PROFILE FOR ECOLOGICAL FIRE MANAGEMENT OF MUA ISLAND

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1. INTRODUCTION

Moa Island is a beautiful and fortunate place. It sits in shallow waters that scarcely divide Australia, perhaps the most ancient land on earth, from one of its youngest, the island of New Guinea. Over the ages sea levels have risen and fallen, and at its lower levels these two so very different lands have been joined, and plants and animals have moved between them. Moa Island is fortunate to have been enriched by that two way flow of the richness of life forms of two very different lands. That history, and the variety of its landscapes, explains in large part why Moa Island is today, for its size, one of the most diverse places in northern Australia for habitat variety and the number of plant species found there. The island is also fortunate in that, unlike most of Australia, its natural landscapes have largely escaped even partial destruction. In addition, it is surrounded by what has been identified as one of the world's most pristine tropical seas.

With its own intrinsic beauty of hills and coastline the island is a tranquil central adornment to one of the world's richest, largest, and least disturbed great natural areas, rimmed by the great mountains of New Guinea, the vast forests and woodlands and undisturbed coastline of Cape York Peninsula, and near the waters and reefs of the northern extent of the world's greatest coral reef.

The people of Australia are also fortunate that these islands and waters have for so long been entrusted by fate to the peoples of the Torres Strait to whom so much of the credit for their current unimpaired condition must surely belong.

1.1 The Need for Fire Management

The vegetation of Moa 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 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. Now, however, the fire regime would seem, from the observations of the writer, and the information provided to him, to be largely the result of the chance action of individuals, and no longer guided by the purposeful activity of island society.

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

Photograph 1. Well managed *Melaleuca viridiflora* dominated woodland on poorly drained soil, south of St Pauls.

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 Moa 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 Moa 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 Moa Island, 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 ore 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 MOA ISLAND

The precise direction of fire management on Moa 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 could be difficult.
The alternatives for fire management on Moa 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 if that is so, as to what purpose would trying to change things serve? That question is addressed below.

From information provided by the rangers it would seem that the island is in good condition because large parts of it are still regularly burnt. It would also seem, from that information, that the fires are lit by hunters and “firebugs”. If the fires are not being lit to serve a larger purpose, and where and when they are lit is largely a matter of chance, then it cannot be guaranteed that that good condition will endure in the longer term.

It was noted that under the present fire regime there is at least one large part of the island that has not been burnt for some time, and early signs of habitat change such as thickening of the understory, and loss of species from the ground cover, were observed there.

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 understood that there could be a desire by some to exclude fire from the hills around St Pauls, and there is clear evidence that much of the grassland there has been derived from the destruction of former rainforest by fire. The writer has sympathy for the view that is held by at least some island residents that it would be a good thing to let the rainforest regenerate. For that purpose the complete exclusion of fire would be an obvious and quick way to achieve it, and in a limited area, with considerable effort and community co-operation, that is possible.

Unfortunately, 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. An outline of the basic knowledge and approach necessary to achieve this is provided in the next section.

2.1 Fire Behaviour of Moa Island Habitats

Map 1 illustrates six divisions of the island into categories according to the way in which fire behaves in various habitats. These are basic divisions and the real situation in regard to fire behaviour is much more complex than this. It must be emphasized that no fire management plan that is not informed by detailed knowledge and on the ground practice in the parcel of land to which it refers, can be more broadly prescriptive. If that experience and knowledge is not present then opportunity must be provided for its development by providing a starting point that reflects a broad understanding of fire behaviour in particular habitats and the general principles that guide its management. This document purports to do no more than that.

The categories into which the island is divided and which are illustrated on **Map 1** are now described, and the way in which fire should be used in each of them outlined.

2.1.1 Category 1

This illustrates the areas which with two exceptions are unlikely to burn in most circumstances. It includes rainforest and other closed forests, including those along streams and some swamps, mangroves and saline areas, rock pavement communities, and coastal dune complexes.

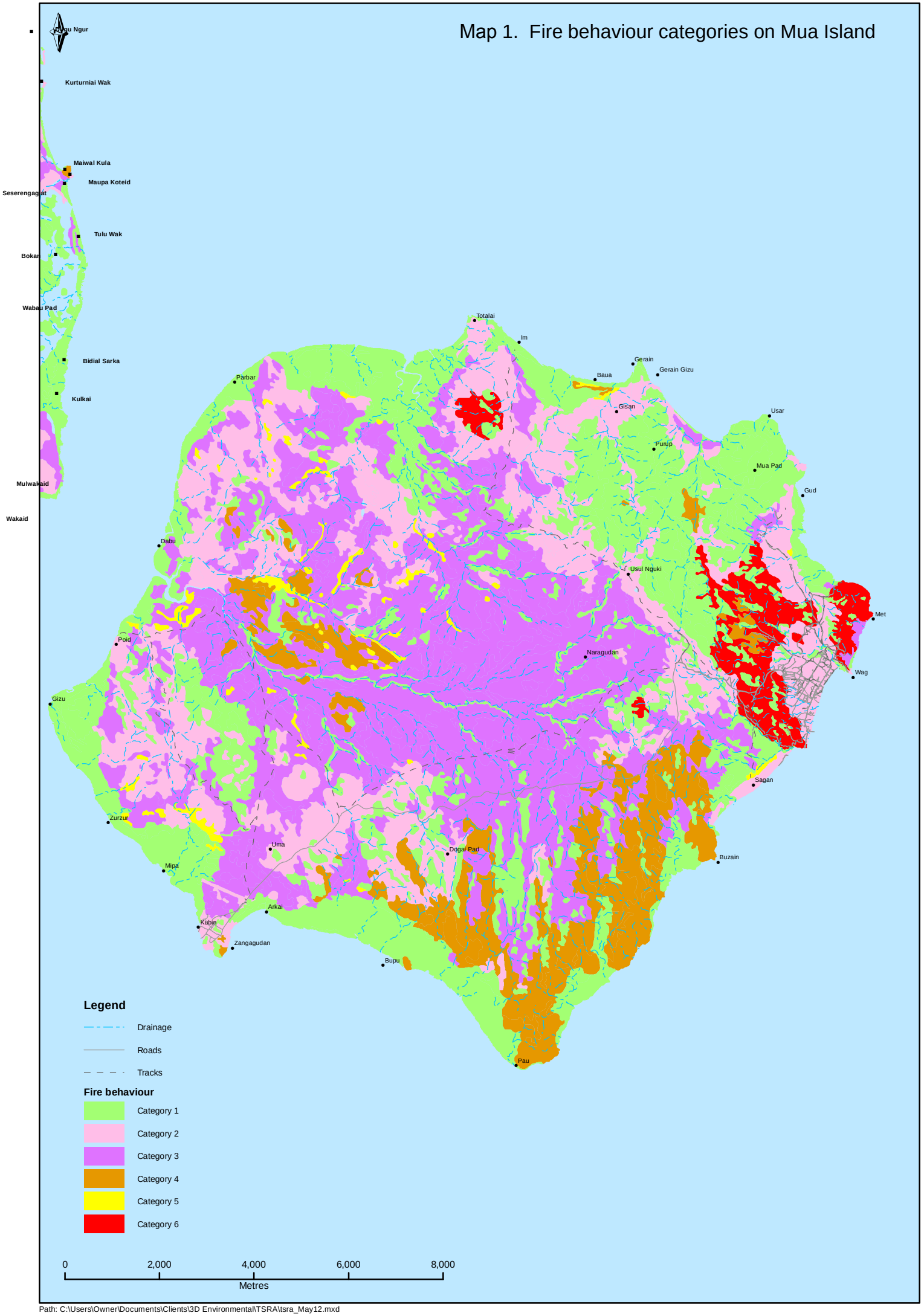
For the purpose of brevity and clarity the term "rainforest" used in the rest of this report refers to all closed forests mapped as vine forest and thicket, both evergreen and semi-deciduous, riparian forests and some swamp forests, and most forests dominated by *Welchiodendron longivalve.*

In the case of the coastal dune complexes, experience might indicate that some action needs to be taken to protect the vine thicket communities within them by some cool burning of interspersed grasslands. This will have to be judged on a case by case basis. Another more significant exception to the fire exclusion precept for this category is the saline grassland dominated by salt-water couch (*Sporobolus virginicus)*. This can be burnt under regularly occurring circumstances and does not appear to be hurt by fire, but it is not clear that it would benefit from it. On that basis it is suggested a conservative approach be adopted and the community not be deliberately burnt.

2.1.2 Category 2

This accommodates areas of better soil which support a heavy medium to tall ground cover of grass which rapidly re-develops after each fire event and reaches maximum fuel accumulation within 3 to 4 years. It covers grasslands and the taller forest and woodland communities, some

Map 1. Fire behaviour categories on Mua Island



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areas which had been cleared and which are either being maintained as grassland or are regrowing.

These are the areas which need the most attention as, without being broken up by numerous small fires, starting with whatever will burn as early as possible after the wet season, they have the potential to support fires which will burn over large areas, possibly for days on end. As most rainforest areas have vegetation types within this category along their margins there is the potential for hot fires within them to damage those margins. Although rainforest boundaries are mostly stable, there is evidence of recent recession in places as a result of fire damage to them. There is also strong evidence that some grasslands have developed after the destruction of former rainforests by fire.

In brief, an appropriate strategy for this category is to break the country up with small fires, ignited progressively during the year, to such an extent that any unplanned fires will quickly run into previously burnt areas, and be incapable of gathering the momentum necessary to sweep over large areas.

