixture with fire prone communities are. Nevertheless they are capable of being eventually destroyed by progressive damage. There are, however, no observations in the island's habitat management profile (3d Environmental 2012) that provide evidence that destruction by this process was occurring anywhere.

It was observed on Moa Island, and it is assumed that it would also be relevant to Badu, that in the beach dune complexes that were being burnt, their vine forest components, as habitats and individual species, were in retreat, and the balance in the complexes was being shifted to grassland. Considering the importance of the vine forest components of the complexes as shelter and food source for many birds, and the range of fruit trees they contain, as well as their important contribution to beach stability, it is considered desirable to halt their attrition where it is observed to be occurring, and in all communities to manage to increase their extent in the complexes.

In all beach dune situations there is only one option available to protect their vine forest communities, and to increase their status within the complexes, and that is to keep the fuel within them, and surrounding them, from building up to the level where they will support hot fires. The targeting of fuel accumulations in these situations, and throughout the coastal dunes, would be highly likely to require more man hours of work than the rangers can deliver. It is recommended, therefore, that they concentrate on those areas most needing attention, and, give high priority to identifying them. The vegetation mapping (Stanton, Fell, Gooding, 2009) and habitat management profile (3d Environmental, 2012) should help in that regard. The remaining areas could be given some measure of protection by the proposed programs of early season burning in surrounding areas.

Map 1. Fire behaviour categories on Badu Island

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Photographs 4 & 5. Coastal dune complexes, where patches of vine forest intermingle with grasslands and grassy woodlands**.** In 4 is a grove of the cycad *Cycas badensis* which is confined to Moa and Badu Island.

Photograph 6. Aerial view of dune vine thicket showing areas interspersed with flammable grasses.

2. **Swamp forests, and shrublands and low woodlands with pandanus sp., as a major component:** These accumulate fuel over many years, and can burn very hotly. Repetitive hot fires can be very damaging and eliminate some understory species. As undesirable as that situation might be it can only degrade, not destroy, the system. The greatest danger to them would come from fires entering them in extreme drought when the soil surface is dry. If there is heavy fuel accumulation at such times canopy scorch will be severe and many, if not all canopy species killed. If there is a peat layer and fire burns into it, all living plants will inevitably be destroyed.

   The recommended approach to managing these swamps is to manage the areas surrounding them as proposed in routine on the ground and aerial operations. In addition however, extra on the ground attention be paid to the surrounds of those swamp forests where there are heavy fuel accumulations, and a decision has been made to burn them in the current season.

   Burning of the swamps is best carried out when surface water is present. Maximum protection from hot fires can be provided by burning every two or three years, but there is no urgency to do that unless it is not possible to effectively manage the level of fuel in surrounding areas. Rangers should be aware of the location of the communities covered by the description of swamp forests capable of burning, and inspect them occasionally - once every three years would be sufficient. When, on the basis of such inspections, a decision is made to burn them, attention should shift to a

more intense program of cool burning in the surrounding areas than would occur under routine fire management. The purpose of that would be to have the freedom of choosing the time at which to burn the swamp without risking a fire within it spreading too far into surrounding country.

3. **Areas of understory thickening:** Earlier work on the island (Stanton and Fell 2009) identified areas where the understory had thickened because of lack of fire. This is an undesirable habitat change because it will eventually lead to the shading out of ground cover and, on the better soils, irreversible change to a closed forest.

   The only management option available to reverse this process is the use of fire, and the longer it has been happening the hotter the fire will have to be.

   The problems of managing the broad landscape with patchy cool fires while applying late season hot fires to part of it are obvious. It will mean the abandonment of aiming for a mosaic of burnt and unburnt country in surrounding areas in favour of a meticulous program of maximum possible fuel reduction over a wide area. The problems are magnified where hot fires have to be applied adjacent to sensitive areas such as vine forest margins or adjacent to swamps.

   A first step is to identify areas where understory thickening is occurring. Of most concern will be those areas where such thickening will most rapidly lead to irreversible change. This will be on the deeper soils supporting the tallest forests. Detailed exploration for the purpose of locating these areas would be time consuming and not an efficient use of limited ranger resources. It would be best to rely on their chance identification during burning operations, and the examination of swamps to determine fuel levels within them. Every opportunity, however, should be taken to examine the interface between swamps and woodlands which is the favoured habitat of the endangered plant *Costus poteriae*. This species which is a fleshy plant less than a metre tall needs plenty of light, and would not be able to survive where woody thickening has reached an advanced stage.

Photograph 7. An area of shrubby thickening within a well developed woodland habitat

Photograph 8. Sedgeland adjoining a melaleuca swamp forest on a sand plain.

Photograph 9. Dense melaleuca regeneration to 2m high with a fire killed margin, on a swampy plain.

Photograph 10. A rainforest margin with grassy forest. The location of the margin is along rock covered ground which protects it from most fires. Very hot late season fires, however, have the potential to kill patches of trees and shrubs along it.

The approach to dealing with understory thickening would vary according to whether or not it was occurring as a clearly identifiable area within an open forest or woodland landscape, or along the margins of sensitive vegetation or swamps. In both cases intensive fuel reduction will have to be undertaken in surrounding areas starting early in the season, and then to await suitable conditions for putting a hot fire through them. In the latter case, if burning is to take place along the margin of a swamp forest which will carry fire, the operation should not be carried out unless the swamp is first burnt earlier in the season. Where fire sensitive vegetation such as vine forest is concerned lighting of fires should be done in a line as close to the margin as possible. In all burning operations to remove a thickening understory the time of day fires are lit is not important as the aim is to generate maximum heat in the fire.

4. **Shrublands of relict sand dunes:** The location of these communities should be known as their fire ecology is very different from that in the areas that surround them. Fuel accumulation within them is very slow and many of them have bare sand between widely separated shrubs and are unlikely to provide a continuous enough fuel cover to carry fire.

