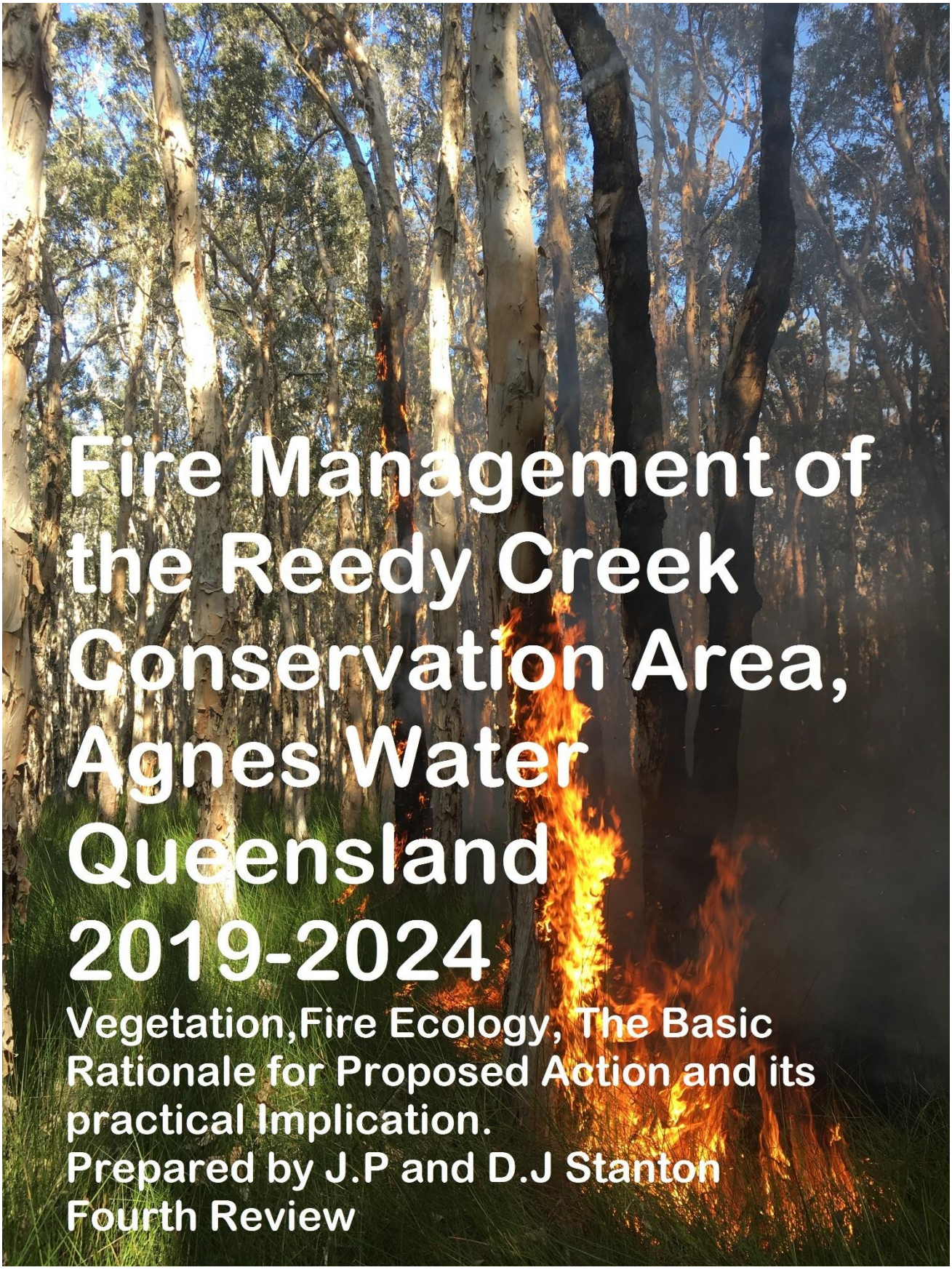


Fire Management of the Reedy Creek Conservation Area, Agnes Water Queensland 2019-2024

Vegetation,Fire Ecology, The Basic Rationale for Proposed Action and its practical Implication.

Prepared by J.P and D.J Stanton

Fourth Review

Executive Summary

A Fire Management Plan (FMP) has been prepared for the Reedy Creek Conservation Area, initiated in 2004 with this report covering its third 5 year review in preparation for the years 2019 to 2024. The major components of the Reedy Creek Conservation areas are the 590ha Conservation Reserve (Lot 1 SP 150900) and the Sunrise 1770 Commonlands (Formerly Lot 3 SP 150900); Whilst these areas are the primary focus of the FMP, it is also necessary to consider neighbouring allotments which include the Red Rock residential community (Lot 2 SP165533) contiguous with the southern boundary of the conservation reserve; a private 10 ha allotment (Lot 4 SP150900) to the north of Springs Road; a small allotment on the northern boundary of the conservation reserve (Lot 5 SP 150900); Recreation Reserve 259; Camping Reserve 2014; the council controlled coastal esplanade; Deepwater National Park to the south and allotments to the west of the Conservation Reserve.

The Reedy Creek Conservation Area comprises a range of vegetation types including eucalypt dominant open forest, banksia dominant woodlands, melaleuca and eucalyptus dominant swamp forests, sedge swamps, shrubland on dune escarpment and vine forest. With the exception of the vine forest community, all vegetation types have the capacity to carry fire, potentially explosively under certain climatic conditions with sufficient fuel. Furthermore, the contiguity of habitats to the south and north of the Conservation Area add compound hazard with the potential for sweeping fires to enter the conservation area, particularly the south. For this reason, a FMP has been prepared with the primary objectives being to:

1. To protect the lives and property of residents both within and adjacent to the Conservation Area, and
   of visitors to it;
2. To provide a situation in which unplanned fires can be readily controlled; 3. To ensure that no single fire event covers a major part of the Conservation Area; 4. To maintain existing habitat diversity and protect sensitive habitats.

To implement the FMP, it has been necessary to subdivide the Conservation Area into discrete management blocks. Individual management blocks are defined by bare earth fire breaks, the layout of which is shown in Map 2 and Map 3 of the main report. Critical factors influencing the FMP as they relate to vegetation types and management block layout are described briefly below:

Swamp areas: The swamp forests which form a broad swathe on the western margins of the conservation reserve pose severe risk of uncontrolled wildfire, particularly in drought years when peat soils begin to dry. The primary recommendation, based on practical experience in preceding years, is to burn the swamps areas on a rotational basis of 2 – 4 years. The swamp area is divided into Block 1 to the south, and Block 2 to the north, separated by an earthen bund wall which acts as a fire break. Block 1 is contiguous with the Deepwater National Park and its management will inherently be influenced by the current fire management practices of the National Parks Service. It is thus extremely important to ensure short interval burning within Block 2 is entrenched to mitigate potential hazards of extremely hot wildfires that may occur within Block 1, emanating from within the National Park.