2.1.3 Category 3

This category includes a range of woodland and forest communities of relatively low stature developed on low fertility sandy soils and rocky footslopes, and melaleuca (paperbark) dominated communities of sandy poorly drained infertile plains and some rocky footslopes. They are united in the common feature of a sparse to moderate ground cover of grasses, sedges and herbs, which does not support fire as easily as the ground cover of those communities in **Category 2.**

Large areas within this category are difficult to ignite unless they have been unburnt for several years, and even then only when the dry season is well advanced. Like areas in **Category 2** they are best managed under a patch burning regime. This type of regime offers the best chance of promoting maximum biodiversity while minimizing the danger of large unplanned fires.

Areas in **Category 3** should only be burnt when the burning program in **Category 2** areas is well advanced. This is because they will be unlikely to burn before well into the dry season, and fires within them have the potential to run into high fuel accumulations in **Category 2** areas, igniting large fires which the program in those areas is designed to avoid.

Photograph 2. The margins of non-flammable rainforest vegetation (Category 1) against a flammable woodland habitat (Category 2).

Photograph 3. Grassland on a poorly drained alluvial flat (Category 2) and a bordering swamp forest (Category 5) near the south-western coastline.

2.1.4 Category 4

This covers areas dominated by shrubs, with some areas of low open woodland. They can be subdivided into two types according to the way in which fires in them behave. There are those dominated by shrubby forms of the tree *Welchiodendron longivalve*, and those in which the shrub or small tree *Asteromyrtus brassii* is a prominent canopy species. The former community is confined to rocky areas of shallow soil often interspersed with large areas of bare rock. Ground cover, depending on the depth of soil and height development of the canopy, varies from a light to moderate cover of sparse grasses, sedges and herbs to almost non-existent. The latter community is mostly developed on old dunes or sandy plains.

The variability of the welchiodendron dominated communities makes it difficult to define an appropriate fire regime for them. Where ground cover is sparse to non-existent they burn rarely, if ever, and would show little obvious change for possibly many decades after a fire. There are, however, likely to be a number of short-lived species within them that would only regenerate from seed, and are likely, therefore, to need a fire for that to happen. Where there is a light ground cover in these communities they will support fire at intervals of a few years, but will need dry and even windy conditions for that to happen.

For those shrublands in which *Asteromyrtus brassii* is prominent, their fire ecology is well known from observations in the large areas they cover in the northernmost parts of Cape York Peninsula. These communities tend to change only slowly with time since last burn, and usually require 4 to 5 years or more before they have acquired enough fuel to burn again. The main changes to be observed are that many species within them are relatively short lived and will only regenerate from seed, gradually disappearing only to reappear after the next fire. There is no imperative to burn these areas as soon as they are ready to burn as most shrub species within them will reappear after burning even when fire has been absent for many decades. The need to continue burning these communities, however infrequently, is due to the fact that after 10 years or so species begin to disappear from them. In the very long term it is inevitable that without fire they will be dominated by a few long-lived species capable of forming a canopy, and therefore excluding those light-demanding species that cannot. More importantly, the fate of the many light-demanding species in the ground layer is of potential concern. As the shrub canopy thickens with time excluding light from the ground layer, there will be a total disappearance of the grasses, sedges, and herbs which comprise it. It is unlikely that most of these would have sufficiently long lasting seeds or tubers to regenerate decades after they had disappeared.

It is important to be aware that these communities often burn in a way that consumes them completely, leaving only blackened bare stems and bare ground. This, despite its appearance, is

not destructive of them as they have great regenerative power after such events, and are more likely to be harmed by the species impoverishment that follows fires that are too mild to remove enough of the canopy, or to consume enough litter, to provide the light and bare ground that is critical for the regeneration of many species.

2.1.5 Category 5

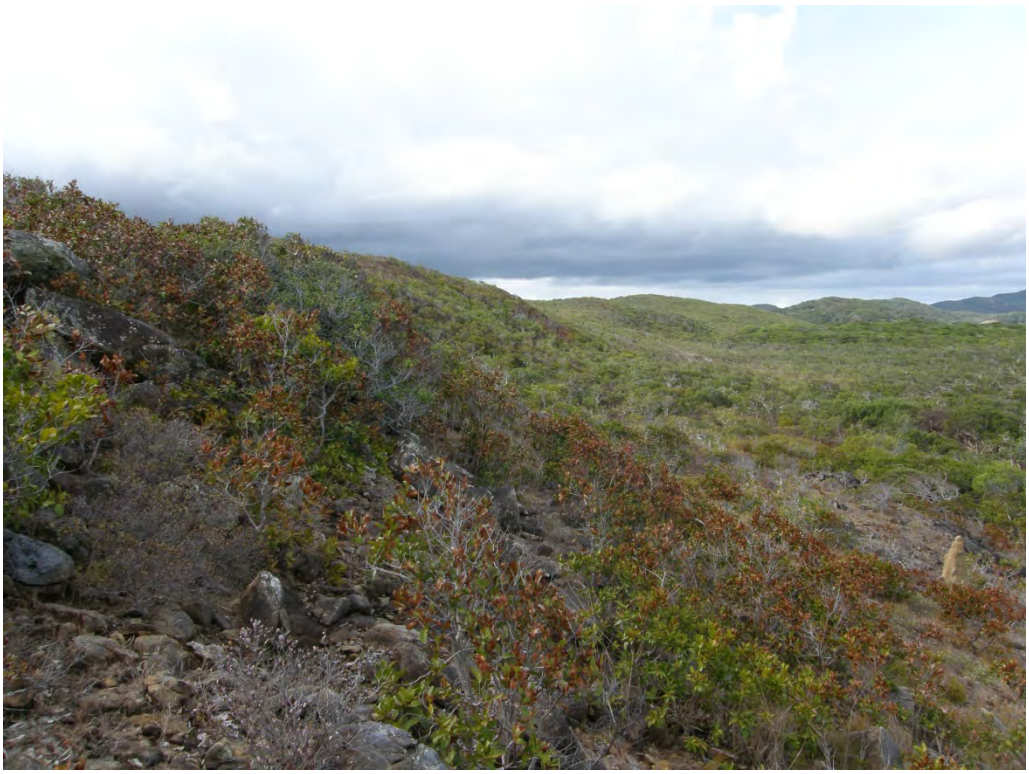
This comprises some swamp forests that are seasonally wet. Although they carry water for much of the year, and possibly throughout in some years, they will support regular fire. They quickly accumulate fuel from the profuse litter provided by such understory plants as pandanus and palms, and in places from heavy growth of grass and ferns. Even those paperbark communities that have little ground cover are profuse shedders of leaf litter that will burn when dry. These swamp forests are generally capable of burning again two years after a fire. As they dry out there is a progressive increase in the amount of fuel available to burn, and late dry season fires can be very hot and destructive. The greatest threat to them, however, arises in those communities that have a surface layer of peat. This is formed from litter which accumulates in wet ground where a lack of oxygen prevents its full breakdown, and it becomes compacted as more litter accumulates.

This peat will burn when dry, generating great heat and providing fires that cannot be extinguished, often burning for weeks, or even months. In the process they kill all living roots, leading to the death and collapse of trees and all other plants. On average, such events are rare in any individual swamp, as demonstrated by the presence of large trees some of which are likely to be more than a century old. The writer has observed such fires several times on Cape York Peninsula, and along the wet tropical coast.

Because swamp forests with a peat layer on the surface soil are of very limited extent on Moa Island, any loss of those forests to fire would be serious. Management of them should aim to avoid that risk which would only arise in the very rare extreme drought events when the peat layer has dried out.

2.1.6 Category 6

This is a limited area with some unique characteristics and management issues. It consists of a single vegetation and mapping unit which is a complex of grassland and open forests and woodlands dominated by the tree *Welchiodendron longivalve.* It has clearly been derived from the destruction by fire of former closed forests (covered by the term rainforests). This would not have resulted from a single fire but as a result of numerous fires over a long period of time. It occurs in



Photograph 4. Category 4 shrubland of welchiodendron on rocky slopes south of Saveka Point showing signs of fire scorching (November, 2007).

Photograph 5. A seasonally wet dune swale with melaleuca (Category 5). This habitat will dry out during the later part of the year.

two locations: one in the hills surrounding St Paul, and the other on a single hill just to the south of the central northern coastline. Its characteristics and management are dealt with in **Section 3.3.2.**

3. RECOMMENDED ACTION FOR THE ESTABLISHMENT OF A FIRE MANAGEMENT PROGRAM FOR THE WHOLE OF MOA ISLAND

3.1 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 Moa, and some other islands, the inheritance of habitats, plant species, and wildlife they have today. Unlike in most parts of Australia where massive change to the natural landscape has occurred, these habitats 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. On Moa 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 that are 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 Moa 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 mosaic burning system, progressively applied during the year, and appropriately applied, 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.

3.2 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.

3.3 A Plan for Progression to the Establishment of Effective Fire Management of the Island as One Unit

3.3.1 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. (See Map **1**)

ii. As soon after the wet season as fire will carry (April-May in most years) burning will begin in those habitats (**Category 2** on **Map 1**) where fuel accumulates most rapidly and there is the greatest potential for fire scorch in sensitive habitats (**Category 1** on **Map 1**; areas that won't burn). 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 (**Category 3** on **Map 1**) threatening the desirable orderly progression of burning across the landscape and running the risk that fires in the first target area (**Category 2**) might cover a wider area than desirable.