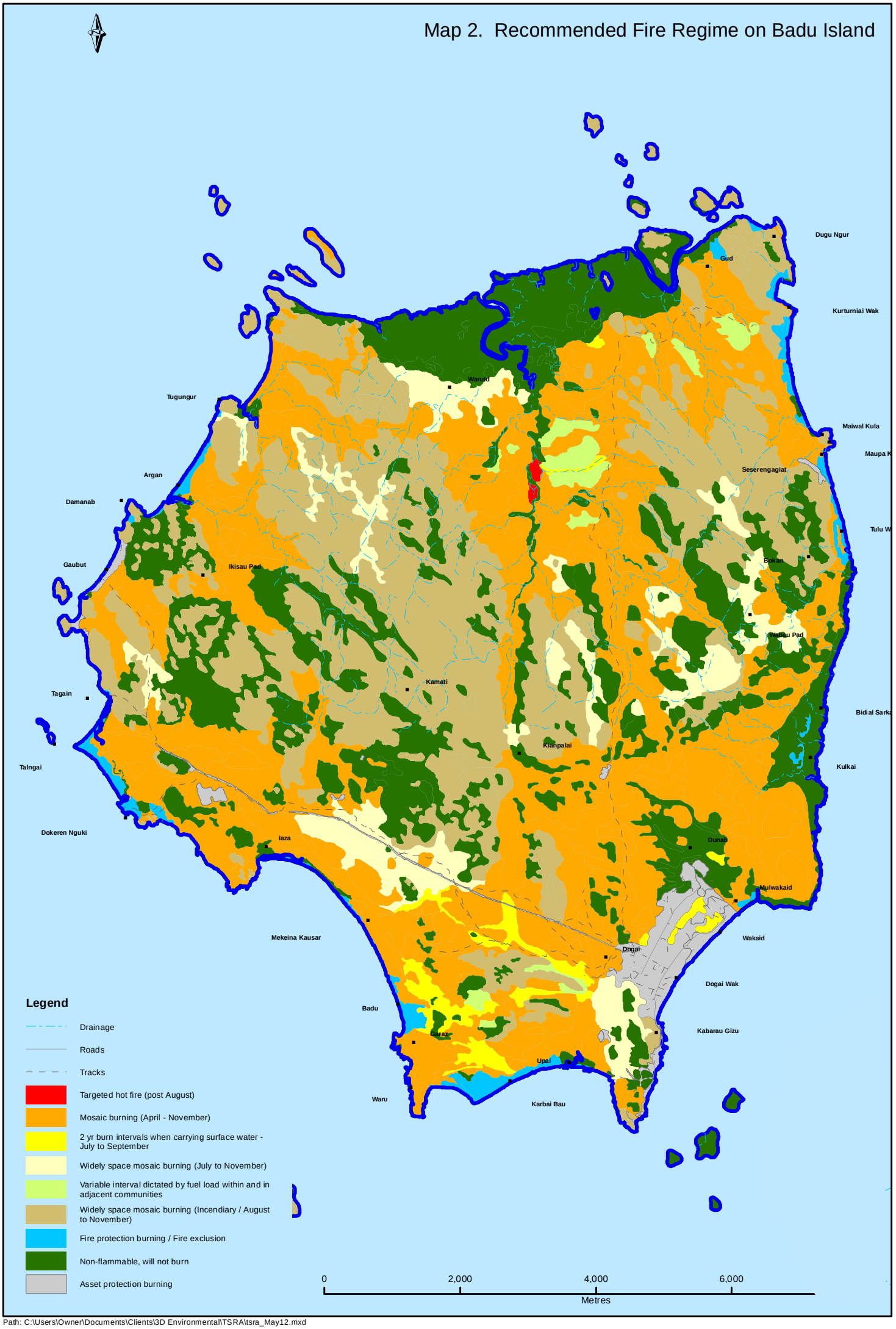
   Those that will burn will only do so at long intervals (+ 5 years). They usually burn in fires that consume much of the standing vegetation, leaving blackened stems on bare sand. Indeed, cooler trickling ground fires are inimical to their future as they do not result in the conditions of light at ground level which will allow many species to regenerate.

   These communities change only very slowly with time since last burn, so there are no pressing reasons for burning them at any particular time. Eventually they are likely to ignite by chance during routine burning operations, but it would be better to learn to burn them deliberately under conditions which will avoid burning all of the community in one fire event. This can be done by first understanding how wind-driven fires move through them. These fires burn rapidly at their head and much more slowly, tending to self- extinguish, along their flanks. While it is not a reliable method it is possible in a strong wind to drive fire through them, leaving an elongated narrow pattern of heavily burnt shrubland with a band where there is only partial scorch of the canopy on the flanks, before passing on to unburnt shrublands. There is a greater chance of achieving this result if the fires are lit late in the evening.

Photograph 11. Low shrubland of relict dune system

5. **Other habitats:** It should be noted that in other habitats shown in **Map 1**, particularly Category 5 (other flammable grassy woodland and open forest, shrubland and grassland), the primary aim is to establish a mosaic of patch burns throughout so that these areas burn on a variable cycle of 2 to 5 years dependent on seasonal and annual climatic variations. **Map 2** provides a general guide for the approach to fire management across the island based on habitat type. Other categories are discussed in **Appendix A2-7.**

Map 2. Recommended Fire Regime on Badu Island



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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 will take place in four overlapping stages. During, or soon after the wet season, priority will be given to securing the town area by grading, slashing, mowing and burning of fire breaks to isolate swamp forests within or adjacent to the town area, so that they can be safely burnt at a time judged appropriate. As soon after the wet season as fires will carry, patch burning will be carried out on the ground in grasslands, and forests and woodlands with a tall grass understory, paying particular attention to rainforest margins. When it is judged that satisfactory progress has been made in these operations, attention will then shift to the remaining forests and woodlands of the plains and valleys, and the adjoining foothills. When all areas that can be easily accessed on the ground are covered, or resources are clearly inadequate to cope with the task while weather conditions are likely to remain favourable (before the end of June in most years) it should be completed by aerial ignition using a helicopter. The extensive areas of range country will be burnt by isolated chance ignitions from fires spreading from the valleys and foothills, and by a final stage of widely spaced ignitions by helicopter during the months of August and September.

Special attention will be paid at all stages to the needs of four habitats, those of the coastal dunes, swamp forests, areas of grassy forest and woodland with pronounced understory thickening, and the shrublands of relict sand dunes. Some coastal dune communities contain numerous patches of vine thicket which have been fire damaged or are potentially at risk from such damage, and will be protected, where possible by early burns of the grasslands neighbouring them. In years when decisions are made to burn them, areas surrounding swamp forests, and patches of vegetation thickening, will be intensively managed to reduce fuel levels and allow them to be safely burnt at appropriate times. The shrublands will be

burnt under conditions where only part of individual communities will be affected, and to minimize the risk of fires within them spreading widely across adjoining areas.

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;
- manage specific habitats to provide appropriate conditions for the survival of sensitive species.

A2-2. Ecological description of the island

Location and Landscape: Badu Island is the second largest island in the Near Western Island Group and along with the other islands of Mabuiag and Moa, is formed on continental igneous basement rock. The island, with an area of 10 467 ha, is centred 142° 09' E 10° 07' S some 46km NNE of Thursday Island, and is characterised by numerous rocky knolls with Mt. Mulgrave forming the highest peak at 198m. Whilst the rocky knolls of Badu's interior and coastal headlands are formed from the coarse grained Badu Granite, the island hosts the most extensive system of sand dunes of any island in the broader Torres Strait region. This includes older deeply leached and degraded dune systems, most likely of Pleistocene age (>11 000 yrs), that attenuate well into the islands interior in deeper valley enclaves; recent (Holocene Age) coastal foredune systems; and a broad aeolian sand sheet on the islands south coast that has been variably stabilised with vegetation. The island is dissected by a number of permanent watercourses which generally flow from east to west, traversing a broad coastal plain on the islands western side.