Eucalypt dominant open forests: It is recommended that a cool season patch burning system be adopted in those communities mapped as 2a and 2c, the open grassy forests of bloodwood and Moreton Bay ash. Its purposes will be to ensure that any wildfires entering the Conservation

Reserve from any direction either self-extinguish or are easily controlled; to provide maximum habitat variety in the landscape, and to ensure that the majority of the Conservation Reserve remains unburnt in any one year. To assist implementation of this plan, the eucalypt dominant open forests are divided into:

1. Block 3 to the south of the east-west run of Springs Road and between the access road to the National Park and (on the coastal side) the road to the Red Rock residential community
2. Block 4 to the east of Springs Road to the boundary of the residential area and north of the Springs Road extension (east-west run). Block 4a is allocated to the north of the Spring Road extension and Block 4b defines a discrete buffer to the west of the residential area.

Block 4b has been subject to annual burning over preceding periods which has been largely successful in maintaining low fuel loads and providing a protective buffer to western margins of the residential estate. For other areas, patch burning is required with recommendations to commence after the end of March, ending when fires begin to burn through the night, with only small strategic burns recommended after the end of September.

Shrubby woodland of bloodwood and banksia: There are large areas of this community south of Springs Road, and a small area to the north of it, although mostly contained within Management Block 3. This habitat behaves differently to the eucalypt dominant open forests and fire will not travel readily unless assisted by heavy fuel load and a strong wind. Fire incursion during general patch burning of eucalypt woodland should be promoted and any areas which remain unburnt for 6 years should be targeted for special ignition, although only after surrounding habitats have been burnt.

The coastal escarpment and vicinity of residential areas: The coastal escarpment is covered Management Blocks 5, 6 and 7, generally occupying steep slopes on the eastern side of the residential area to the coastal esplanade. Because of the extreme difficulty of establishing a patch burning system that will meet all environmental objectives in this area while guaranteeing the safety of residences, the protection of lives and property will take a defensive approach. It has also become increasingly difficult to undertake such prescribed burning within these areas due to permitting requirements. Fuel reduction has necessarily been facilitated by strategic cutting of ground cover (brush cutting, mowing or slashing) within the Commonlands, coupled with green buffer plantings.

Recommendations for protection of houses within the residential development area: Bush Heritage Australia has no control over or responsibility for fire mitigation in land parcels that are privately owned and the onus for fire mitigation falls on Lot owners. The Body Corporate is responsible for issues of compliance in relation to State and Local government bushfire fire planning requirements. Recommended mitigation actions pertaining to private housing should thus be considered guidelines. The most pertinent aspects of fire management in regard to protection of houses are identified briefly below:

1. The possibility of wind driven canopy fires that could threaten residential areas is slight but the greatest contribution that can be made to reducing that possibility to a vanishingly small level is the management of the Conservation Reserve as is proposed in the Fire Management Plan, and as it is currently being implemented. A strategy to reduce the risk of wind driven fires in eucalypt dominant open forest

involves green buffer establishment and mowing. It should be noted that there is no possible strategy that would ameliorate the destructive potential of any fire that enters the dense shrublands on the coastal escarpment in a worst case scenario.

2. Where the vegetation surrounding a house is tall open forest (Types 2a, 2c, 2d) with a grassy ground cover a buffer of 20m width should be regularly mowed, by any method, and any shrubs and small trees (except those species of vine forest affinities) removed. Any hollow trees in that buffer should also be removed. Mowing can, with advantage, be continued beyond the 20m buffer, but trees and shrubs should not be removed. Instead, their development should be encouraged in order to suppress the ground cover.
3. Open shrublands on steep slopes should be removed within 10m horizontal distance of a house and either replaced with dense plantings of fire resistant shrubs and small trees (local vine forest species only), or a low creeping ground cover (such as couch grass) should be encouraged. Vital to this strategy is the elimination of any exotic grass species, or lantana, which thrive in openings and clearings and burn easily and hotly.
4. Closed shrubland (Type 4c) should be treated in the same manner as open shrubland, except that beyond the 10m zone, because of the total suppression of ground cover, there is no need for management of the community.
5. Bare sand within a few metres of the footprint of the building should be covered only with materials that will not burn (pebbles, gravel, cement, etc.) Mulch should not be used.
6. Strategic planting of belts of fire resistant trees (local vine forest species) near property boundaries, should be encouraged as per the current green buffer strategy.

Fire breaks around houses: Fire breaks around houses can be created through cutting and removing shrubs and trees. On flat country this would involve clearing a strip with a width of approximately twice the height of the vegetation. That would require clearing a minimum width of 20m and a maximum width of 30m. On steep slopes regular removal of leaf litter and ground cover beyond the 10m horizontal distance buffer previously recommended for minimal security would be useful. However, removal of small trees should be avoided as this will affect the windbreak effect of the existing canopy shape, enabling much faster upslope wind speeds, further increasing the chance of fires reaching the crown.

Dealing with Wattle / Shrub Stands: If wattle stands are removed in close proximity to housing, the fire danger will only be reduced temporarily, as after such clearing, regrowth wattle will have increased branching at lower levels. Once ignited, regrowth would be more likely to develop a crown fire. If a decision is taken to commit the work time and expense to such wattle removal, the sites will require permanent maintenance, to gain a slight reduction in fire risk. It is also recommended that residents avoid cutting the dense stands of wattle that often occur on the escarpment as these generally present much lower fire hazard than the grasses which replace them.

Wet heath habitats: Whilst previous FMPs stressed the importance of burning the small wet heath community south of Rocky Point (mapped as 5c), it also stressed the danger of such an exercise due to the potentially explosive nature of habitat. Previous attempts to burn this habitat

by BHA have resulted in two spot over events. There is merit in burning the swamp from an ecological sense as this is part of the habitats natural ecological cycle of the habitat, removing choking shrubs such as *Glochidion ferdinandii* (which is thickening at present) and reinvigorating sedge layers. Current permit requirements combined with restricted access for fire fighting equipment (contrary to Health and Safety Policy requirements) however limit the opportunity for targeted fire and it is now prudent to note that mitigation of fire hazard in forested areas surrounding the swamp and on the eastern fall of the escarpment will be through mowing, slashing and green buffer planting rather than prescribed burning of the swampland itself.

Operational procedures: Permits to complete hazard reduction burns details the following requirements at a minimum:

- No burning to be undertaken when winds are forecast to exceed 11 kph.
- Bare earth fire breaks are in place that are > 4m width prior to burning.
- 2 capable persons must be present and a 4 X 4 slip on unit must be able to access the site prior to burning.

Additionally ignition should always be undertaken at a time of day of decreasing hazard, i.e., falling temperatures, falling wind speed, and rising relative humidity. This criterion generally precludes operations before about 2.00pm.

Monitoring: At a minimum, areas burnt each year should be mapped as precisely as possible. Given the small size of the area it is suggested that this could be most effectively done by walking transects across the area or following the boundaries of burnt areas. The location of points on the ground could be determined using aerial photos, GPS, or both.

Table of Contents

1. THE AREA

The area dealt with in this report covers what is defined as the Reedy Creek Conservation Area (shown in Map 1) being formed by:

1. Lot 1 SP 150900 (590ha). Conservation Reserve. This is of central importance to the conservation management of the area. Although the designation Conservation Reserve has no status under the
   Queensland Nature Conservation Act, it is an appropriate term, however, in that the area is freehold land held by the Australian Bush Heritage Fund and dedicated to permanent conservation management.