The nature of the ground cover in the tall grass areas mapped as **Category 2** 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 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 those areas mapped as **Category 2** 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 **Category 2** areas 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 areas of moderate to sparse ground cover identified as **Category 3** on **Map 1**. 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 **Category 2** areas. **Category 3** area contains 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.

v. Shrubland communities, and communities of rock pavements (**Category 4** on **Map 1**) pose some peculiar problems of management which vary 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, will not burn under most circumstances, and then only in trickling ground fires. There are also areas which carry enough ground cover to support regular light fires. When, as is the case in places on Moa Island, 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. As is the case for the welchiodendron dominated shrublands there is a risk to surrounding communities if they are burnt late in the year.

Considering all the matters discussed above it is judged that, until more experience of burning these communities under Moa Island conditions has been gained by some years of operating a fire-management program for the whole island, a conservative approach should be adopted. This should take the form of relying on chance ignition of them from operations in surrounding areas (mostly category **3**) and if helicopter ignition is undertaken in July and August those operations should be extended to the shrubland areas.

vi. The swamp forests of **Category 5** (see **Map 1**) are mostly 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 are capable of supporting very hot fires even while they hold water.

Photograph 6. In a swamp forest John Wigness demonstrates how pandanus leaves support hot fires. The fire was confined to the tree as there was insufficient litter on the ground to ignite, as the result of a fire a year earlier. By chance the lone tree had escaped that fire.

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.

Because of variations in the nature of these 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.

vii. There are large areas of a grassland-woodland complex on Moa Island where the evidence from landscape patterns shows clearly that it has developed on areas that

formerly supported rainforest. The main areas of this complex are illustrated on Map 2. This attrition of rainforest must have been driven by fire, and would have occurred over a long period of time. The 1971 aerial photography provides evidence that the patterns have been stable for at least 40 years but no attempt was made to determine whether they are pre-European in origin.

The patterns of rainforest and grassland/woodland complex are now stable because the rainforest has retreated to rocky areas the edges of which provide an impediment to further incursion by fire. The grassland/woodland complex is a native ecosystem and its management is covered well by the recommendations for **Category 2** areas. A question arises, however, as to whether it should be maintained as such or be rehabilitated as a long term aim. There is no appropriate answer to that question arising from ecological consideration. The rainforest and grassland are both natural ecosystems and which is to be preferred is a matter of value judgement, or a question of aesthetics, that must be left to a community decision. The relevance to this report however, is that the fire management of the grassland/woodland complex will vary depending on what the long term objectives for the area are. This will be discussed further in the sections that follow**.**

viii. 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 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 remove an 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.

Fires that burn through the night: When this begins to happen it indicates it is time to either cease operations for the year, or continue after the first storms. Alternatively, fires should be confined to areas where it is known they will be confined by breaks, such as provided by creek lines or earlier burns, and lit so that they burn into the wind.

3.3.2 Short Term Objectives

1. Year 1 – 2012

If rangers are to develop their capabilities to the point where they are providing fire management for the whole island then they will first have to demonstrate a capacity to provide safety for the communities and the infrastructure they depend on. Indeed, without that their activities could generate unease in the minds of some members of the community that could negatively impact on their ability to function in the wider environment.

In the first year, therefore, they should take whatever opportunities are available to further their training in fighting or working with fire in the community situation. Any new rangers should first get appropriate training in that area.

All rangers should be familiar with the Fire and Rescue Services Act 1990 and be actively involved in any local brigades formed under that legislation, including possibly accepting positions as First Officers or Rural Fires Warden.

This year should also be seen as an opportunity to become completely familiar with the island's geography, including the location of all roads and tracks, huts and any infrastructure remote from the main settlement. Rangers should also be constantly trying to develop an understanding of the way fire behaves in all habitats, under varying fuel loads, and at different times of the year, by lighting fires which are allowed to burn a few square metres before they are extinguished.

Photograph 7. Learning about fire behaviour. A test fire lit to test early season readiness to burn (24th April). The fire was extinguished but clearly would have failed to carry much further.

2. Year 2 – 2013

This year should be devoted to a relatively small project close to the community, to assist in the development of skills and confidence in techniques of progressive burning for ecosystem management, and in the skills they have been trained in to protect the community and its infrastructure and the use of equipment. As ensuring the safety of the community and infrastructure will be a mandatory feature of every year's work it is an important starting point for not only building the confidence of the rangers, but also the confidence of the community in them. Working in a highly visible locality will, if the program is successful in achieving its aims, also facilitate the achievement of that latter aim.

It is, of course, possible that a mistake at this early stage could destroy public confidence and kill fire management of the island at birth. That risk is minimal if work starts early in the season and a cautious approach is adopted, and will have to be accepted.

The recommended area of operation is as defined on **Map 2**. It is the grassland/open forest and woodland complex surrounding St Pauls, including both flats and lower slopes and the hills themselves. It includes, to the north of the town areas of swamp forest, melaleuca woodlands, clearings, and regrowth vegetation. It is confined to areas north of the Kubin-St Pauls Road from

near the turn-off to the old airport clearing eastwards towards the town. Its limits are defined by margins of the large area of continuous rainforest to the west of the town and north of the old airstrip, and to the north of the town by mangroves and the coastline.

Photograph 8. Surviving rainforest trees protected by rock in a grassland/open forest and woodland complex on hills near St Pauls.

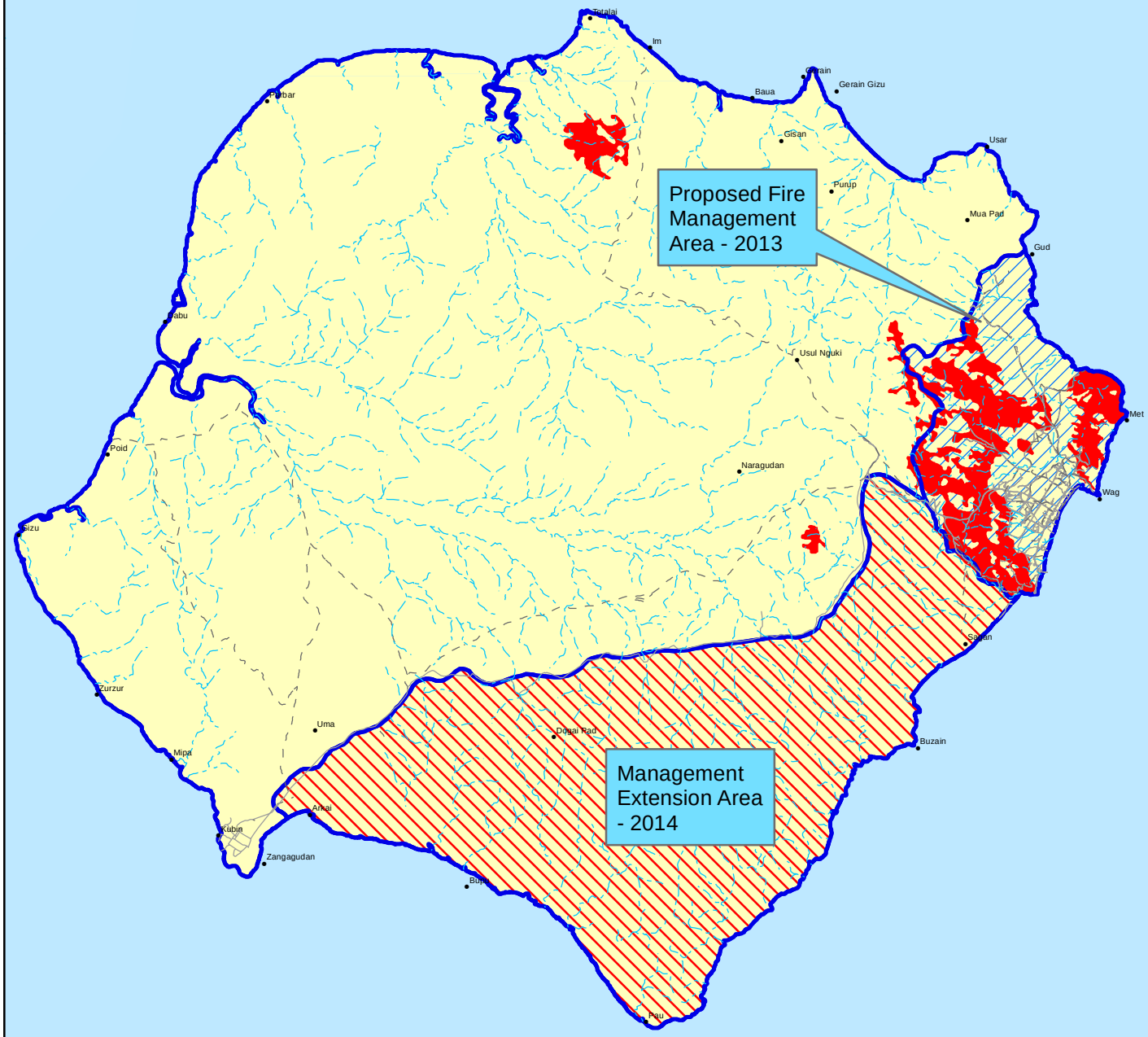
To completely establish the limits of the area it will be necessary to create a break between the road to the old airport from near its turn-off from the St Pauls Road, northwards to the rainforest margin. This could be done by burning a wide strip of grass in this location as early as possible.