The majority of the system is stabilised with vegetation cover ranging from sedgeland to eucalypt woodland blanketing gently undulating ridges. In the area to the south-west of the Badu township (in the vicinity of the current water bore field), a large portion of the dune field is unstable with the dominant land surface formed by exposed coarse silica sand

demonstrating a range of transient morphologies which include shallow deflation basins, blowouts and low depositional mounds.

Climate: Badu Island, 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. March is typically the wettest month producing on average precipitation of 415mm out of an annual average of 1983 mm, making Badu the wettest recording station in the Torres Strait. This can be compared to Dauan which is the driest at 1082 mm (BOM 2008). 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°.

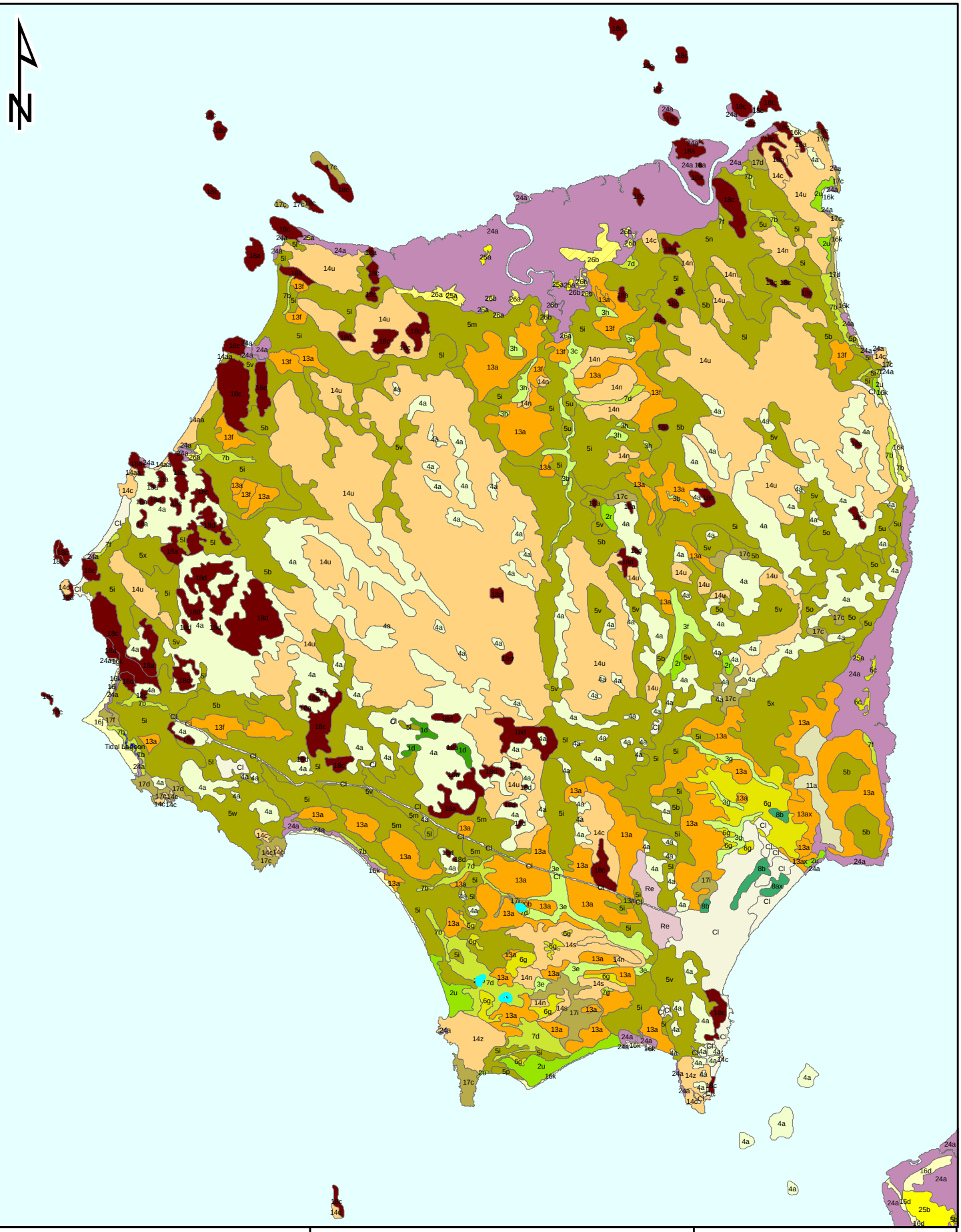
Vegetation: The island is blanketed with a mosaic of natural vegetation with cleared and otherwise disturbed areas forming 2 % of the islands total area. A total of 18 broad vegetation groups are represented on the island of which eucalypt dominant woodlands are the most extensive occupying 3336 ha or 32 % of the islands area. Welchiodendron dominant closed forest and restricted areas of rainforest occupy a number of the low rocky knolls, being most extensive on the flanks and peak of Mt Mulgrave whilst shrubland habitats are extensive on islands rocky interior where they mosaic with bare granitic pavement. Due to the extensive nature of dune sand on the island, Badu hosts well developed examples of dune vine thicket. The dune system also hosts a complex system of vegetated freshwater swamps and wetlands to an extent that does not occur elsewhere in the Torres Strait. Vegetation mapping for the island is shown in following pages.

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

It is not known when traditional burning was abandoned and there is no documentation of fire history since then. From information provided by rangers it appears that the island is regularly burnt by a number of people and that burning has been co-ordinated to the extent that there is some agreement that the burning should be done about the month of October. The condition of the island's habitats indicates that they are largely stable under the prevailing fire regime.

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.



NOTES:

Figure: Vegetation Communities and Broad Vegetation Groups of Badu Island

Client: Torres Strait Regional Authority

0 750 1,500 2,250 3,000
Metres

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Evergreen vine forest and vine thicket

1d, Mesophyll/notophyll vine forest + *Endiandra glauca + Acacia polystachya + Syzygium bungadinia + Canarium australianum + Dysoxylum oppositifolium*. Granite and rhyolite slopes

Deciduous/Semi deciduous vine forest and vine thicket

2r, Semi deciduous vine forest + *Sterculia quadrifida + Canarium australianum + Cleistanthus peninsularis + Terminalia subacroptera + Antiaris toxicarya var. macrophylla +/- Paraserianthes toona + Alstonia actinophylla +/- Xanthoxylon rhetsa +/- Maniltoa lenticellata var. lenticellata.* Diorite footslopes.

2u, Semi-deciduous vine forest + *Manilkara kauki + Terminalia spp. + Sterculia quadrifida + Premna serratifolia + Acacia crassicarpa + Drypetes deplanchei + Millettia pi¤ata.* Coastal dunes.

Swamp and riparian forest complexes

3b, Medium to tall *Melaleuca leucandendra +/- Melaleuca argentea + Syzygium forte subsp. forte + Dillenia alata* open forest. Fluvial sands and silts.