2. Sunrise 1770 Commonlands (Formerly Lot 3 SP 150900). Subdivided residential land between the
   Conservation Reserve and the coast (excluding the private allotments), bounded to the north by local council Recreation Reserve 259 (Lot 40 SP206868) and Dawson's (Lot 4 on RP-907757), which are outside the
   Conservation area), and bounded to the south by the Red Rock residential community (Lot 2 SP165533).

It should be noted that the Conservation Reserve refers only to the area of intact vegetation contained within Lot 1 SP150900 while the Conservation Area refers to the broader collection of land parcels including subdivided residential allotments. In addition to the above, the report deals with contiguous crown lands east of Springs Road and north of Dawson's & Rocky Point, for which complementary management would make the management of the Conservation Area much simpler. These are the Red Rock residential community (Lot 2 SP165533); a 10 ha block formerly designated for an ecotourism facility (Lot 4 SP150900), a small allotment formerly dedicated to the construction of an environmental interpretive centre (Lot 5 SP 150900), Recreation Reserve 259 and Camping Reserve 204 (Lot 52 SP155903). The neighbouring Rocky Point residential area, plus Cornell's (Lot 5 on RP-619130) and Dawson's lots are not covered by this plan. Bush Heritage Australia will be pursuing cooperative fire management arrangements with all these neighbours, who may later choose to join the broader management objectives of the Conservation Area.

The coastal esplanades adjacent to both the freehold areas, and the crown reserves are treated as an integral part of any fire management plans and actions for the Conservation Area.

The area is south of the small township of Agnes Water, approximately 360km north of Brisbane.

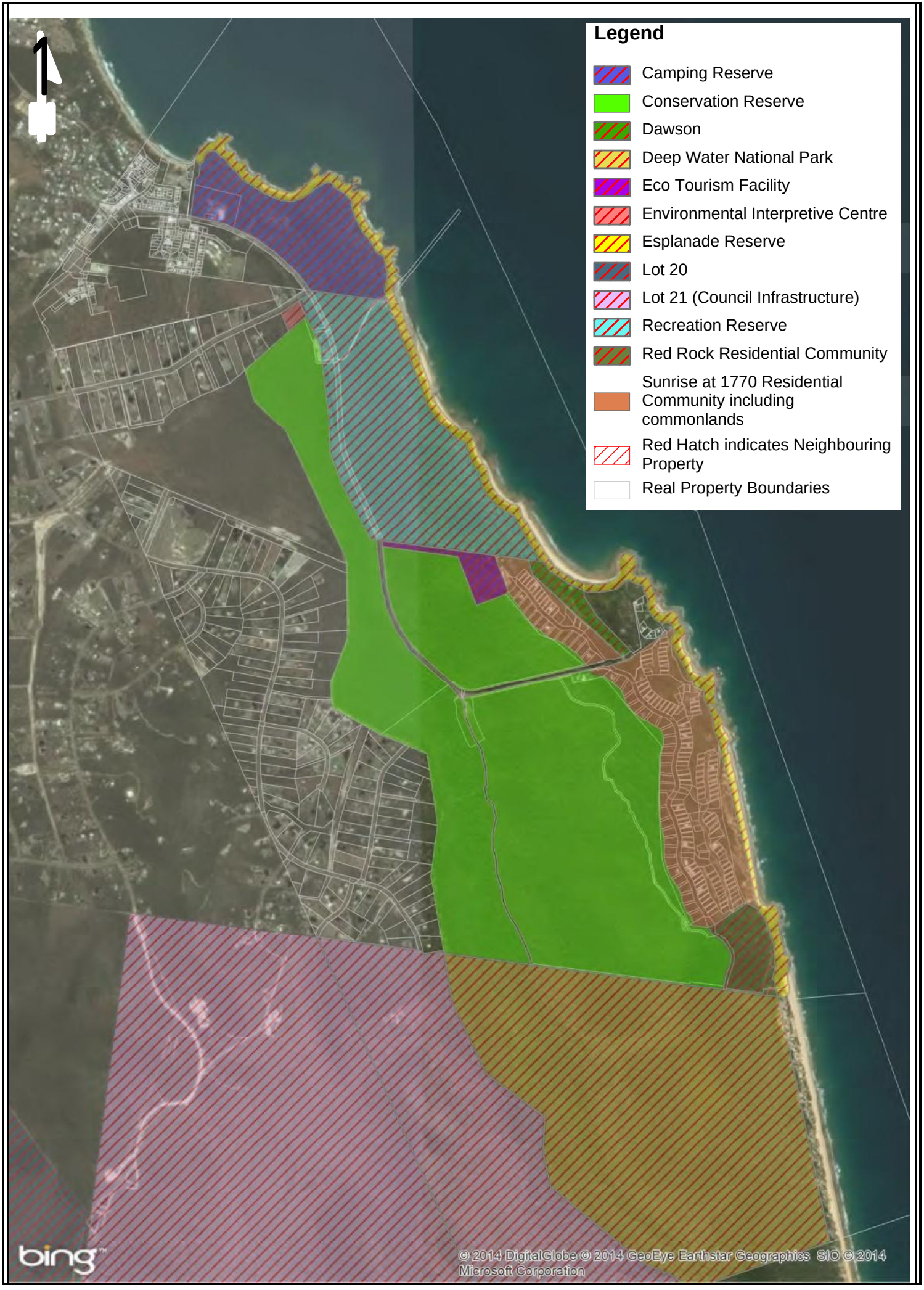
2. PURPOSES OF THE REPORT AND THE KNOWLEDGE BASIS OF ITS PREPARATION

The purpose of this report is to provide a prescription for the management of fire within the Conservation Area and some contiguous areas, based on an understanding of the likely behaviour of fire in their various habitats, the regime necessary for the maintenance of those habitats, and the overriding necessity to provide maximum security possible for the lives and property of residents within the area, and in neighbouring areas.

Previous versions of the report (2006, 2009) were compiled based on the personal knowledge and over 40 years' experience of J.P. Stanton as a land manager across a broad range of Queensland environments. As much of this material retains relevance, it has been left within this

report unchanged. The changes incorporated into this current review are necessitated by changes to residential layouts, increased dissection of the remaining bushland areas within the Sunrise Residential Area and the need for Bush Heritage Trust to re-evaluate risks and responsibilities.

Within this document, objectives, strategies and actions are described in preceding sections as this information is considered paramount. Detail on the natural environment, which informed development of strategies and actions is covered in some detail from sections 7 to 9.



Map 1. Reedy Creek Landuse

Date 15/08/2014

3. HUMAN ACTIVITIES IN THE REEDY CREEK CONSERVATION AREA

Fire management activities within the Reedy Creek Conservation Area have become increasing constrained by human activities and associated infrastructure (both within the Conservation Area and adjoining it) in the period since the original fire management report was prepared (2005).

Subdivision and building activity with associated development of access has occurred between the eastern boundary of the Conservation Reserve and the coastline with the former Lot 3 SP 150900 subdivided into a large number of individual allotments, many of which host constructed dwellings. There is also the recent construction of a desalination facility directly adjacent to the highly flammable *Melaleuca quinquenervia* dominant swamplands (vegetation community 3a, Section 9).

Photo 1 showing perimeter fence of desalination facility against highly flammable swamplands.