Within this area the grassland/open forest and woodland complex is contiguous with grasslands of flats and lower slopes, and some cleared and regrowth areas belonging to **Category 2**. It is not possible, therefore, to separate these two areas in practice and the management requirement of **Category 6** will be adopted throughout. For other habitats the management prescriptions for their various categories as spelt out in **Section 2** and defined on **Map 1** will apply.

The recommended action will vary according to which of two long-term habitat outcomes is desired, i.e., (1) rehabilitation of the rainforest, or (2) stabilization of the present pattern of rainforest and other closed forest communities and grassland.

For either alternative the preparation of fire breaks around the township will be the first priority. The nature and location of these firebreaks cannot be prescribed in this report, and is best

Map 2. Proposed areas to implement short term fire objectives



Legend

- Drainage
- Roads
- Tracks
- Category 6

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Metres

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determined by those on the ground. It will most likely involve the use of existing roads and some early burning. The second priority for action should be to fortify the firebreak provided by the road from the old airport turn-off to the town by burning a substantial strip along its northern side. Further action will then be defined by which of the two long-term objectives is selected and these alternative actions are described below.

Alternative Objective 1 - Rehabilitation of the Rainforest: While rainforest could slowly expand under the recommendations of (2) below, the outcome is uncertain and results would not be visible quickly. If, however, fire could be permanently excluded from at least the higher slopes and ridge tops a progression towards reforestation would gain unstoppable momentum.

A decision to exclude fire from an area runs a high risk of failure. In remote areas there is a problem in providing adequate firebreaks, and the risk of lightning ignited fire. Near settled areas firebug activity could also be a serious problem. Perversely, however, this risk could be decreased in the vicinity of St Pauls if there is strong community interest in the project.

If the risks are considered worthwhile then the following action would be entirely concentrated on utilizing a wide strip consisting of the area above any prepared break adjacent to the road and the township as a “sacrifice” area in which as much fuel reduction as the prevailing fuel load will allow is carried out by burning before the end of June every second year. This will be difficult because of lack of fuel if the area happens to burn in 2012. If that happens, then the focus in 2013 should be on using a helicopter to ignite, early in the year and throughout the area any patches that missed burning. The purpose of such action would be to limit as much as possible, the spread of any late fire in that year.

If there is sufficient fuel in 2013 a helicopter should be used to spread a line of fire well upslope from the township and road. If this takes place in mid to late afternoon at a time when fires will extinguish at night (April to mid-June depending on the seasonal conditions) then the spread of the fire will be limited. This operation will then need to be followed as soon as possible by late afternoon ignition over several days of whatever remains unburnt immediately above the road and township.

The operation described above defies precise description and will depend very much on the judgement of those involved, and as stated above, there is a high risk of failure to achieve its objectives. It can, however, be done in a way that poses no risk to the community or those involved, and would ideally be approached in the first year as a training exercise.

Alternative Objective 2 - Stabilization of the Present Vegetation Patterns: This would be a much simpler process than the one described above under (1). It would involve early firebreak preparation along the road edge and around the town, follow essentially by the procedures outlined for **Categories 2 & 3** vegetation types (see **Section 6.1**) with a shift in focus of timing and intensity of ignition to acknowledge the prime purpose of giving maximum protection to remnant rainforest species and clumps of vegetation scattered through the grassland.

Because of the size of the area involved and the difficulty of ground access provided by its rugged topography, helicopter based ignition is the only option for most of it. The task becomes one of ensuring that all fires in the area are cool ones that will self-extinguish either late in the afternoon or at night. This should be done by an intensive pattern of ignition as soon after the wet season as fires will carry, followed by another operation a few weeks later. The appropriate timing for the first operation should be determined from ground based ignition for preparation of firebreaks along the road and around the town, and in those grasslands of the lower slopes and flats to the north of the township. The helicopter should not be used until preparation of those breaks has been completed.

3. Year 3 – 2014

The program set out for the year 2013 is the first step in developing a fire management program to cover the whole island, and is intended to continue indefinitely with any adjustments that might be considered necessary to cater for experience gained in the previous year.

The recommendations for 2014 embody one more step in a cautious approach designed to build experience and confidence before moving into the final stage of establishing a fire management program to cover the whole island. It is recommended that work be extended into an area that is defined as all parts of the island between the road from Kubin to St Pauls and the coastline (See Map 2).

This area contains a majority of the habitats found on the island but appears to have been burnt far less frequently than other parts of it. On casual inspection of some areas of open forest near the road it would seem likely that some significant parts of it would be in need of a fire to halt understory thickening and consequent loss of ground cover.

Extending operations to this area would remove the need to burn a firebreak north of the road between the old airport turn-off and St Pauls, but will replace it with a need for extensive burning on the seaward side of the main road from the turn-off to the old airport to the vicinity of Kubin. It

will also involve a significant extension of responsibility for protection of infrastructure to around Kubin and on the southern outskirts of St Pauls.

Because of the likely significant accumulations of fuel adjacent to the main road, and the potential for fires driven by the prevailing wind to jump it, considerable work will be required to reduce fuel in a strip of a minimum width of 100m, but preferably much more, in all habitats that will support fire along its full length. Because of that scale of fuel accumulation, however, it should be possible to commence burning early in the season. A suggested mode of operation would be to light along the road edge, avoiding times of strong wind and starting, for maximum safety for those involved, at a time of decreasing hazard (most likely between 2.00 and 3.30 pm). This would be followed by a program of walking in from the road to distances of 100-200m to fill in those areas where the burn from the road edge did not travel far enough.

Once the fuel reduced break along the road is completed burning can commence within the full area scheduled, according to the guidelines for the various fuel types set out in Section 3.

4. Year 4 – 2015

During this year attention will shift to implementation of the full fire management direction for the island as set out in **Section 3.3.1** of this report.

The operations under **Section 3.3.2** (short term objectives) for Year 2 – 2013, will continue as an essential part of this broader task, but those scheduled for Year 3 – 2014 will be subsumed by it and no longer relevant on a continuing basis.

4. REFERENCES

Gammage, B. 2011 – *the biggest estate on earth*. Allen and Unwin

Jones, R. 1969. *Aust Natural History 16*, pages 224-48.

Russell-Smith, J, Whitehead, Cooke, P. (eds) 2009. *Culture, Ecology and Economy of Fire Management in North Australian Savannas: Rekindling the Wurk Tradition*. Tropical Savannas CRC, CSIRO Publishing, Collingwood, Victoria.

5.0 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.

Each year burning will start as soon after the wet season as fires will carry, and move progressively from the grasslands and forests and woodlands with a tall grass understory, to other woodlands and forests with a sparser ground cover, and then the more rugged parts of the island dominated by shrublands. The most accessible areas will be burnt from the ground and other areas by helicopter. Shrublands will be burnt by widely spaced ignition points from the air and from chance escapes from fires in adjacent areas. Particular attention will be given to the protection of rainforest and vine thicket edges, and to the prevention of peat fires in swamps. In both cases a management strategy to minimize the risk of late season hot fires will be adopted.

The hills near St Pauls which, the evidence suggests, once supported rainforest, but are now a complex of grassland and rainforest remnants, will be managed by different fire regimes, depending on whether the aim is merely to protect and stabilize existing rainforest boundaries, or to provide an environment in which they can expand to re-occupy their former range.

A2. FIRE MANAGEMENT STRATEGY

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

The aims of the fire management strategy are to:

- to ensure as the highest priority the protection of life and property;
- to 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;
- to replace any existing fire patterns dominated by relatively few large fires with smaller more numerous ones;
- to provide the conditions under which fires can self-extinguish;
- to protect the edges of rainforests and vine thickets from scorch, and to promote the rehabilitation or protection of rainforests in the rainforest-grassland complex near St Pauls;
- to manage specific habitats to provide appropriate conditions for the survival of sensitive species.

A2-2. Ecological description of the island

Location and Landscape: Moa Island is the largest island in the Near Western Island Group and the second largest island in the Torres Strait. The island, with an area of 17 001 ha, is characterised by numerous rocky knolls with Banks Peak forming the highest point at 376m. Moa Island is topographically diverse, with a rugged east and south facing coastline dominated by rocky coastal headlands, and an expansive sandy coastal plain which forms a broad enclave behind the islands north-eastern coastline. The drainage features and watercourses of Moa are the best developed of all the islands in the Torres Strait. Tutalia, Kai and Double Creeks are the largest of these watercourses, originating from wet elevated terrain in the Moa Peak area and draining across the coastal plain towards the west and north-west.

Climate: The islands of the Torres Strait have a monsoonal climate, characterised by south-easterly trade winds that blow relentlessly between May and September and a period of more

variable north-westerly trade winds occurring between October and April. The Moa Island recording station is the second wettest in the Torres Strait Island group with a mean annual rainfall of 1 797mm (BOM 2008a) compared to Badu which is the wettest at 1 983 mm and Dauan which is the driest recording station at 1 082mm (BOM 2008c). It is expected that rainfall on Moa Peak is much higher than the recording station, being enveloped in cloud for significant portions of the year. Seasonal records indicate rainfall dramatically increases from November to December with the onset of the monsoon storm season. February is the wettest month on average with 382 mm falling and September the driest with 6.7 mm falling. 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°.