3c, Tall *Melaleuca dealbata / Melaleuca leucadendra* open forest/*Acacia sp*. open forest / *Mesophyll* vine forest complex. Seasonal swamps.

3e, *Melaleuca quinquenervia + Pandanus sp. +/- Deplanchea tetraphylla swamp forest/ Lophostemon suaveolens +/- Asteromyrtus brassii +/- Acacia crassicarpa +/- Deplanchea tetraphylla* open swamp forest complex (7d/8b -50/50).

3f, *Lophostemon suaveolens + Melaleuca leucadendra + Corymbia clarksoniana* open forest.

3g, Tall *Melaleuca dealbata + Acacia crassicarpa + Acmena hemilampra + Deplanchea tetraphylla + Syzygium forte subsp. forte* swamp forest complex.

3h, *Syzygium angophoroides + Lophostemon suaveolens + Maranthes corymbosa +/- Syzygium forte* subsp. forte +/- *Podocarpos greyii* swamp forest.

Welchidendron dominant closed to open forests and wo

4a, *Welchiodendron longivalve + Acacia polystachya +/- Terminalia subacroptera +/- Canarium australianum +/- Bombax ceiba var. leiocarpum* open to closed forest.

Eucalypt dominant open forests and woodlands

5b, *Corymbia clarksoniana + Corymbia nesophila +/- Corymbia tessellaris +/- Corymbia stockerii subsp. Peninsularis +/- Welchidendron longivalve* woodland and open forest. Alluvial, remnant sandy plains and granite footslopes.

5i, *Corymbia clarksoniana +/- Corymbia novoguinensis +/- Livistona muelleri* woodland and open forest. Coastal dunes and sandy alluvial outwash.

5l, *Corymbia stockeri subsp. peninsularis +/- Corymbia nesophila +/- Eucalyptus tetrodonta +/- Eucalyptus cullenii* woodland. Hillslopes on rhyolite and granite.

5m, Low *Corymbia spp. (C. stockeri, C. nesophila, C. clarksoniana) + Melaleuca stenostachya +/- Melaleuca viridiflora +/- Asteromyrtus symphiocarpa* woodland. Alluvial outwash and degraded dunes.

5n, *Eucalyptus platyphylla + Erythrophloeum chlorostachys +/- Corymbia nesophila +/- Corymbia novoguinensis +/- Eucalyptus tetrodonta +/- Corymbia stockeri subsp. peninsularis* woodland and open forest. Alluvial terraces and degraded dunes.

5o, *Corymbia tessellaris +/- Corymbia clarksoniana* woodland and open woodland. Coastal dunes, alluvial plains and acid volcanic hillslopes.

5p, Low *Corymbia polycarpa/Corymbia novoguinensis + Acacia crassicarpa + Teminalia subacroptera +/- Sterculia quadrifida +/- Syzygium suborbiculare* woodland and open woodland. Coastal dunes

5u, *Eucalyptus platyphylla +/- Corymbia tessellaris* woodland and open woodland. Coastal dunes, alluvial plains and acid volcanic/plutonic headland and hillslopes.

5v, *Eucalytpus stockerii sub.sp peninsularis + Welchidendron longivalve + Acacia polystachya +/- Corymbia tessellaris* woodland/ open forest complex. Granite hills.

5w, *Corymbia tessellaris + Corymbia clarksoniana/ novoguinensis + Melaleuca viridiflora +/- Paranari nonda* woodland and low open woodland.

5x, *Corymbia spp. + Melaleuca viridiflora + Lophostemon suaveolens + Pandanus* sp woodland and low open woodland.

Acacia dominant open forests and woodlands

6c, Low *Acacia crassicarpa + Terminalia subacroptera + Sterculia quadrifida + Manilkara kauki + Syzygium suborbiculare* open forest and woodland. Beach ridges.

6g, *Acacia crassicarpa +Asteromyrtus brassii* open forest and low open forest. Coastal dunes.

Melaleuca dominant open forests

7b, *Melaleuca saligna* open forest. Alluvial plains, drainage depressions and dune swales.

7d, *Melaleuca quinquenervia +/- Melaleuca saligna +/- Melaleuca cajuputi subsp. platyphylla +/- Lophostemon suaveolens* open forest. Coastal dunes and alluvial swamps.

7f/7fs, *Melaleuca leucadendra* open forest. Seasonal swamps and riparian margins.

7g, *Melaleuca dealbata* woodland and open forest. Coastal dune complexes

Lophostemon dominant woodland and open forest

8ax, *Lophostemon suaveolens +/- Melaleuca cajuputi subsp. platyphylla +/- Pandanus sp. +/- Livistona muelleri* woodland and open forest. Alluvial remnants of the Fly platform.

8b, Low *Lophostemon suaveolens +/- Melaleuca saligna + Asteromyrtus brassii + Acacia crassicarpa* open forest. Sandy alluvial soils.

Pandanus dominant woodland and shrubland

11a, *Pandanus sp. +/- Melaleuca catjaputi subsp. platyphylla +/- Acacia leptocarpa +/- Melaleuca acacioides* shrubland and low woodland. Alluvial plains (Quaternary and Pleistocene).

Legend- Vegetation Communities and Broad Vegetation Badu Island

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Melaleuca dominant shrublands and woodlands

13a, *Melaleuca viridiflora +/- Pandanus sp.* shrubland and low woodland. Alluvial plains, residual sands, acid volcanic slopes and coastal dunes.

13ax, *Melaleuca cajuputi subsp. platyphylla +/- Pandanus sp*. shrubland. Alluvial plains.

13f, Low *Melaleuca viridiflora + Corymbia clarksoniana* woodland. Alluvial plains and residual sands.

Shrublands and shrubland complexes

14c, *Welchiodendron longivalve* shrubland. Escarpments and hillslopes on rhyolite and granite

14n, *Acacia crassicarpa + Leucopogon ruscifolius +/- Neofabricia myrtifolia +/- Pouteria sericea +/- Psydrax banksii +/- Halfordia kendack* shrubland and open shrubland.

14s, Low sparse *Leucopogon ruscifolius + Acacia crassicarpa + Syzygium sub-orbiculare* shrubland with *Corymbia novoguinensis* emergents.

14u, Low *Corymbia stockerii subsp. stockerii + Welchiodendron longivalve* open forest/ *Welchidendron longivalve* closed scrub/ Deciduous shrubland/rock pavement complex (5v/4a/18a/18d – 30/40/20/10)

14z, *Grevillea parallela + Cochlospermum gillivraei + Paranari nonda +/- Syzygium suborbiculare +/- Pandanus* sp. shrubland and open shrubland

14aa, *Grevillea parallela + Syzygium suborbiculare + Cycas badensis + Acacia crassicarpa + Planchonea careya + Premna serratifolia* shrubland.

Coastal dune complexes

16j, Low groved *notophyll vine thicket/* grassland and herbland complex.(2z/17j - 80/20)

16k, Coastal foredune grassland, herbland, woodland and vine thicket complex. (17j/17d/10b/1c – 50/20/20/10).