When fully developed residential areas will cover extensive areas formerly occupied by eucalyptus dominant open forest. Excluded from development will be the shrub lands and grasslands and the littoral vine forests.

The difficulties of fire management have increased over recent years with a progressive development of allotments and there is now recognition that, whilst retaining the same basic approach, that strategies to mitigate fire must be adapted to the changing urban environment and associated risk scenarios. Of most concern at full development will be the impingement of the south-western allotments of the Sunrise at 1770 Residential Community on the fire hazardous sparse shrubby woodland of bloodwood and banksia (see vegetation community 2e, Section 9).

On the western side of the Conservation Reserve, major fire management issues arise because of the close proximity of proposed intensive urban development, in particular the desalination facility, to the swamp forest (see vegetation community 3a, Section 9) which has the potential to virtually explode with intense and uncontrollable wildfire which would not be constrained by any likely fire break. An urban water supply, tapping into the water table of the swamp may exacerbate the hazard through lowering that water table during periods of drought and increasing the chance that the swamp will ignite.

Since inception of the fire plan, there has been no recorded ignition of flammable vegetation, from escaped camp or cooking fires originating from the foreshore. It should be noted that the

presence of an esplanade here provides unrestricted public access to this area and any fires arising in such a manner have potential to be severe. Such an event cannot be discounted.

A gazetted and constructed road, known as Springs Road, traverses the eastern edge of the swamp forest for half its length, entering the Conservation Reserve from the north, and after a little over a kilometre of passage through the Reserve along the eastern edge of the swamp, turns sharply east to provide access to the residential communities of Rocky Point and Sunrise at 1770. From the bend in Springs Road a partially gazetted road runs south to the boundary of the Deepwater National Park and then eastwards to form the boundary between the Conservation Reserve and the National Park. A dirt track providing four-wheel drive access to the park roughly parallels the gazetted route along the western edge of the dune, and then follows a course approximating the park boundary. This route is constantly used during daylight hours by visitors to the National Park.

4. OBJECTIVES OF FIRE MANAGEMENT

The proposed strategy for fire management of the Reedy Creek Conservation Area, as outlined in Section 9 below, is based on the following objectives, with the first two being those of the highest priority. It needs to be emphasised that the most important role that the Bush Heritage and reserve management can play in ensuring property safety within the residential areas is to minimise the potential hazard from wildfire, by continuing to manage the vegetation communities within the Conservation Reserve that border the Sunrise Residential Area as set out in the FMP.

1. To protect the lives and property of residents both within and adjacent to the Conservation Area, and of
   visitors to it;
2. To provide a situation in which unplanned fires can be readily controlled;
3. To ensure that no single fire event covers a major part of the Conservation Area;
4. To maintain existing habitat diversity;
5. To manage for specific wildlife and habitat values in all or part of the Conservation Area if these are identified by research, and are demonstrated to be rare and threatened;
6. To control exotic species of plants and to protect the margins of vineforests;
7. To ensure that all of the above objectives are met in ways that are not detrimental to the legitimate interests of neighbours;
8. To develop and implement methods of monitoring the long term impact of fire management on all significant habitats.

5. THE BASIS AND RATIONALE OF THE PROPOSED FIRE MANAGEMENT STRATEGY

What may be termed a “natural” fire regime has not existed in Australia since before the arrival of Aboriginal man. In pre-aboriginal Australia, sources of ignition of the highly inflammable vegetation that covered most of the continent during the Pleistocene epoch were predominantly lightning, and possibly volcanic activity in some very restricted areas. If for no other reason, the pattern of human settlement would make the re-establishment of such a regime, and with similar habitat impacts, impossible in a conservation area in southern Queensland. In a landscape of habitats which have evolved under the impact of aboriginal burning practices it would also be destructive of wildlife values. As a high risk scenario in relation to the welfare of the community it would be unacceptable.

The alternatives, in relation to the nature of fire within the Conservation Area, are to accept a wildfire regime determined by vandals and accidental escapes from the burning activities of neighbours, or to take control with a program of prescribed burning. To accept the former would be to abrogate responsibility for land management, leaving the most important aspect of reserve management to the chance activities of others. It is necessary, therefore, to initiate a prescribed burning program.

The aboriginal fire regime which shaped the vegetation of the area has long gone, and the habitats we now observe would have changed under the influences of a new regime. What those changes have been has not been documented and the question is somewhat irrelevant as it is no longer possible to re-establish the world of the Aborigine. One basic principle of aboriginal burning, however, which was concerned with their own welfare as people who lived intimately with a fire-prone environment, and was responsible for the development of much habitat variety in the landscape, is enshrined in Objective 3 of Section 7. In practice, it means that the landscape will be managed, as far as possible, with numerous small fires of low to moderate intensity. The reality, however, of dealing with a remnant landscape in a closely settled area means that compromise has to be made with this ideal in order to meet some other fire management objectives.

Implicit in all aspects of the strategy is the belief that the maintenance of existing habitats, although of very high priority *must be subservient to interests of preserving human life and property*. Unplanned fires, therefore, must be easily dealt with. The single most important factor determining fire behaviour in any given circumstances, and the only one over which a manager has any influence, is the level of fuel accumulation. Protection of life and property, therefore, depends on effective management of fuel levels in all burnable habitats. In most situations this involves the use of fire and the questions to be answered in relation to that use relate to appropriate frequency, intensity, and season of burn. The answers to all these questions must be habitat specific.

In considering the imperatives of safety of life and property, and the strategies necessary to ensure them a worst case scenario has been hypothesized. This would involve fires from two directions.

a. A fire in the swamp communities of the western section of the Conservation Reserve (communities 2f, 3a, 3c, and 5c) when the ground is dry, and driven by a strong westerly wind under conditions of low humidity. Under such conditions, burning bark carried by the wind could ignite spot fires within residential areas near the coast.

b. Fires lit on the esplanade or nearby, under drought conditions, driven by a gale force south-easterly wind up steep slopes, towards houses.

Anticipation of these conditions creates an imperative to manage fuel levels in the swamp, to ensure that fires cannot burn across the Conservation Area from west to east or vice versa, and that levels of ground layer fuel are kept as low as possible below infrastructure within the Sunrise Residential Area.

Providing current level of prescribed burning conducted by Bush Heritage Australia in the Reedy Creek Cconservation Area is maintained, and fuels are not allowed to accumulate for decades in the adjoining National Park, Red Rock development and Council controlled reserve to the north, a worst case wildfire scenario for the residential areas would not involve a crown fire.

Even under a climate change regime which presents obstacles to predicting future climate, there is no likely scenario in the foreseeable future under which fires resembling those of this year's Victorian Fires, (February, 2009) could be generated. The lack of many decades of fuel accumulation is the best guarantee of mitigating a wildfire of any magnitude and is achieved through the recommended fuel reduction burns in the FMP.

It is unlikely, given maintenance of the current level of fire management on the Conservation Reserve, and the management of a fuel reduced buffer supported by a fire line, on the western side of the residential developments, that fires burning on the Reserve will enter the residential areas. The risk, though small, that that could happen, however, must be acknowledged, as must be the greater risk of a fire originating within the residential areas or the adjacent esplanade.