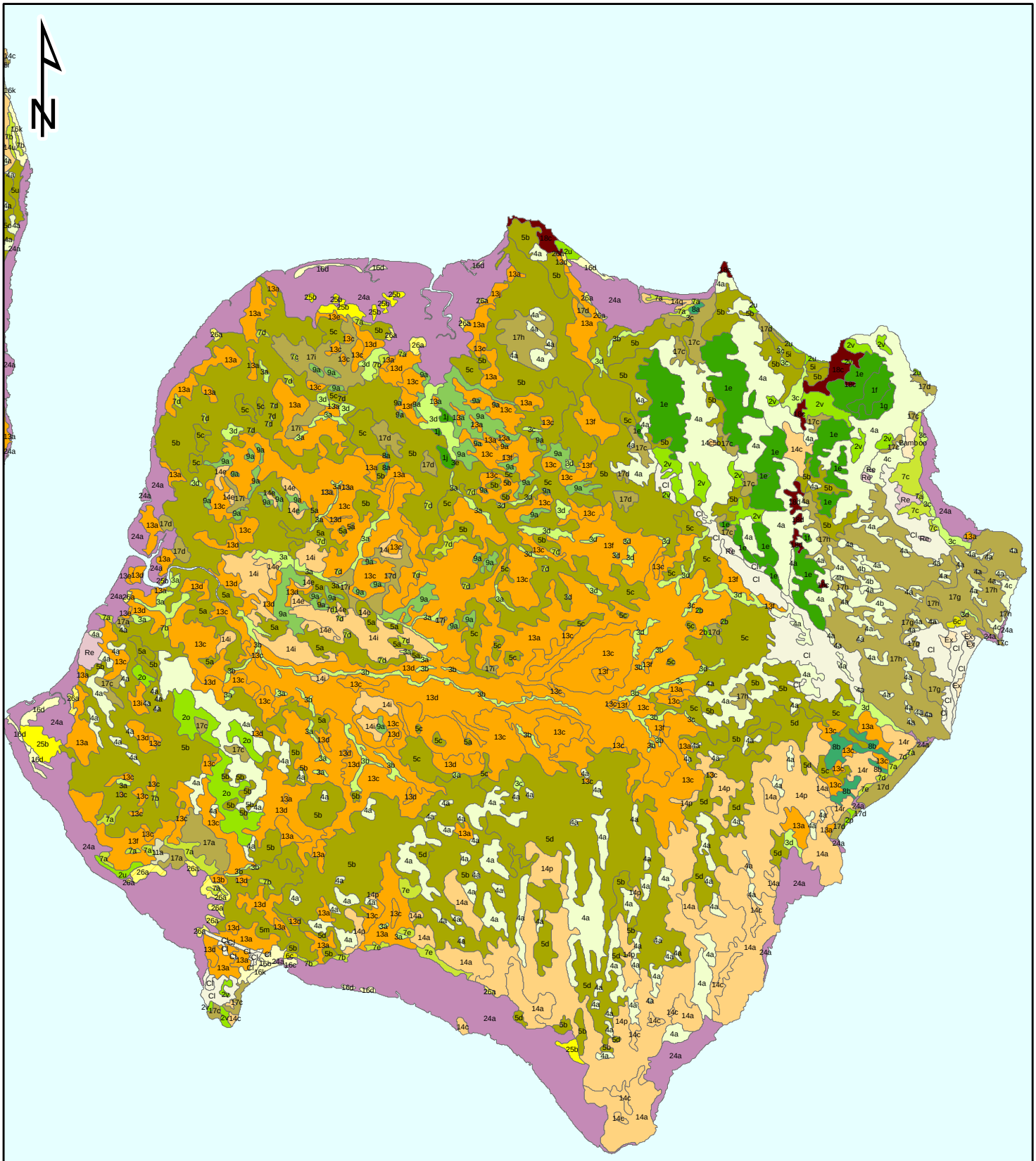
Vegetation: The island is blanketed with a mosaic of natural vegetation with cleared and otherwise disturbed areas forming <2.5% of the islands total area. A total of 18 broad vegetation groups are represented on the island of which eucalypt dominant woodlands are the most extensive occupying 4782 ha or 28% of the islands area. Rainforest habitats dominate the islands elevated regions as well as moist locations on drainage lines whilst shrublands are most extensive on infertile substrates including leached sandy plains and infertile rocky hills and headlands. The islands vegetation communities are shown in following pages.

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

From observations made during field assessments, traditional burning has been abandoned and replaced with a more opportunistic approach to the use of fire, mostly by hunters and random firing events. In recent periods, most of the island has been subjected to fire at varying intervals with the most regular burning carried out from roads and tracks in the more accessible gentler country and the hills adjacent to St Pauls. Less accessible areas appear to have been burnt less frequently, and fire incursion into these more remote areas has resulted from fire that has spread occasionally from those lit along roads and tracks. Large areas east of the Kubin-St Pauls road, with the exception of accessible coastal dunes south of St Pauls, appear to have been burnt infrequently. It is apparent that most fires have been in the latter half of the year in conditions that have promoted the greatest fire intensity and burn extent.

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 Moa Island

Client: Torres Strait Regional Authority

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Metres

Scale 1:92,000 | Drawn By DG | Checked DS | Date 26/10/2012 | A4

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Evergreen vine forest and vine thicket

1e, Mesophyll/notophyll vine forest + *Myristica insipida + Maranthes corymbosa + Cryptocarya cunninghamii + Dysoxylum latifolium + Calophyllum sil +/- Arenga australasica*. Granite footslopes.

1f, Complex notophyll vine forest + *Pouteria sp. + Calophyllum sil sp. + Argyrodendron polyandrum + Palaquim galactoxylon + Acmenospermum claviflorum + Licuala ramsayii*. Upper slopes on granite.

1g, Evergreen notophyll vine thicket + *Calophyllum sil + Syzygium branderhorstii + Diospyros hebecarpa + Schefflera actinophylla + Podocarpus grayae +Licuala ramsayi.* Upper slopes on granite.

1j, Tall evergreen notophyll vine forest + *Syzygium angophoroides+Acmena hemilampra + Acacia aulacocarpa +Syzygium forte subsp. forte + Podocarpus greyae*

Deciduous/Semi deciduous vine forest and vine thicket

2b, Semi deciduous vine forest/thicket + *Canarium australianum + Terminalia subacroptera + Bombax ceiba var. leiocarpum + Cochlospermum gillivreai + Cleistanthus peninsularis + Ficus virens var. sublanceolata*. Footslopes on granite and rhyolite.

2o, Semi deciduous notophyll vine forest + *Acacia sp.* (DGF8919+) + *Barringtonia calyptrata + Maranthes corymbosa + Syzygium forte subsp. forte + Bombax ceiba var. leicarpum + Canarium australianum*. Footslopes on metagranite.

2p, Semi deciduous vine thicket (windsheared) + *Bombax ceiba var. leiocarpum + Premna serratifolia + Acacia crassicarpa + Manikara kauki + Drypetes deplanchei + Terminalia subacroptera +/- Arenga australasica.* Coastal dunes.

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

2v, Semi-deciduous vine thicket + *Acacia polystachya and Terminalia subacroptera*. Coastal headlands on rhyolite and granite.

Swamp and riparian forest complexes

3a, *Lophostemon suaveolens + Melaleuca quinquenervia + Syzygium angophoroides + Asteromyrtus brassii + Dillenia alata* swamp forest complex. Alluvial depressions, drainage lines and dune swales.

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.

3d, Evergreen mesophyll vine forest / *Sclerophyll vine forest complex + Syzygium forte subsp. forte + Syzygium bamagense + Horsfieldia Australiana +/- Melaleuca leucadendra +/- Lophostemon suaveolens*. (1i/3b- 50/50)

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).

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.

4b, *Welchiodendron longivalve* low woodland, low open woodland and tall open shrubland

4c, Low *Welchiodendron longivalve + Melaleuca dealbata* open forest. Granite footslopes and peidmont fans.

Eucalypt dominant open forests and woodlands

5a, *Corymbia novoguinensis +/- Eucalyptus stockeri subsp. peninsularis* woodland and open forest. Remnant sandy plains.

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

5c, *Corymbia clarksoniana + Melaleuca stenostachya + Melaleuca viridiflora +/- Asteromyrtus symphiocarpa +/- Parinari nonda +/- Asteromyrtus brassii* woodland. Alluvial plains and sandy rises.

5d, Low *Corymbia clarksoniana + Melaleuca viridiflora + Welchiodendron longivalve + Asteromyrtus brassii + Acacia leptocarpa* woodland and shrubland complex. Acid volcanic hills.

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

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

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

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

Acacia dominant open forests and woodlands

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

Melaleuca dominant open forests

7a, Low *Melaleuca cajuputi subsp. platyphylla* open forest. Alluvial plains and drainage depressions.

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

7c, Tall *Melaleuca dealbata + Corymbia clarksoniana* open forest. Alluvial plains

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

7e, Low *Melaleuca dealbata +/- Melaleuca saligna +/- Lophostemon suaveolens* open forest. Dune swales.

Lophostemon dominant woodland and open forest

8a, *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.

Legend- Vegetation Communities and Broad Vegetation Moa Islands

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Asteromyrtus/Neofabricia dominant open forests

9a, *Asteromyrtus brassii + Syzygium angophoroides + Acmena hemilampra subsp. hemilampra +/- Acacia crassicarpa +/- Melaleuca quinquenervia* open forest. Sandy rises erosional plain.