Grasslands and grassland complexes

17c, Open to closed tussock grassland with emergent shrubs. Coastal headlands

17d, Medium to tall *Mnesithea rottboellioides + Heteropogon triticeus + Cymbopogon spp. +/- Imperata cylindrica +/- Themeda triandra* grassland. Alluvial and residual plains, coastal dunes and granite footslopes.

17f, Imperata cylindrica dominant grassland. Coastal dunes.

17i, Low sedgeland with emergent shrubs and trees. Residual sand plains and degraded dunes.

Rock pavement complexes

18a, Deciduous shrubland/Rock pavement complex. Rocky slopes on acid volcanic and plutonic rocks.

18c, *Welchiodendron longivalve +/- Acacia polystachya* closed shrubland / Low deciduous shrubland/rock pavement complex (18a/14c – 50/50)

18d, *Corymbia stockerii subsp. peninsularis + Welchidendron longivalve + Psydrax banksi + Dodonoea sp. + Ficus platypoda* rock pavement complex.

Wetland complexes and mosaics

20b, Open wetland complex. Perennial swamps.

Mangrove forest, woodland and shrubland complexes

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

Samphire grasslands

26a, Closed *Sporobulus sp*. grassland.

26b, *Sporobulus sp*. grassland/Chenopod forbland and herbland complex

Samphire herblands and shrublands and salt pans.

25a, Dwarf *halophytic* shrubland and saltpan. Hypersaline muds.

Regrowth

Re, Regrowth

Tidal Lagoon

Tidal Lagoon

Cleared

Cl, Cleared

Legend- Vegetation Communities and Broad Vegetation Badu Island

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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
Badu township area	Highly flammable swampland and fringing rank grassland habitat occurs as a broad swath within the community. Flammable vegetation occurs up to boundary fences of dwellings.	A program of hazard reduction burning is required to manage the risk that hot wildfire poses to dwellings.	Badu Council	
			Badu Community	
			Island Rangers	Troy Stow
			Rural Fires – Fire warden	
Other camps - Galbut	Rank grassland may accumulate on the margins of dwellings which poses a hazard during wildfire events. Requirements to prioritise assets requiring protection outside of the major settlement areas.		Badu Council	
			Badu Community	
			Island Rangers	Troy Stow
			Rural Fires – Fire warden	
			PBC??	
Airport – including potential smoke problems	Surrounded by vegetation of moderate flammability although smoke from fires has potential implications for aircraft transit.		Badu Council	
			Badu Community	
			Island Rangers	Troy Stow
			Rural Fires – Fire warden	

Asset	Issues	Specific Requirements	Stakeholders (to be listed)	Contact
			Commercial airline operations	
Powerline and generators	The location of generators and powerlines requires consideration. Generators and powerline easements are located west of the piggery and at the borefield. Other facilities should be identified.	• Hazard requires management around facilities including slashing of grass around generators and power poles. • Ergon to be given minimum of 2 weeks notice prior to a planned burn. • Ergon on ground maintenance teams to cut grass 2 m from around poles and look after generators.	Ergon Energy??	
			Badu Council	
			Island Rangers	Troy Stow
Water supply infrastructure	The risk that fires pose to water supply infrastructure including the borefield and associated facilities needs to be considered in burning plans.		Badu Council	
			Island Rangers	Troy Stow
Cultural assets (requiring further documentation)	Cultural assets and the risk fire poses to them requires further consideration and documentation.		Island Rangers	
			PBC	

Asset	Issues	Specific Requirements	Stakeholders (to be listed)	Contact
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.	Badu Council	
			Badu Community	
			Island Rangers	Troy Stow

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 are restricted to disturbed lands around settlements and include a number of herbs and scrambling vine species such as stylo (*Stylosanthes* spp.), siratro (*Macroptilium atropurpureum),* phasey bean (*Macroptilium lathryioides*) and beggar weed (*Desmodium tortuosum*). Such areas should be identified and an approach to burning and subsequent herbicide treatment considered on a case by case basis.

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 Badu Island are provided in **Table A2 – 7**.

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

Fire Category	BVG	Vegetation Community	Description	Fire Behaviour/ Recommendations
Category 1	Communities of young coastal dunes	16j	Low groved notophyll vine thicket/ grassland and herbland complex (2z/17j - 80/20).	Hot fires will degrade habitats, particularly where they penetrate into grassland pockets. Preventative cool burns on the margins of habitat, particularly vine thicket components. Interspersed cool burns in grassland patches to prevent hot wildfire incursion and promote vine thicket expansion.
		16k	Coastal foredune grassland, herbland, woodland and vine thicket complex (17j/17d/10b/2aa – 50/20/20/10).	
		6c	Low *Acacia crassicarpa* + *Terminalia subacroptera* + *Sterculia quadrifida* + *Manilkara kauki* + *Syzygium suborbiculare* open forest and woodland.	
		14aa	*Grevillea parallela* + *Syzygium suborbiculare* + *Cycas badensis* + *Acacia crassicarpa* + *Planchonia careya* + *Premna serratifolia* shrubland.	
		5p	Low *Corymbia polycarpa/Corymbia novoguinensis* + *Acacia crassicarpa* + *Terminalia subacroptera* +/- *Sterculia quadrifida* +/- *Syzygium suborbiculare* woodland and open woodland.	
Category 1a	Semi-evergreen vine forest and thicket on dunes	2u	Semi-deciduous vine forest + *Manilkara kauki* + *Terminalia* spp. + *Sterculia quadrifida* + *Premna serratifolia* + *Acacia crassicarpa* + *Drypetes deplanchei* + *Millettia pinnata.*	Hot fires will degrade habitats, particularly where they penetrate into margins of vine thicket. Preventative cool burns on the margins of habitat, particularly vine thicket components.
2	Swamp and riparian forest and forest complexes	3e	*Melaleuca quinquenervia* + *Pandanus sp.* +/- *Deplanchea tetraphylla* swamp forest/ *Lophostemon*	Susceptible to hot, late season fires and will burn with considerable