Protection against any fires originating within the residential areas will depend on denying them the opportunity to gain size and momentum, and that would depend on a quick response to extinguish them, as well as the maintenance of a low fuel load adjacent to houses and wherever else possible. It is clear, however, that the ability of any fire within the residential area to gain the momentum that would make it difficult to extinguish, has been significantly reduced since the plan was written, by the development of additional roads and tracks, and the maintenance carried out on some of the inter-allotment Commonlands. A well-developed system of fire breaks is now established with mineral-earth buffers of up to 4m width and the establishment of "green buffer" areas where vine forest species have been planted under the eucalypt forest canopy to shade out flammable grasses and reduce inherent fire risk. The location of fire breaks and current extent of "green buffer" plantings is shown in Map 2.

Hence the revised strategy presented in Section 6 below, whilst designed to meet the objectives of fire management strategy set out in Section 4, considers alternative strategies cognisant of the reduced fire risk in some areas.

6. PROPOSED FIRE MANAGEMENT STRATEGY

In the period following the previous review, a number of changes have occurred to both the physical and administrative environment of the Reedy Creek Conservation area and associated residential estate. Of particular note are the following changes:

1. Remnant vegetation in the Sunrise 1770 Commonlands has become increasing dissected with roads and dwellings and exists in a number of isolated fragments.

2. Fire permit conditions have become less flexible. In particular, the following elements have become problematic. BHA no longer approves the use of quad bikes for safety reasons. This limits the opportunity for vehicular access along some fire breaks, particularly on the escarpment. Current permit conditions require that a 4 x 4 slip on unit be used to attend any prescribed fire event. The impeded vehicular access along some fire breaks also impinges on health and safety policy requirements.

3. Fire management in the adjacent Deepwater National Park has shifted to a 15 year burning cycle. This is well removed from the current average burning cycle of habitats in the conservation area which ranges from 1 to 6 years.

These elements have been considered within this revised strategy. It should also be noted that for the vegetation communities referenced in this section, detailed description of their floristics, structure and fire behaviour are provided within Section 9.

Following previous versions of the plan, the objectives of fire management presented in Section 4 cannot be addressed simplistically with individually tailored strategies. They are intertwined in the sense that a strategy to meet the demands of any one objective will have consequences for most of the others. There are two aspects to this. One is the value of some strategic regular mowing of the ground cover in the Commonlands to maximise the fire break potential of existing roads and tracks. In the 5 year period following the 2009 plan review, extensive mowing and slashing of ground covers has been undertaken by BHA staff in the vicinity of houses, particularly on the eastern fall of the high-dune where prescribed burning is problematic. Hence, following previous versions of the plan, no attempt has been made to compartmentalise various strategies and a whole of landscape approach is retained In presenting a single multi-faceted strategy in this way, it has been necessary to compromise the demands of most objectives to meet the overriding concerns of the first two regarding human safety. It is not considered, however, that these compromises have significantly affected the ability of the overall strategy to meet all the central requirements of each objective. The compromises, in large part, involve acceptance of the reality of dealing with a small remnant area heavily dissected by the patterns of human usage.

Photo 2. Mowing / slashing of grasses in eucalypt woodland type 2c on eastern fall of high-dune aimed at protecting property upslope.

Map 2. Maintained firebreaks and green planting areas.

Date 6/07/2014

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It should be noted that implementation of the strategy retains a requirement for a co-operative approach from landowners to the west and north of the Conservation Reserve. A fire-line has been completed along the western boundary of the Conservation Reserve which provides a secure position from which fires can be lit. The fire line has been subject to ongoing regular maintenance, necessitated by the large number of individual landholders involved, and its essential role in providing security for the community adjacent to the Reserve. The changing nature of fire management within the National Park, shifting to an extended 15 year fire interval is problematic to management of habitats and hazards within the Reedy Creek Conservation Reserve. Recommended responses to the changing fire management regimes are provided within following sections.

The melaleuca swamp forests that parallel the western boundary of the Conservation Reserve pose difficult fire management problems that are fully dealt with in the Fire Management Plan (Section 9.8) which calls for a rotational burning of the melaleuca communities (Types 3a, 3b, 3c and other swamp communities that are adjacent) in two sections at 4-6 year intervals. It is clear from observations of fire recovery from the most recent burn in 2005 that fuel build up has been such that it is likely that after 3 years there is a significant chance that the swamp could support an intense fire. It is therefore recommended that the management plan be amended to reduce the burning interval in the swamp from 4-6 years to 2-4 years. The wide interval acknowledges that while a two year frequency is possible, and would provide maximum security against wildfire, seasonal conditions may prevent it.

The various elements of the proposed strategy are dealt with below. It should be noted that the conservation reserve and associated residential area have been subdivided into Management Blocks and these are referred to throughout following sections of the report. Management Blocks are shown on Map 3. Prescribed actions have been separated into sub-headings which pertain to management within:

1. The Reedy Creek Conservation Reserve
2. Sunrise 1770 Commonlands
3. Evacuation plan

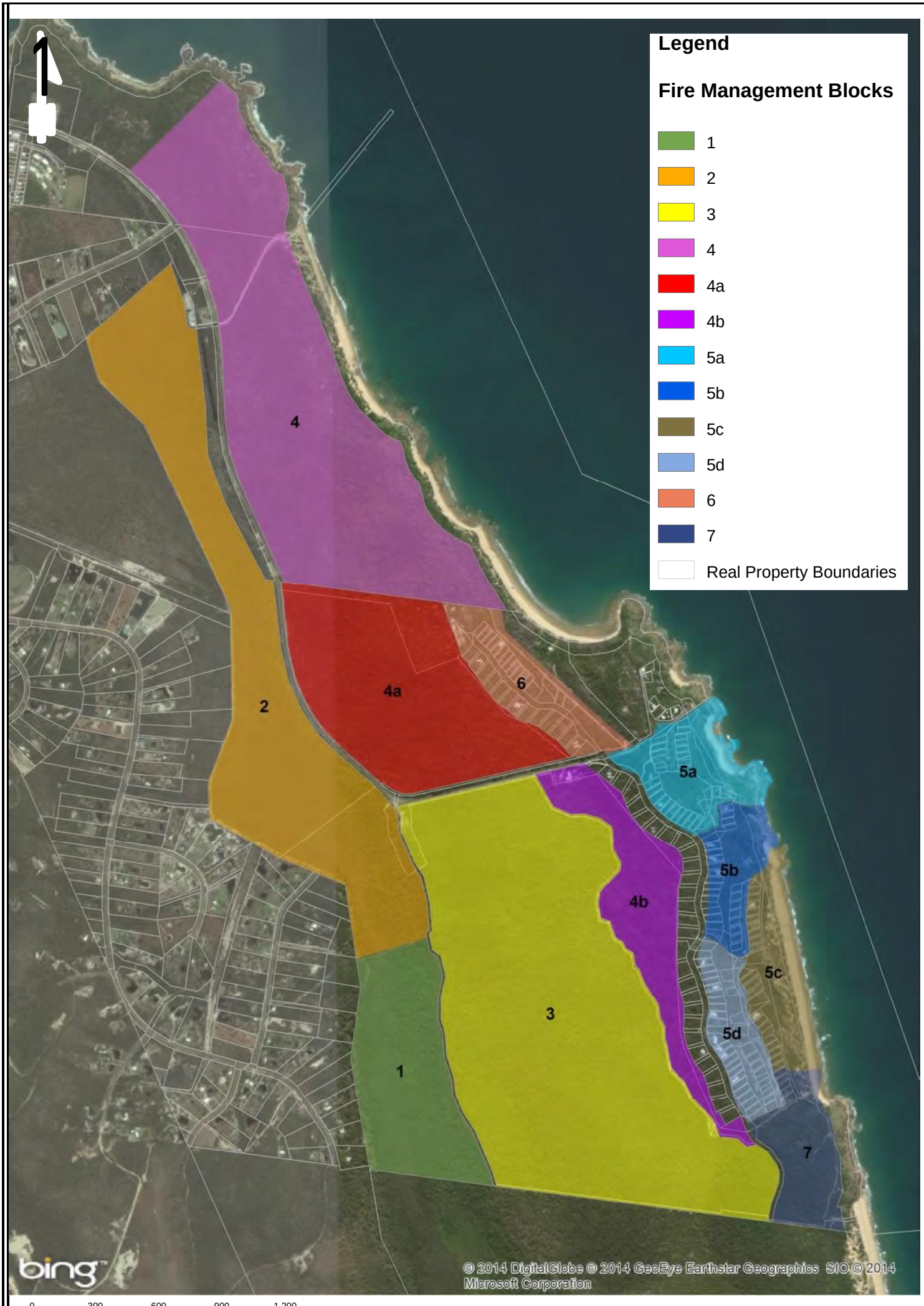
Specific guidelines for private residences are contained within Appendix A.