Casuarina dominant woodland and open forest

10a, *Casuarina equisetifolia* open forest + *Diospyros maritima + Premna serratifolia + Milletia pinnata.* Coral cays

10b, *Casuarina equisetifolia* woodland and open forest +/- *Terminalia catappa* woodland and open forest. Coastal foredune

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).

Palm dominant forest and woodlands

12a, *Livistona meulleri* woodland.

12b, Low *Nypa fruiticans* closed forest.

Melaleuca dominant shrublands and woodlands

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

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

13c, *Melaleuca viridiflora + Asteromyrtus symphiocarpa +/-Asteromyrtus brassii + /- Banksia dentata +/- Melaleuca saligna +/- Leucopogon ruscifolius* shrubland. Alluvial soils and residual sand plains.

13d, *Melaleuca saligna + Melaleuca viridiflora + Asteromyrtus symphiocarpa +/- Asteromyrtus brassii +/- Corymbia spp. +/- Banksia dentata* low woodland. Alluvial outwash plains, residual sands and coastal dunes.

13e, *Melaleuca acacioides* shrubland. Alluvial outwash on saline margins.

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

13i, *Melaleuca stenostachya shrubland +/- Melaleuca viridiflora* low woodland. Alluvial plains and granite headlands.

13j, *Melaleuca acacioides +/- Melaleuca viridiflora* open shrubland. Alluvial outwash on saline margins.

Shrublands and shrubland complexes

14a, Dwarf *Welchiodendron longivalve + Alyxia spicata +/- Melaleuca viridiflora +/- Acacia spp. +/- Asteromyrtus brassii* shrubland. Coastal headlands and ridgelines.

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

14e, Low open shrubland with *Baeckea frutescens, Melaleuca viridiflora and Asteromyrtus brassii*. Residual sand dunes.

14i, *Asteromrytus brassii + Melaleuca saligna + Baeckea frutescens + Leucopogon yorkensis + Leucopogon ruscifolius +/- Lophostemon suaveolens* shrubland and low shrubland. Residual sand plains.

14p, *Asteromyrtus brassii + Petalostigma pubescens + Melaleuca viridiflora + Asteromyrtus brassii + Acacia crassicarpa + Corymbia clarksoniana* shrubland. Acid volcanic hills.

14q, Low *Cycas sp*. open shrubland. Relict beach ridges.

14r, *Acacia crassicarpa + Pandanus sp. + Melaleuca viridiflora +/- Parinari nonda +/- Banksia dentata +/- Lophostemon suaveolens* shrubland. Coastal outwash plains.

Coastal dune complexes

16b, Coastal foredune grassland/ Casuarina equisetifolia +/- Pandanus sp. +/- Acacia crassicarpa shrubland complex. (17j/ 10b/6c – 30/20/50).

16c, Coastal dune swale shrubland/Low open forest complex + Cochlospermum gillivraei + Canarium australianum + Terminalia subacroptera + Acacia crassicarpa + Melaleuca saligna + Melaleuca acacioides. (14t/7b – 70/30)

16d, Coastal dune shrubland and vine forest complex (14t/2z – 70/30).

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

Grasslands and grassland complexes

17a, Tall *Ischeamum australe +/- Imperata cylindrica +/- Themeda triandra +/- Mnesithea rottboellioides +/- Heteropogon triticeus* grassland. Alluvial remnants of the Fly Platform.

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.

17g, *Imperata/Themeda* grassland complex with emergent shrubs. Alluvial plains.

17h, *Imperata cylindrica + Themeda triandra* grassland/*Welchiodendron longivalve* open forest and woodland complex. Fire degraded granite slopes.

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

Rock pavement complexes

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.

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.

25b, Salt pan. Hypersaline muds.

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Samphire grasslands

26a, Closed *Sporobulus sp*. grassland.

Exotic species

Ex, Communities dominated by exotic species

Bamboo, Bamboo thicket

Regrowth

Re, Regrowth

Cleared

Cl, Cleared

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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
St Pauls township area	Highly flammable vegetation including native grassland occurs up to the community boundaries with pockets of thick grassland intruding into community boundaries.		St Pauls Council	
			St Pauls Community	
			Island Rangers	
Kubin township area	Flammable vegetation occurs up to the community boundaries, particularly on the northern approach to the township. The accommodation village is at particular risk with flammable grassland occurring to the building boundaries.		Kubin Council	
			Kubin Community	
			Island Rangers	John Wigness (ph: _____)
Airport – including potential smoke problems	Surrounded by vegetation of moderate flammability although smoke from fires has potential implications for aircraft transit.		Kubin Council	
			Kubin Community	
			Island Rangers	John Wigness (ph: _____)

Asset	Issues	Specific Requirements	Stakeholders (to be listed)	Contact
Powerline and generators	The location of generators and powerlines requires consideration. An easement has been cleared for the powerline running between Kubin and St Pauls. Poles on this easement may be at risk during intense fire.	• 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	Marie Gonzo marie.gonzo@ergon.com.au Ph: 4069 0816
			Kubin Council	
			St Pauls Council	
			Island Rangers	John Wigness (ph: _____)
Other settlements and huts (e.g. Poid)	Requirements to prioritise assets requiring protection outside of the major settlement areas.			
Water supply infrastructure	The risk that fires pose to water supply infrastructure for both the Kubin and St Pauls township needs to be considered in burning plans.		Kubin Council	
			St Pauls Council	
			Traditional Owners	
			Island Rangers	John Wigness (ph: _____)
Cultural assets (requiring further documentation)	Cultural assets and the risk fire poses to them requires further consideration and documentation.			

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*).

A major problem however is that introduced grasses, in particular annual mission grass (and possibly *Themeda intermedia)* which occur on the fringes of St Pauls are favoured by regular firing, particularly hot dry season fires. Specific issues for these grasses are detailed below. Possible treatment solutions are suggested.

Table A2-5. Grassy weed threats and suggested trial treatments.

Grass	Problem	Treatment
Annual mission grass *(Cenchrus pedicellatum subsp. Unispiculum)*	It has the ability to remain green until the late dry season providing fuel for fires which occur later and are hotter than normal seasonal fires. Hot fires burnt late in the season in annual mission grass damage adjacent native vegetation leading to displacement and expansion of the area of annual mission grass infestation.	Trial early season burns in native grassland and woodland habitats adjacent to annual mission grass infestations. As annual mission grass won't burn in early season conditions, remaining tussocks can be can sprayed or grubbed (pulled) with a lower risk of harming native communities. It is important that control actions occur prior to maturation of seed heads.
Themeda intermedia	Limited information on the risk this species poses to natural habitats is available. It should best be treated as highly invasive and warranting priority control.	Trials as per annual mission grass.

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

Table A2 – 7. Fire behaviour and recommended treatment for vegetation communities on Moa Island.

Fire Behaviour Category	BVG	Vegetation Community	Description	Fire Behaviour/ Recommendations
Category 1	Evergreen vine forest and thicket	1i	Evergreen mesophyll vine forest + *Horsfieldia australiana, Syzygium bamagense* + *Acmena hemilampra* subsp. *hemilampra* + *Buchanania arborescens.*	No burn/ will not burn under most circumstances.
		1j	Tall evergreen notophyll vine forest + *Syzygium angophoroides* + *Acmena hemilampra* subsp. *hemilampra* + *Acacia auriculiformis* + *Syzygium forte* subsp. *forte* + *Podocarpus grayae*	
		1e	Mesophyll/notophyll vine forest + *Myristica insipida* + *Maranthes corymbosa* + *Cryptocarya cunninghamii* + *Dysoxylum latifolium* + *Calophyllum sil +/- Arenga australasica.*	
		1f	Complex notophyll vine forest + *Pouteria* sp. + *Calophyllum sil* + *Argyrodendron polyandrum* + *Palaquium galactoxylon* + *Acmenospermum claviflorum* + *Licuala ramsayi.*	
		1g	Evergreen notophyll vine thicket + *Calophyllum sil* + *Syzygium branderhorstii* + *Diospyros hebecarpa* + *Schefflera actinophylla* + *Podocarpus grayae* + *Licuala ramsayi.*	
	Semi-evergreen vine forest and thicket	2b	Semi deciduous vine forest/thicket + *Canarium australianum* + *Terminalia subacroptera* + *Bombax ceiba* var. *leiocarpum* + *Cochlospermum gillivraei* + *Cleistanthus peninsularis* + *Ficus virens* var. *sublanceolata.*	
		2o	Semi deciduous notophyll vine forest + *Acacia auriculiformis* + *Barringtonia calyptrata* +	

Fire Behaviour Category	BVG	Vegetation Community	Description	Fire Behaviour/ Recommendations
			Maranthes corymbosa + *Syzygium forte* subsp*. forte* + *Bombax ceiba* var*. leiocarpum* + *Canarium australianum.*	
		2p	Semi deciduous vine thicket (windsheared) + *Bombax ceiba* var*. leiocarpum* + *Premna serratifolia* + *Acacia crassicarpa* + *Manilkara kauki* + *Drypetes deplanchei* + *Terminalia subacroptera* +/- *Arenga australasica.*	
		2u	Semi-deciduous vine forest + *Manilkara kauki* + *Terminalia* spp*.* + *Sterculia quadrifida* + *Premna serratifolia* + *Acacia crassicarpa* + *Drypetes deplanchei* + *Millettia pinnata.*	No burn/ will not burn under most circumstances. Asset protection burns are required in littoral vine thicket habitats occurring on dunes, particularly where interspersed with grassland.
		2v	Semi-deciduous vine thicket + *Acacia polystachya* and *Terminalia subacroptera.*	No burn/ will not burn under most circumstances.
	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.	
		3d	Evergreen mesophyll vine forest / Sclerophyll vine forest complex + *Syzygium forte* subsp*. forte* + *Syzygium bamagense* + *Horsfieldia australiana* +/- *Melaleuca leucadendra* +/- *Lophostemon suaveolens.* (1i/3b- 50/50)	
	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	6c	Low *Acacia crassicarpa* + *Terminalia subacroptera* +	