Fire Category	BVG	Vegetation Community	Description	Fire Behaviour/ Recommendations
			suaveolens +/- *Asteromyrtus brassii* +/- *Acacia crassicarpa* +/- *Deplanchea tetraphylla* open swamp forest complex (7d/8b -50/50).	intensity First communities to be burnt after wet season. Well spaced fires lit progressively from as soon after the wet season as they will carry until, in most years, early June
	Melaleuca dominant open forests	7d	Melaleuca *quinquenervia* +/- *Melaleuca saligna* +/- *Melaleuca cajuputi* subsp. *platyphylla* +/- *Lophostemon suaveolens* open forest.	
	Lophostemon dominant woodland and open forest	8b	Low *Lophostemon suaveolens* +/- *Asteromyrtus brassii* +/- *Acacia crassicarpa* +/- *Melaleuca saligna* +/- *Deplanchea tetraphylla* open forest and swamp forest.	
3	No specific BVG although tends to occur in Eucalypt dominant woodlands (on fertile substrates)	A range of habitat types although known occurrences affect VC5u	Woodland and open forest types affected by shrubby thickening	Targeted, hot, late season fires required to arrest/ reverse shrubby invasion
4	Shrublands and shrubland complexes	14u	*Acacia crassicarpa* + *Leucopogon ruscifolius* +/- *Neofabricia myrtifolia* +/- *Pouteria sericea* +/- *Psydrax banksii* +/- *Halfordia kendack shrubland* and open shrubland.	Will burn explosively under extreme conditions at long intervals. Burn in conditions that avoids scorching the entire community. Such conditions may occur during periods of high wind.
5	Swamp and riparian forest and forest complexes	3f	*Lophostemon suaveolens* + *Melaleuca leucadendra* + *Corymbia clarksoniana* open forest.	Burns with considerable intensity under hot, dry conditions. Maximum fuel loads accumulate after 3-4 years. Fuel loads need to be broken up by a mosaic of small fires with burning program commencing early in the year (when fuel will first ignite).
	Eucalypt and Corymbia dominant open forests and woodlands	5l	*Corymbia stockeri* subsp. *peninsularis* +/- *Corymbia nesophila* +/- *Eucalyptus tetrodonta* +/- *Eucalyptus cullenii* woodland.	
		5o	*Corymbia tessellaris* +/- *Corymbia clarksoniana* woodland and open woodland.	
		5x	*Corymbia spp.* + *Melaleuca viridiflora* + *Lophostemon suaveolens* + *Pandanus sp* woodland and low open woodland.	
		5b	*Corymbia clarksoniana* + *Corymbia nesophila*	

Fire Category	BVG	Vegetation Community	Description	Fire Behaviour/ Recommendations
			+/- Corymbia tessellaris +/- Corymbia stockeri subsp. *peninsularis +/- Welchiodendron longivalve* woodland and open forest.	
		5i	*Corymbia clarksoniana +/- Corymbia novoguinensis +/- Livistona muelleri* woodland and open forest.	
		5n	*Eucalyptus platyphylla +/- Erythrophloeum chlorostachys +/- Corymbia nesophila +/- Corymbia novoguinensis +/- Eucalyptus tetrodonta +/- Corymbia stockeri* subsp. *peninsularis* woodland and open forest.	
		5u	*Eucalyptus platyphylla +/- Corymbia tessellaris* woodland and open woodland.	
	Melaleuca dominant open forests	7b	*Melaleuca saligna* open forest.	
		7f	*Melaleuca leucadendra* open forest.	
		7g	*Melaleuca dealbata* woodland and open forest.	
	Pandanus dominant woodland and shrubland	11a	*Pandanus* sp. *+/- Melaleuca cajuputi* subsp. *platyphylla +/- Acacia leptocarpa +/- Melaleuca acacioides* shrubland and low woodland.	
	Melaleuca dominant shrublands and woodlands	13f	Low *Melaleuca viridiflora* + *Corymbia clarksoniana* woodland.	
		13a	*Melaleuca viridiflora +/- Pandanus* sp. shrubland and low woodland.	
	Grasslands and grassland complexes	17c	Open to closed tussock grassland with emergent shrubs.	
		17d	Medium to tall *Mnesithea rottboellioides* + *Heteropogon triticeus* + *Cymbopogon* spp. *+/- Imperata cylindrica +/- Themeda triandra* grassland.	
		17f	*Imperata cylindrica* dominant grassland.	
		17i	Low sedgeland with emergent shrubs and trees.	
	Shrublands and	14z	*Grevillea parallela* +	

Fire Category	BVG	Vegetation Community	Description	Fire Behaviour/ Recommendations
	shrubland complexes		*Cochlospermum gillivraei* + *Parinari nonda* +/- *Syzygium suborbiculare* +/- *Pandanus* sp. shrubland and open shrubland.	
	Regrowth communities	RE	Regrowth vegetation	
6	Eucalypt and Corymbia dominant open forests and woodlands	5m	Low *Corymbia* spp. *(C. stockeri, C. nesophila, C. clarksoniana)* + *Melaleuca stenostachya* +/- *Melaleuca viridiflora* +/- *Asteromyrtus symphyocarpa* woodland.	Low to moderate fuel capacity means fire will generally not ignite or penetrate until late in the year. Targeted and incendiary burning
		5v	*Corymbia stockeri* subsp *peninsularis* + *Welchiodendron longivalve* + *Acacia polystachya* +/- *Corymbia tessellaris* woodland / open forest complex.	
7	Shrublands and shrubland complexes	14c	*Welchiodendron longivalve* shrubland.	Will not burn unless conditions are severe and several years of fuel have accumulated. Widely spaced spot fires, mostly incendiary burns, later in the season (from August onwards).
		14s	Low sparse *Leucopogon ruscifolius* + *Acacia crassicarpa* + *Syzygium suborbiculare* shrubland with *Corymbia novoguinensis* emergents.	
		14u	Low *Corymbia stockeri* subsp. *peninsualris* + *Welchiodendron longivalve* open forest / *Welchiodendron longivalve* closed scrub/ Deciduous shrubland/rock pavement complex (5v/4a/18a/18d – 30/40/20/10).	
	Rock pavement and pavement complexes	18a	Deciduous shrubland / Rock pavement complex.	
		18c	*Welchiodendron longivalve +/- Acacia polystachya* closed shrubland / Low deciduous shrubland/rock pavement complex (18a/14c – 50/50).	
		18d	*Corymbia stockeri* subsp. *peninsularis* + *Welchiodendron longivalve* + *Psydrax banksii* + *Dodonaea polyandra* + *Ficus* sp. rock pavement complex.	
8	Evergreen vine forest	1d	Mesophyll/notophyll	No burn/ will not

Fire Category	BVG	Vegetation Community	Description	Fire Behaviour/ Recommendations
			vine forest + *Endiandra glauca* + *Acacia polystachya* + *Syzygium bungadinnia* + *Canarium australianum* + *Dysoxylum oppositifolium.*	burn under most circumstances.
	Semi-evergreen vine forest and thicket	2r	Semi-deciduous vine forest + *Sterculia quadrifida* + *Canarium australianum* + *Cleistanthus peninsularis* + *Terminalia subacroptera* + *Antiaris toxicaria* var. *macrophylla* +/- *Paraserianthes toona* + *Alstonia actinophylla* +/- *Zanthoxylum parviflorum* +/- *Maniltoa lenticellata* var. *lenticellata.*	
	Swamp and riparian forest and forest complexes	3b	Medium to tall *Melaleuca leucadendra* +/- *Melaleuca argentea* + *Syzygium forte* subsp. *forte* + *Dillenia alata* open forest.	
		3c	Tall *Melaleuca dealbata* / *Melaleuca leucadendra* open forest/*Acacia* sp. open forest / Mesophyll vine forest complex.	
		3g	Tall *Melaleuca dealbata* + *Acacia crassicarpa* + *Acmena hemilampra* subsp. *hemilampra* + *Deplanchea tetraphylla* + *Syzygium forte* subsp. *forte* swamp forest complex.	
		3h	*Syzygium angophoroides* + *Lophostemon suaveolens* + *Maranthes corymbosa* +/- *Syzygium forte* subsp. *forte* +/- *Podocarpus grayae* swamp forest.	
	Welchiodendron dominant closed to open forests and woodlands	4a	*Welchiodendron longivalve* + *Acacia polystachya* +/- *Terminalia subacroptera* +/- *Canarium australianum* +/- *Bombax ceiba* var. *leiocarpum* open to closed forest.	
	Acacia dominant open forests and woodlands	6g	*Acacia crassicarpa* +*Asteromyrtus brassii* open forest and low open forest.	