6.1 Reedy Creek Conservation Reserve

Element 1 - The Management of Swamp Areas: This is the most critical of all elements of the strategy for the dangers that the swamp areas pose of uncontrollable fire in a worst case scenario, and the great risk of a wildfire destroying large areas of swamp forest.

On the basis that patch burning attempts in swamps are fraught with unpredictable results and consequent danger to the people involved, it is proposed that all swamp communities west of Springs Road and the road to the National Park be treated as one unit. This involves Vegetation Communities 2f, 3a, 3b, 3c, 5c.

Original recommendations for burning of swamp area involved rotational burning on a fire free interval of 4 to 6 years. Practical experience on the site indicated that relatively intense fires will carry within the swampland on a 2 year cycle under suitable conditions and hence recommendation are made to burn the swamp on a reduced interval of 2 -4 years. Requirements for longer burning intervals reflect variations in seasonal conditions that may prevent burning in any given year. Hence neither season of burning nor the interval at which it occurs can be strictly prescribed, as they depend on water levels in the swamp and prevailing weather conditions.



Map 3. Fire Management Blocks

Date 30/07/2014

Fuel accumulates at a fairly constant rate in these types of swamp community wherever they occur along the east coast of Queensland. This is because they are immune to seasonal vagaries because of permanent high soil moisture levels. Experience in North Queensland indicates that they are generally capable of burning within 4 years of a previous fire, and even when there is surface water within the swamp. To achieve maximum fuel reduction without destroying surface peat layers, burning should be carried out when water levels are close to the surface or just above it. Burning is also likely to require relatively low humidity, and for safety, wind speeds below 10 knots (as per current permit conditions).

The recommended procedure is as follows:

1. Divide the swamp into two sections using the causeway across it at the location indicated on Map 3. A northern section (Block 2) will then be formed by a continuation of the western fire line along the margins of the swamp until it meets Bicentennial Drive. The approach to the southern block requires co-operation from National Parks to ensure the block is burnt appropriately. Considering the potential for a 15 year burning interval within contiguous habitats on Deepwater National Park, if co-operation to burn on a reduced interval cannot be negotiated, then the burning regime of National Parks should be adopted in Block 2. This replaces a previous recommendation to construct a fire break using chemical means and slashing along the park boundary and arises out of difficulties anticipated in practically installing such a feature.

2. Considering the potential for extremely hot fires within Block 2 if a long burn interval is adopted, it is pertinent to note the extreme importance of adhering meticulously to a reduced 2 – 4 year interval in Block 1 to the north if fire hazard is to be managed. Burning within Block 2 should be undertaken in the following manner to ensure hazard risk is managed.
    a. Late evening test burns along the fire line margin should be carried out until there is an indication that they will carry some distance away from it.
    b. At such a time the blaze should be extinguished and a burning operation along the length of fire line in the chosen section planned for the first suitable day afterwards.
    c. No burning should be carried out during hazardous times of day, even if it is likely that the fire will reach the road at such times.

A hazardous time of day is defined as any time when fire hazard is not decreasing. A decreasing fire hazard occurs with falling temperatures and wind speed, and rising humidity, generally after 2.00pm.

While every effort should be made to ensure that fire is contained within the swamp forest area and west of the National Park access track, if it does cross that track it should be allowed to burn, provided other elements of the strategy as outlined below, have been implemented.

In the year following burning of the southern section of swamp forest (Block 1), the northern section (Block 2) should be burnt. The timing of burning will, as before, depend on the result of test burns along the fire line as the swamp dries out. To guard against the possibility of a fast moving fire front being driven towards Bicentennial Drive ignition should proceed from north to south beginning along the northern fire line near Bicentennial Drive and progressing southwards along the western fire line and Springs Road at the same time. Ignition should begin late in the evening and continue as long into the night as fire will carry. If it is incomplete after the first day it should be completed in following days, adjusting the commencement time to earlier in the afternoon if necessary in the light of the previous day’s experience.

In both northern and southern sections of the swamp any areas unburnt once the boundaries are secured should be ignited at a time of decreasing hazard. This will of necessity, involve walking into the swamp.

Important follow-up operations after both burns should involve early morning patrols to extinguish fires in burning logs or trees within 50m of the boundary. This will ensure that burning trees (up to 30m tall) do not fall across the fire line and that hazards do not arise from wind driven sparks. If burning trees cannot be extinguished with water they should be cut down.

In all cases, operations should cease if the wind begins to consistently exceed 10 knots, or develops a consistent westerly direction (The common spring phenomenon of a land breeze at night and in the early morning is exempted from this caveat).

Element 2 - Patch burning in the eucalypt dominant open forests. (Blocks 3, 4a & 4b): It is proposed that a cool season patch burning system be adopted in those communities mapped as 2a and 2c (grassy forests of bloodwood and Moreton Bay ash) within Blocks 3, 4a and 4b, which should be extended to neighbouring block where cooperation is forthcoming. Its purposes will be to ensure that any wildfires entering the Conservation Reserve from any direction either self-extinguish or are easily controlled; to provide maximum habitat variety in the landscape, and to ensure that the majority of the Conservation Reserve remains unburnt in any one year.

An alternative approach to what is proposed here was considered and that is to burn the Conservation Reserve in two blocks, north (Block 4) and south (Block 3a) of Springs Road, in different years, and at 3 year intervals. This was rejected because it met neither the requirement that wildfires should be easily controllable at all times, as in some years large areas would remain unburnt, nor environmental requirements. It would require the construction of environmentally damaging fire breaks, and impose fixed burning patterns on a large part of the landscape. Neither, unless there was follow-up action on the ground and away from the marginal breaks, would it guarantee that its aims of burning out most of the block being targeted would be achieved.