Fire Behaviour Category	BVG	Vegetation Community	Description	Fire Behaviour/ Recommendations
			Sterculia quadrifida + *Manilkara kauki* + *Syzygium suborbiculare* open forest and woodland.	
	Lophostemon dominant woodland and open forest	8b	Low *Lophostemon suaveolens* +/- *Asteromyrtus brassii* +/- *Acacia crassicarpa* +/- *Melaleuca saligna* +/- *Deplanchea tetraphylla* open forest and swamp forest.	
	Asteromyrtus/Neofabricia dominant open forests	9a	*Asteromyrtus brassii* + *Syzygium angophoroides* + *Acmena hemilampra* subsp*. hemilampra* +/- *Acacia crassicarpa* +/- *Melaleuca quinquenervia* open forest.	
	Coastal Dune Complexes	16b	Low groved notophyll vine thicket/ grassland and herbland complex (2z/17j - 80/20).	Asset protection burns required in littoral vine thicket habitats occurring on dunes, particularly where interspersed with grassland habitats.
		16c	Coastal dune swale shrubland / Low open forest complex + *Cochlospermum gillivraei* + *Canarium australianum* + *Terminalia subacroptera* + *Acacia crassicarpa* + *Melaleuca saligna* + *Melaleuca acacioides* (14t/7b – 70/30).	
		16d	Coastal dune shrubland and vine forest complex (14t/2aa – 70/30).	
		16k	Coastal foredune grassland, herbland, woodland and vine thicket complex (17j/17d/10b/2aa – 50/20/20/10).	
	Rock pavement and pavement complexes	18c	*Welchiodendron longivalve* +/- *Acacia polystachya* closed shrubland / Low deciduous shrubland/rock pavement complex (18a/14c – 50/50).	No burn/ will not burn under most circumstances.
		18d	*Corymbia stockeri* subsp*. peninsularis* + *Welchiodendron longivalve* + *Psydrax banksii* + *Dodonaea polyandra* + *Ficus* sp. rock pavement complex.	
	Mangrove forest, woodland and shrubland complexes	24a	Mangrove closed and open forest, woodland and shrubland complexes (24d/24c – 80/20).	

Fire Behaviour Category	BVG	Vegetation Community	Description	Fire Behaviour/ Recommendations
	Samphire herblands and shrublands and salt pans	25a	Dwarf halophytic shrubland and saltpan.	
		25b	Salt pan.	
	Samphire grasslands	26a	Closed *Sporobolus sp.* grassland.	
Category 2	Grasslands and grassland complexes	17a	Tall *Ischaemum australe* +/- *Imperata cylindrica* +/- *Themeda triandra* +/- *Mnesithea rottboellioides* +/- *Heteropogon triticeus* grassland.	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).
		17c	Open to closed tussock grassland with emergent shrubs.	
		17d	Medium to tall *Mnesithea rottboellioides* + *Heteropogon triticeus* + *Cymbopogon* spp. +/- *Imperata cylindrica* +/- *Themeda triandra* grassland.	
		17g	*Imperata/Themeda* grassland complex with emergent shrubs.	
	Eucalypt and Corymbia dominant open forests and woodlands	5b	*Corymbia clarksoniana* + *Corymbia nesophila* +/- *Corymbia tessellaris* +/- *Corymbia stockeri* subsp. *peninsularis* +/- *Welchiodendron longivalve* woodland and open forest.	
	Melaleuca dominant open forests	7c	Tall *Melaleuca dealbata* + *Corymbia clarksoniana* open forest.	
	Pandanus dominant woodland and shrubland	11a	*Pandanus* sp. +/- *Melaleuca cajuputi* subsp. *platyphylla* +/- *Acacia leptocarpa* +/- *Melaleuca acacioides* shrubland and low woodland.	
	Regrowth (sclerophyll)	RE	Regrowth woodland	
	Cleared areas	Cl	Cleared areas	
Category 3	Welchiodendron dominant closed to open forests and woodlands	4c	Low *Welchiodendron longivalve* + *Melaleuca dealbata* open forest.	Low stature woodlands with sparse ground cover. Difficult to ignite except in hot dry conditions although will burn with intensity under certain conditions. Mosaic/ patch burning required as per **Category 2** although first ignition event will occur later in the year.
	Eucalypt and Corymbia dominant open forests and woodlands	5a	*Corymbia novoguinensis* +/- *Corymbia stockeri* subsp. *peninsularis* woodland and open forest.	
		5c	*Corymbia clarksoniana* + *Melaleuca stenostachya* + *Melaleuca viridiflora* +/- *Asteromyrtus symphyocarpa* +/- *Parinari nonda* +/- *Asteromyrtus brassii* woodland.	
		5d	Low *Corymbia clarksoniana* + *Melaleuca*	

Fire Behaviour Category	BVG	Vegetation Community	Description	Fire Behaviour/ Recommendations
			viridiflora + *Welchiodendron longivalve* + *Asteromyrtus brassii* + *Acacia leptocarpa* woodland and shrubland complex.	
		5i	*Corymbia clarksoniana* +/- *Corymbia novoguinensis* +/- *Livistona muelleri* woodland and open forest.	
		5m	Low *Corymbia* spp. *(C. stockeri, C. nesophila, C. clarksoniana)* + *Melaleuca stenostachya* +/- *Melaleuca viridiflora* +/- *Asteromyrtus symphyocarpa* woodland.	
	Melaleuca dominant open forests	7b	*Melaleuca saligna* open forest.	
	Melaleuca dominant shrublands and woodlands	13a	*Melaleuca viridiflora* +/- *Pandanus* sp. shrubland and low woodland.	
		13c	*Melaleuca viridiflora* + *Asteromyrtus symphyocarpa* +/- *Asteromyrtus brassii* + /- *Banksia dentata* +/- *Melaleuca saligna* +/- *Leucopogon ruscifolius* shrubland.	
		13d	*Melaleuca saligna* + *Melaleuca viridiflora* + *Asteromyrtus symphyocarpa* +/- *Asteromyrtus brassii* +/- *Corymbia* spp. +/- *Banksia dentata* low woodland.	
		13e	*Melaleuca acacioides* shrubland.	
		13f	Low *Melaleuca viridiflora* + *Corymbia clarksoniana* woodland.	
		13i	*Melaleuca stenostachya* shrubland +/- *Melaleuca viridiflora* low woodland.	
		13j	*Melaleuca acacioides* +/- *Melaleuca viridiflora* open shrubland.	
	Grasslands and grassland complexes	17i	Low sedgeland with emergent shrubs and trees	
Category 4	Welchiodendron dominant closed to open forests and woodlands	4b	*Welchiodendron longivalve* low woodland, low open woodland and tall open shrubland.	Generally will not burn unless fuel loads have developed over a period of 5 yrs or greater.
	Shrublands and shrubland complexes	14a	Dwarf *Welchiodendron longivalve* + *Alyxia spicata* +/- *Melaleuca viridiflora* +/-	

Fire Behaviour Category	BVG	Vegetation Community	Description	Fire Behaviour/ Recommendations
			Acacia spp. +/- *Asteromyrtus brassii* shrubland.	Will burn intensely when sufficient fuel loads have developed and conditions are hot and fanned by a strong wind.
		14c	*Welchiodendron longivalve* shrubland.	
		14e	Low open shrubland with *Baeckea frutescens, Melaleuca viridiflora* and *Asteromyrtus brassii.*	
		14i	*Asteromyrtus brassii* + *Melaleuca saligna* + *Baeckea frutescens* + *Leucopogon yorkensis* + *Leucopogon ruscifolius* +/- *Lophostemon suaveolens* shrubland and low shrubland.	
		14p	*Asteromyrtus brassii* + *Petalostigma pubescens* + *Melaleuca viridiflora* + *Acacia crassicarpa* + *Corymbia clarksoniana* shrubland.	
		14q	Low *Cycas* sp. open shrubland.	
Category 5	Melaleuca dominant open forests	7a	Low *Melaleuca cajuputi* subsp. *platyphylla* open forest.	Swamp forests that quickly accumulate fuel and will burn after a 2 year interval. Burning when the peaty substrate dries poses considerable threat to the habitats as peat fires are difficult to distinguish. Burning on a 2 – 3 year interval when ground conditions are moist.
		7d	*Melaleuca quinquenervia* +/- *Melaleuca saligna* +/- *Melaleuca cajuputi* subsp. *platyphylla* +/- *Lophostemon suaveolens* open forest.	
		7e	Low *Melaleuca dealbata* +/- *Melaleuca saligna* +/- *Lophostemon suaveolens* open forest	
	Swamp and riparian forest and forest complexes	3a	*Lophostemon suaveolens* + *Melaleuca quinquenervia* + *Syzygium angophoroides* + *Asteromyrtus brassii* + *Dillenia alata* swamp forest complex	
	Melaleuca dominant shrublands and woodlands	13b	*Melaleuca cajuputi* subsp. *platyphylla* +/- *Pandanus* sp. shrubland.	
Category 6	Grasslands and grassland complexes	17h	*Imperata cylindrica* + *Themeda triandra* grassland / *Welchiodendron longivalve* open forest and woodland complex (17f/4a – 90/10).	Unique characteristics require early season burns around the margins of vine thicket pockets to protect and promote expansion. General mosaic burning throughout grassland areas.