Fire Category	BVG	Vegetation Community	Description	Fire Behaviour/ Recommendations
	Wetland complexes and mosaics	20b	Open wetland complex.	
	Mangrove forest, woodland and shrubland complexes	24a	Mangrove closed and open forest, woodland and shrubland complexes (24d/24c – 80/20).	
	Samphire herblands and shrublands and salt pans	25a	Dwarf halophytic shrubland and saltpan.	
	Samphire grasslands	26a	Closed *Sporobolus sp.* grassland.	
		26b	*Sporobolus sp. Grassland / Chenopod forbland and herbland complex (26a/25a - 50/50).*	

Vegetation communities 1: Vine thickets and dune complexes on coastal dune complexes.

Strategy: Protect these communities from fire damage to the margins. When burning in adjacent communities light the first fires close to the margins. In coastal dune complexes some of the vine thickets could be showing damage from fires, in which case there would be a need for preventative cool burns in the interspersed grasslands. The need for such action could only be determined on a case by case basis and its identification would rely on ground inspections by the rangers.

Vegetation communities 2: Seasonally wet swamp forests and woodlands that will support fire.

Strategy: Fires entering these swamp communities when they are dry have the potential to do severe damage. Those communities which have peat layers can be destroyed if dry peat layers ignite. Their maintenance in good condition therefore, depends on appropriate patch burning strategies in surrounding country that minimize the risk of wildfires entering the swamps when they are dry, and regular (+2 year intervals) fuel reduction in them, by burning when they carry surface water.

Vegetation Communities 3: Woodland and open forest habitats subject to shrubby thickening.

Strategy: Shrubby invasion can impact a range of woodland and open forest communities although is typically associated with habitats on fertile substrates which have been denied regular fire.

The only management option available to reverse this process is the use of fire, and the longer it has been happening the hotter the fire will have to be. A first step is to identify areas where understory thickening is occurring. Of most concern will be those areas where such thickening will most rapidly lead to irreversible change. Maintenance of mosaic burning in the

surrounding landscape should be undertaken prior to targeting these habitat with hot fire under dry conditions late in the year. Early season burns during cool periods may be counterproductive.

Vegetation community 4: Shrublands of relict sand dunes

Strategy: These communities are slow accumulators of fuel and there is no pressing need to burn them after any particular time period. A decision will be made to burn them when sufficient fuel is judged to have accumulated and in a year when intensive management of fuel in surrounding areas can be carried out conveniently. Attempts will be made, using wind driven fires, to avoid burning all of individual occurrences of this community in one year.

Vegetation communities 5: Vegetation communities of moderate to high flammability. Communities with a medium to tall grassy ground cover, including grasslands and the taller forest and woodland communities and previously cleared areas. Includes some eucalypt woodland habitats where fuel accumulation rate may be relatively low (5v, 5m)

Strategy: These communities accumulate fuel more quickly than others and should be the first burnt after the wet season. Well spaced fires should be lit progressively from as soon after the wet season as they will carry until, in most years, early June, with the aim of reducing the capacity of unplanned late season fires to spread. As a high proportion of the rainforest areas have margins with these communities it is desirable that a cautious approach to them be adopted by lighting the first fires of the season near their margins (see Vegetation Communities 1, above.) Aerial ignition should be considered for the later burns.

The ability to start early burning in these areas depends on having on average between one third and two thirds of them with at least two years' fuel accumulation, and patch burning operations should cease if they seem likely, in any one year, to cover more than half of the available area.

Vegetation communities 6: Communities with a sparse to moderate ground cover. Includes a range of woodland and forest communities of relatively low stature developed on low fertility sandy plains, often poorly drained, and rocky footslopes. Includes taller woodland habitats that where the ground cover is broken by rocky terrain or mixed with welchiodendron VC (5v).

Strategy: Ignite widely spaced fires through these communities during a period that should extend, in most years, from June to mid August, with the aim of promoting maximum diversity in the landscape while minimizing the danger of large unplanned fires. Burning in these areas should overlap with a program in vegetation communities 2, and be simultaneously targeted by any aerial ignition runs in the latter part of those communities. Aerial ignition should be followed up by ground ignition until seasonal conditions (indicated by fires continuing to burn for several days) are judged to be too severe to continue.

Vegetation communities 7: Communities of the range country, including woodlands, shrublands of rock pavements and closed forests.

Strategy: Most spot ignited fires in these communities will not carry far, or will trickle across the rocky landscape for days. Much of the area, in any year, will have been long unburnt. They will be burnt, relatively late in the season (August, September) using a helicopter, with ignition points widely spread across the landscape. Reliance will also be placed on chance ignition of relatively limited areas from spread of earlier fires in the valleys and foothills.

Vegetation communities 8: Vegetation communities that generally will not burn including vine forests (except where on dunes), welchiodendron forests, open wetlands and mangroves.

Strategy: Where exposed to flammable vegetation on margins, these vegetation types should be protected from fire to limit damage to their margins. When burning in adjacent communities light the first fires close to the margins, late in the day. Many areas will not require any specific action due to physical protection from fire provided by rocky talus substrates.

A2-8. Management requirements for sensitive species.

Table A2-8 details specific requirements for sensitive flora species known to occur on Badu Island that may be influenced by fire regime. Additional baseline survey on sensitive fauna species populations is required before specific management issues are identified in regard to fauna. In the case of fauna species, as it is for the majority of flora species, mosaic burning of the landscape commencing early in the year is considered the most appropriate management action.