Experience has shown that in most of the grassy forests of eastern Queensland it is difficult and generally impossible, to burn the same area at the same time of year in consecutive years. After two years, although ignition may be possible, fires will not travel far in the cool season, but late in the season extensive mild fires are possible. After 3 years extensive hot wildfires are possible late in the year and little difficulty is experienced in burning during the cool season.

These patterns are subject to variations in annual rainfall and with a succession of drought seasons it could be four to five years post fire before extensive cool season burns are possible again. It is anticipated, however, that once a regular cool season burning cycle is established, that in any one year, between 20% and 50% of the area of the Reserve will burn. If, in any one year, more than half of what remains after prescribed burning is completed is burnt by wildfire, it would indicate that the adopted strategy might be ineffective and should be critically examined and adjusted if found wanting.

The area to be covered in this element of the strategy is all of Vegetation Communities 2a, and 2c within Blocks 3, 4a and Block 4b.

a. Block 3. South of the east-west run of Springs Road and between the access road to the National Park and (on the coastal side) the road to the Red Rock residential community (as the allotments develop this should be construed as meaning west of either the allotments or the access road).

b. Block 4. *(Block 4a illustrates the alternative to Block 4 depending on the extent of application of this plan.)* East of Springs Road up to the development boundary and North of the Springs Road extension (east-west run). Block 4b forms a narrow area between Block 3 and the Sunrise 1770 Commonlands.

The conservation objectives of the Reedy Creek Reserve (and other blocks under this agreement) would be greatly enhanced if neighbouring public lands also adopted this fire management plan. Reserve management staff will negotiate to this end with the local council land managers (responsible for Lot 21, and the Camping and Recreation Reserves - Lot 40). If co-operative arrangements can be adopted, block 4 would apply, if not block 4a relates only to the Conservation Area. It should be noted that Block 4b has been a further management allocation in the period following the 2009 review. This block falls between a constructed fire break and the residential area in this current review and has specific aims at producing a low fuel buffer on the western side of the residential allotments.

It should be noted that Block 4b (see Map 3) has been subject to annual burning over the period following the 2009 FMP which appears to have been largely successful in maintaining low fuel loads and appears contrary to advice given in preceding paragraphs in regard to fire interval. Examination of fire scar data (prepared by BHA) indicates mosaic burning over considerable portions of the block (meaning the entirety of the block was not consumed in a single fire) with a clean burning event over approximately a third of the area in 2012 (see Appendix D). It should be noted that there appears to be no substantial loss of ecological condition within grassy habitat associated with Block 4b as a result of this much reduced burning interval. Long term monitoring points are located within this block (FP003, FP004) which will give an indication of long term trends associated with a regime of frequent fires.

The Shire Council is Trustee of both the camping and recreation Reserves. Should its agreement to co-operate in joint management discontinue into the future, there will be no alternative but to construct, north of the east-west run of Springs Road, a fire-trail approximating the boundary of the Conservation Reserve. Such a trail would provide a baseline from which to conduct burning operations, and should (with the Council's agreement) be a "give and take" one, with its correct alignment in relation to the landscape and the need to provide proper grades and drainage, being more important than its correct location on cadastral boundaries. Its construction, however, should be a last resort. At the time of review, co-operative burns with the council have been undertaken on the boundaries of Lot 40 and the conservation reserve and appear to have been successful.

The precise guidelines for action under this element of the strategy are as follows:

1. Begin burning within relevant blocks as soon as possible after the end of March and finish as soon as fires begin to burn through the night. Any fires after the end of September should be confined to small strategic burns after good rains. In most years it could be anticipated that the window of opportunity will be limited to the period from mid-June to the end of August. The time period given, however, allows for much flexibility in the event of summer and autumn drought and/or late winter rains. It should be noted in Block 4b, which is burnt on an annual cycle, the limited fuel will likely mean that successful ignition will occur later in the season than other areas on a longer interval.

2. Do not begin patch burning operations until a wide strip has been burnt along the western side of the track to the Red Rock Residential Community, along the eastern side of the road to the National Park, and (within 2a community) along the National

Park boundary. If there are early indications that this will not be achieved in the first year, then postpone the beginning of operations for another year.

3. After the boundaries, as defined above, are secured, commence patch burning operations by walking inside the area and lighting whatever will burn. This would be a safe procedure provided only one party of two people working together was involved, and ignition was carried out progressively into the wind.

4. In the following year of operations, merely carry out the patch burning operations by lighting whatever will burn. No attempt should be made to burn a break along the roads or along the allotment boundaries.

5. In year 3 of operations re-establish burnt strips along the road before commencing patch burning operations. Burn boundary breaks at 2 year intervals thereafter.

6. Fragmented patches of eucalypt woodland should be subject to green buffer planting and physical removal of flammable ground covers through mowing and slashing. It is considered no longer appropriate to undertake controlled burning in these due to an inability to meet permit requirements and inherent risk to properties in the vicinity.

Element 3 - The burning of the shrubby woodlands of bloodwood and banksia, Community 2e, within Blocks 3 & 4 /4a: There are large areas of this community south of Springs Road, and a small area to the north of it. Because of its different behaviour towards fire (i.e. different fire ecology), although proposed to be managed with a patch burning strategy, it must be assumed that this will not be achieved with the approach adopted in the nearby 2a communities.

Fire does not travel easily in these shrubby communities unless assisted by heavy fuel loads or driven by a wind. Mild and extensive fires are probably neither ecologically desirable nor possible to achieve.

During patch burning in 2a forests no attempt should be made to keep fire out of the 2e communities. With the aid of a GPS device, however, any incursion into them should be mapped annually. Eventually, any parts of them that are likely to have remained unburnt for 6 years or more should be specifically targeted for ignition. Along the National Park boundary, as soon as there is confidence that a significant width of country adjacent to the road and within this community, will burn, it should be ignited.

For 2e communities, the same seasonal restrictions that have been applied to the burning of 2a communities should be applied.

The 2e community north of Springs Road (in Block 4a) is too small an area to be treated separately from the surrounding country, and should be burnt whenever it will carry fire.

It is a matter of concern that full development of the proposed allotments in the Sunrise at 1770 residential development will see the southern allotments, west of the road, abutting the type 2e community. Given the difficulty of burning on effective break in the community until it has reached a hazardous stage there would be little alternative to sacrificing a strip, to the West of housing lots, that would be annually slashed and burnt off to at least a 30m width.

6.2 Sunrise 1770 Commonlands

This will target areas east of the road to the Red Rock residential community (Block 7) and south of the Rocky Point development, in particular those areas occupying the coastal escarpment in the vicinity of residential areas (Blocks 5a, b, c, d and Block 6). Because of the extreme difficulty of establishing a patch burning system that will meet all environmental objectives in this area while guaranteeing the safety of residences, the protection of lives and property will take a defensive approach. Any other approach would be a high risk one because of steep slopes; exposure to strong coastal winds; forest areas with a dense canopy and lack of grassy ground cover making burning under mild conditions difficult; and the presence of extensive shrub communities which are difficult to burn under mild conditions.