Category 1 vegetation communities: Rainforests and related closed forests and vine thickets. Includes those along streams and swamps, and vine thickets in 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, late in the day. 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.

Category 2 vegetation communities: Communities with a medium to tall grassy ground cover, including grasslands and the taller forest and woodland communities and previously cleared areas.

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 could be considered for the later burns.

Category 3 vegetation communities: Communities with a sparse to moderate ground cover. Includes a range of woodland and forest communities of relatively low stature that are developed on low fertility, poorly drained sandy plains and rocky footslopes.

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 Category 3 vegetation should overlap with Category 2 vegetation communities and both vegetation types should be targeted by aerial ignition runs in the mid to latter part of the burning window (July to August). 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.

Category 4 vegetation communities: Shrublands dominated by *Welchiodendron longivale* or *Asteromyrtus brassii.*

Strategy: These communities are often difficult to burn except by hot (predominantly late season fires). They are generally not harmed by infrequent hot fires, which, however, would be undesirable in surrounding communities. A cautious approach should be adopted, by burning them at the same time as programs in vegetation communities 3, relying on both chance spread of fire from within those communities, and by extending aerial burning operations in them.

Category 5 vegetation communities: 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.

Category 6 vegetation communities: Complex of grasslands and open forests near St Pauls.

Strategy: Strategy will vary depending on whether the aim is to restore the rainforest in a long-term program, or to stabilize present vegetation patterns. Either option will require a fire break to be prepared around the lower section of the hills and as far as necessary beyond that to protect the town of St Pauls. If the goal is to restore the rainforest the break will be used to try to keep fire permanently out of the higher parts of the hills. If the goal is to stabilize present patterns of vegetation the function of the firebreak will be to secure infrastructure in St Pauls so that the hills can be subjected to an annual early season patch burning operation using ground ignition on the lower part of the hills, and aerial ignition (via helicopter) procedures on the higher parts.

A2-8. Management requirements for sensitive species.

Table A2-8 details specific requirements for sensitive flora species known to occur on Moa 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. Will grow under forest canopies although the ability to reproduce is hampered.	Mature cycads are generally tolerant of hot fires although hot 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

Species	Habitat requirements	Fire Management Requirements
		in the landscape.
Dendrobium x superbiens *(Orchidaceae)* ***Dendrobium biggibum*** *(Orchidaceae)* ***Dendrobium johannis*** *(Orchidaceae)* All vulnerable NC Act, EPBC Act	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 Moa 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 Moa 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 Moa Island fire program should be prepared at the completion of each burn season. This should provide a summary of areas burnt, timing, conditions as well as mapping of burn scars. Senior ranger guided by ranger 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. Suggested burn plan 2013

Objectives of fire management on Moa Island for 2013 should include:

- Protection of life and property within St Pauls township.
- Consideration given to weed control, in particular containment of annual mission grass infestations.
- Biodiversity conservation. This will focus on the rainforest grassland complex on the hills near St Pauls, and will adopt one of two strategies. Strategy 1 would focus on rehabilitation of the rainforests within the complex; Strategy 2 would aim to protect them from any fire damage that would lead to further recession of their boundaries.
- Protection of cultural sites as identified by Moa Island Rangers and traditional land owners.

A map of the proposed 2013 burn program area is appended to this document.

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

Area	Strategy
St Pauls township area	• Prepare map of roads on the margin of St Pauls township area that could be used as a fireline to burn from to protect the township, and to provide the basis for fire management on the hills as proposed under strategy options 1 and 2. • Identify any other infrastructure within the area covered by the burn plan that needs protection. • Encourage owners to mow or slash around any properties that have long grass on or within their boundaries. • In conjunction with pilots of any chartered helicopters, devise a plan to minimize the risk of incendiaries being dropped within the area/areas protected by fire breaks.

Table A2-12. Considerations for biodiversity conservation

Habitat	Strategy
Rainforest-grassland complex	1. Burn from roads to establish breaks around the township area. 2. Burn early to create a break from the road to the old airport northwards to the rainforest margin.

Habitat	Strategy
	Option 1. Rehabilitation of former rainforest areas within the rainforest grassland complex. Expand the firebreak on its outer (hillslope) edge by burning in as many stages as necessary to create a wide fuel reduced area. This will be carried out as early as possible, in a period during which fires will go out at night with ignitions in the period between mid-afternoon and dark. Helicopter ignition will be used, in addition to ground ignition to ensure that all necessary burning can be carried out in the narrow seasonal time period available. No further burning will be carried out after this period. **Option 2.** Protect and stabilize boundaries of rainforest patches. This will involve firebreak preparation as for Option 1 immediately followed by an intensive pattern of aerial ignition throughout the hills, followed up by a similar operation a few weeks later.

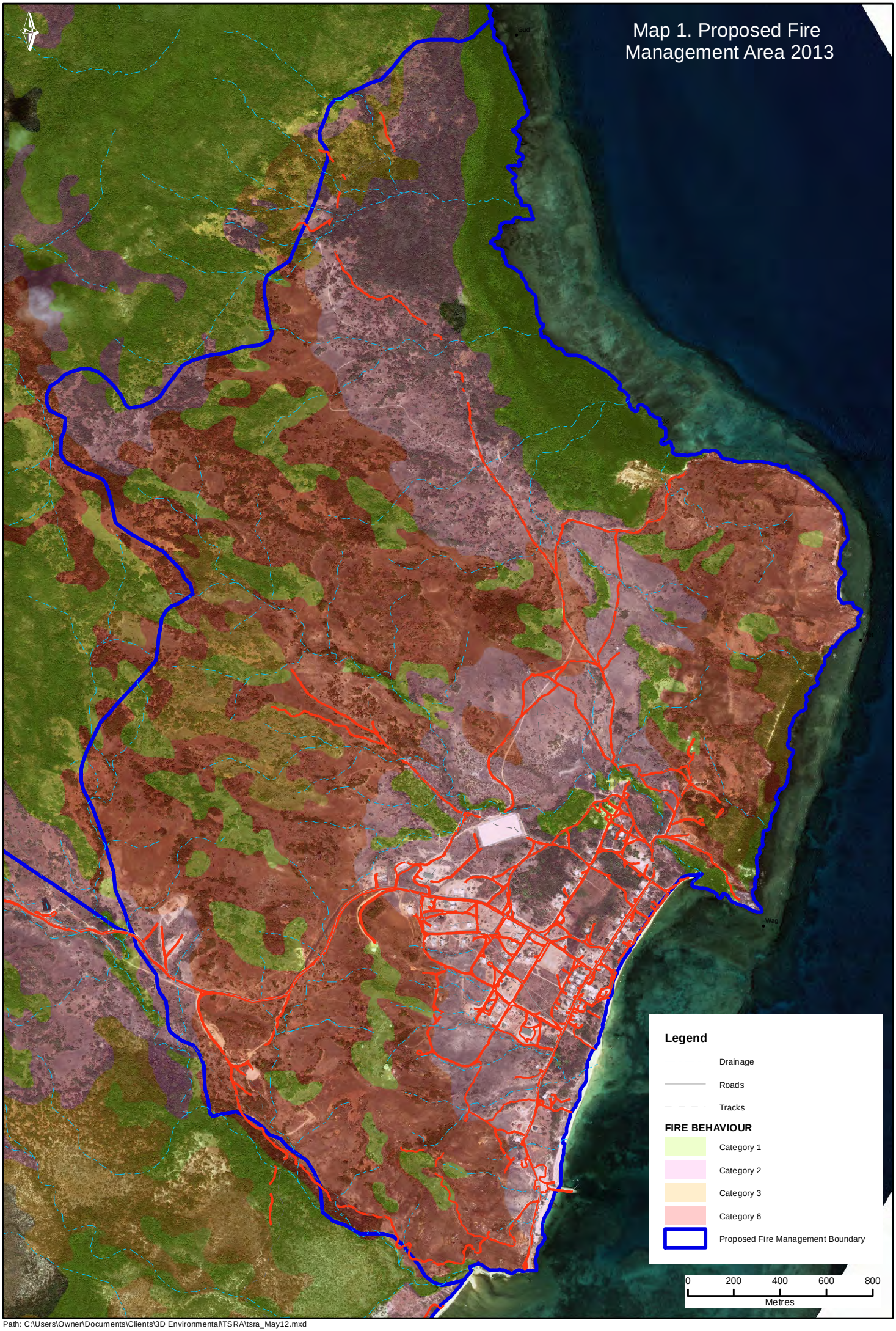
Table A2-13. Considerations for weed control

Issue	Strategy
Annual mission grass infestations	1. Identify and map all occurences of annual mission grass on the margins of St Pauls township. 2. Undertake early season burns in native habitats on the margins of infestations to reduce fuel loads and vegetative matter. 3. Upon completion of the early season burn, use herbicide to kill infestations of annual mission grass. 4. Dead stands of annual mission grass can be burnt when conditions allow. 5. Monitor the success of the trial through establishment and recording of photographic monitoring points both prior to and following the program inception

Table A2-14. 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.	

Action	Responsibility	Date Achieved
• 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?		



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