Table A2-8. Management recommendations for sensitive flora species

Species	Habitat requirements	Fire Management Requirements
Costus poteriae (endangered NC Act) (Costaceae)	Margins of streams and wetlands, typically on the fringes of closed/ open forest vegetation. Will not thrive where light reaching the ground layer has been significantly reduced by the development of an understory.	Where habitat is being consumed by shrubland encroachment, a hot fire will be required, followed by burning every two years. The use of hot fires including experimentation with storm burning (i.e., burning after the first storms) will require meticulous attention to early season fuel reduction burning in surrounding areas.
Cycas badensis (vulnerable NC Act) (Cycadaceae)	A broad range of woodland and shrubland communities.	Mature cycads are generally tolerant of hot fires although hot

Species	Habitat requirements	Fire Management Requirements
	Will grow under forest canopies although the ability to reproduce is hampered.	fires will often destroy seedlings and seed. The seed bank is generally short lived, up to three years and any hot fire during this period will destroy the seed bank and limit ongoing recruitment. Seedlings are however tolerant of cooler fires which may promote population expansion. Healthy populations of the cycad will generally comprise a number of size classes of plants ranging from seedlings to mature adults. The recommended fire management framework that promotes patchiness in seasonal burning is considered the best practice for maintenance of the islands cycad population.
Germainia capitata (vulnerable NC Act, EPBC) (Poaceae)	Woodland and melaleuca shrubland habitats that experience seasonal inundation and periodic waterlogging.	Mosaic burning in woodland habitats, particularly focusing on control of shrubland encroachment, will promote retention of the species in the landscape.
Eremochloa ciliaris (near threatened NC Act) (Poaceae)	Eucalypt dominant woodland habitats.	Mosaic burning in woodland habitats, particularly focusing on control of shrubland encroachment, will promote retention of the species in the landscape.
Dendrobium x superbiens *(Orchidaceae)* ***Dendrobium biggibum*** *(Orchidaceae)* ***Dendrobium johannis*** *(Orchidaceae)* All vulnerable NC Act, EPBC Act	Not recorded on Badu although expected to occur due to the suitability of the habitat. A range of low woodland and shrubland habitats although most typically associated with low open melaleuca dominant woodland.	Orchid diversity is promoted by a moderate fire regime that retains grassy ground cover yet avoids severe canopy or branchlet scorch. Mosaic burning in woodland habitats, particularly focusing on control of shrubland encroachment, will promote retention of the species in the landscape.

A2-9. Operational Tasks

This section provides a checklist of items that are considered essential to delivery of fire management on purpose of this section is to list those matters that are essential to the delivery of fire management on the island. Responsibilities for each task should be allotted each year and recorded in the annual burn plan.

Table A2-9. Operational requirements of the Badu 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 Badu 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 supervisor 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 supervisor 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 Badu Island fire program should be prepared at the completion of each burn season. This should provide a summary of areas

Requirement	Comments/ Responsibility
	burnt, timing, conditions as well as mapping of burn scars. Senior ranger guided by ranger supervisor
Preparation of annual burn plan	To be completed prior to commencement of the annual burn program with consideration given to previous years activities. Incendiary burning should be considered in inaccessible locations which are suffering from the long term absence of fire.

A2- 11. Burn plan 2012 -2013

Burn Plan: Year 2012: This year will be devoted to building community support for future fire management programs by becoming involved in dealing with fire problems in the urban area, in particular with managing fires in the swamp forest in and adjacent to the town area. This will require full involvement with any brigade set-up under the Rural Fires Act and training in relevant legislation. As there is limited fuel in the swamp for burning in a controlled manner this year (2012), it will likely have to be postponed until 2013. This year, therefore, should be devoted to preparations for next year's operations by the construction of fire-breaks and trails, by encouraging land-owners to clear long grass from near houses and fence lines, and by liaising with them in relation to planned operations in 2013.

Early attention will be given to planning the works and preparations required for this year, and after the 2013 wet season, for the proposed burning of the swamps in the middle of that year. Attention will also be focused on increasing knowledge of the island's geography by driving or walking all roads and tracks, walking away from roads, and, at the end of the year, a helicopter flight around the island with the prime purpose of ascertaining what parts of the island burnt during the year. This will facilitate planning for burning in 2013. Knowledge of fire behaviour will be gained by lighting small test burns, extinguished before leaving them, in a wide range of habitats and under a range of seasonal conditions.

Burn Plan: Year 2013: There will be two separate operations in this year. One will be to burn the swamp and surrounding areas in and adjacent to the urban area, and the second will be to spread patch burning operations widely across the island's landscape to lay the basis for a permanent shift, in following years, of the pattern of burning from a late season to an early season one.

There will be three phases to the urban area work. First, there will be completion and cleaning of firebreaks and access tracks following work on them in 2012. Secondly, there will be

burning between the breaks and swamp edge, followed, if conditions are judged appropriate, by burning of the swamp.

Patch burning operations will occur progressively from as soon after the wet season as fires will carry to no later than mid September, both on the ground and in helicopter operations right across the island with the aim of leaving a minimum of fuel for late year fires. It is intended that these operations will, by reducing the occurrence of widespread late season fires, leave enough unburnt country to provide a better basis for progressive patch burning operations in the following year and subsequent ones.

Table A2-11. Considerations for protection of life and property**.**

Area	Strategy
Badu Township and Galbut	• During late wet season complete a system of fire breaks around town swamp area by slashing and/or grading, then burning slashed grass. Burn swamp after wet season while it still contains water or ground surface is still moist. • Liaise with owners to ensure long grass and other flammable material is cleared from around houses by slashing or mowing, and raking. • Identify potential fire hazards around other island settlements and essential infrastructure, and liaise with owners to ensure appropriate action is taken to protect them, including early burning around them if necessary.

Table A2-12. Considerations for biodiversity conservation

Habitat	Strategy
Coastal dune complexes containing vine thickets and related vegetation, and woodlands or isolated trees of vine thicket species	Early burn grass areas to protect sensitive species and communities from late season fires. If resources for this work are limited, concentrate on these areas where there has been recession of vine thickets from the influence of past fires.
Swamp forests and other wetland areas that will support fire	Burn while there is still surface water at intervals of two years or more. In years when they will not be burnt, carry out intensive fuel management in adjacent areas to minimize the chance of fire entering them when they are dry.
Areas of vegetation thickening within grassy woodland and forest areas	Vegetation thickening reduces biodiversity within the ground layer species of the site, and could, in the long term, spread, leading to an inability of the habitat to regenerate itself. When such areas are identified, attempts will be made to reverse the thickening process by one or more late season fires. Before such burns there will be intensive fuel reduction in surrounding areas to limit the spread of late season fires.

Table A2-13. Considerations for weed management.

Identify areas that will not be covered by the island-wide burning program, mostly in the vicinity of settled areas, where it could be useful to burn patches of heavy weed infestation, with follow-up spraying when new plants begin to germinate.

Table A2-13. Fire management program checklist (example)

Action	Responsibility	Date Achieved
• Has equipment been checked and serviced, and will it be adequate for the planned program?		
• Have all necessary approvals and permits been obtained, and relevant people advised?	Is there a fire warden? Is Council approval needed?	
• 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.	
• Are adequate maps available?	Consult with 3D Environmental / TSRA GIS section on this.	
• Are safety and emergency plans in place?		
• Have those involved been briefed on the requirements of the burn plan, on safety and emergency plans, and trained in the use of equipment?		
• Has responsibility for post burning season reporting been allocated?		