Element 4 – Low open forest of Corymbia intermedia and Corymbia tessellaris: Measures are currently in place to minimise fuel accumulation within a wide area downslope from houses within Sunrise and Red Rocks developments, and to minimise the chance of fires entering the coastal slopes from the west. In the 2004-09 FMP it was proposed that much of the necessary fuel reduction within the residential area be carried out using prescribed burns, a large part of the responsibility for which would lie with the Conservation Reserve manager. It has become increasingly difficult to undertake such burning for reasons previously outlined (see introductory portion of Section 9). Fuel reduction has necessarily been facilitated by strategic cutting of ground cover (brush cutting, mowing or slashing) within the Commonlands, coupled with green buffer plantings (see Section 9, Map 2). It is required that individual householders take full responsibility for such work on their own properties where they occur on the coastal escarpment and adjacent areas.

Reportedly some lot owners hold fears that dense mono-specific stands of wattle shrubs or low forest, on the slopes below and within the housing area, pose a high fire threat to the assets lot owners intend to construct here. It is possible that such stands can carry flames up to create a crown fire. However, compared with regrowing wattle (after mechanical removal), increased grassy fuel loads developing after canopy removal and not being maintained by owners, these wattle stands have more compact litter at ground level and more space between the ground and the canopy. This makes it less likely that ground fires will climb into the canopy. Such ignition is only likely in a drought scenario, and then only if a fire originates well downhill, and is driven uphill by a strong wind. The lack of public access to downslope areas should also make ignition unlikely.

Element 5 - Wet heath habitats: Whilst previous FMPs stressed the importance of burning the small wet heath community south of Rocky Point (mapped as 5c), it also stressed the danger of such an exercise due to the potentially explosive nature of habitat. Previous attempts to burn this habitat by BHA have resulted in two spot over events. There is merit in burning the swamp from an ecological sense as this is part of the habitats natural ecological, removing choking shrubs such as *Glochidion ferdinandii* (which is thickening at present) and reinvigorating sedge layers. Current permit requirements however limit the opportunity for targeted fire and it is now prudent to note that mitigation of forested areas surrounding the swamp and on the eastern fall of the escarpment will be through mowing, slashing and green buffer planting rather than prescribed burning of the swampland itself.

7. THE NATURAL ENVIRONMENT OF THE CONSERVATION AREA

7.1 Climate

Climatic records for Bundaberg from the beginning of record keeping to the year 1975 were available to me and because these were sufficient to establish the likely range of annual and monthly variation in the main climatic indices of the subject area that are relevant to an understanding of its fire climate, no attempt was made to secure up to date information. It can be assumed, however, that recently observed general trends in the climate of south-east Queensland of lower and more variable rainfall, and more frequent periods of drought and hot weather, will also apply here.

The available data indicate that, on average, 58% of the total average annual rainfall (approx. 1,200mm) falls in the months of December to March. Although this indicates a strong seasonal trend, it is significant that there is a high variability around the average. Significant rain can fall in any month, and there is also a high possibility of no or very low rainfall in any month, including November to April. When the figures for 3pm relative humidity are examined there is a falling trend from March to September with a rise to a maximum figure from there to February. The monthly range is from 48% to 61%. This would not indicate a significant enough change through the year to influence fire behaviour, other factors not considered. The average figures do, however, obscure the fact that very low humidities can frequently occur from May to September, under the influence of winds from the west, and less frequently, but in combination with very high temperatures, from October to mid-December.

In summation, the climate offers no impediment to either wildfire or prescribed burning operations at any time of the year, but the risk of severe fire rises steadily from April through to December. Other climatic indices do not shed any significant light on likely fire behaviour and are not used here.

7.2 Geology and Vegetation.

(See Appendix C- “Vegetation Communities of Reedy Creek Conservation Area – Agnes Waters” by D.J. Stanton, with appended map.)

8. THE NEED FOR FIRE MANAGEMENT

All of the habitats of the Conservation Area except the vine forests (synonym for rainforests) have evolved under the influence of fire. The evidence for that is incontrovertible. The question that must occupy our minds in relation to them is one of the most appropriate level of fire intensity, frequency, and seasonal timing for their maintenance, or if it becomes an objective of management policy, to change them in some significant way. These requirements are covered by the term “fire regime” which is constantly used in this report.

In an intensively settled area such as the Conservation Area and its surrounds, an overriding concern is the protection of life and property and a fire regime that is optimal for maintenance of habitat might not provide maximum security in that regard. Whatever compromises have to be made in adjusting habitat management requirements to those of safety, total fire exclusion is not an option, and for the reasons outlined below.

Underwood (2004) enunciated three General Rules about bushfires in Australia which could not be stated more simply and which are as applicable in the Agnes Water situation as they are for southern Australia, which he mostly had in mind:

1. Any attempt to exclude fire from eucalypt forests is doomed to failure. Lightning, arson, or accidental ignition can never be permanently eliminated.
2. The longer a eucalypt forest remains unburnt, the greater the probability that the next fire will be large and intense. The intensity and difficulty of control always increase with increasing fuel load, and
3. Large all-consuming bushfires cause far greater damage (including environmental damage) than small, patchy mild fires.

The above principles highlight the simple choice that land managers face in dealing with sclerophyll habitats: will they be burnt in ways and under conditions determined by the land managers, or by wildfires determined by the activities of arsonists, escapes from fires on other lands, or by lightning ignition. There are no criteria, either those relating to human safety or environmental benefit by which the latter scenario is ever likely to be judged the best option.

9. FIRE ECOLOGY OF THE VEGETATION COMMUNITIES OF THE REEDY CREEK CONSERVATION AREA

Vegetation mapping of the Conservation Area (see Appendix C for report and accompanying map) has identified 22 vegetation communities. In the absence of precise knowledge of the fire ecology of each of them, they are grouped below in Broad Vegetation Types for which general observations, based on experience of similar habitats elsewhere can be made. The component vegetation communities as described in Appendix C, and mapped, are indicated in brackets:

1. Vine Forests. (1a, 1b).
2. Open Forests (and some woodlands) dominated by *Corymbia intermedia* and *Corymbia tessellaris* with a ground cover varying from shrubby to grassy. (2a, 2c, 2d).
3. Tall open forest, *Corymbia intermedia* dominant, with a developing vine forest understory (2b).
4. Sparse woodland with a sub-canopy of *Banksia aemula* (2e).
5. Swamp woodland of *Eucalyptus robusta* (2f).
6. Forest and woodland of *Eucalyptus tereticornis* (2g).
7. Grassy, open forest of *Melaleuca quinquenervia* (3b, 3d)
8. Tall open forest and woodlands of *Melaleuca quinquenervia* with a ground cover of ferns and sedges (3a, 3c).
9. *Melaleuca quinquenervia, Melaleuca dealbata* and the palm *Livistona decora*, on sand (3d).
10. Shrublands (4a, 4b, 4d).
11. Frontal dune communities (4c, 5b).
12. Grasslands of rocky headlands (5a).
13. Heath and sedge swamps (5c).
14. Palm (*Livistona decora* forests) (6).
15. Regrowth communities (7).

9.1 Vine Forest Communities 1a, 1b

Fire plays no part in the regenerative processes of vine forest, and if severe, can destroy it. Neither type of vine forest found on the Conservation Area shows evidence of fire damage, and it can be assumed that a continuation of the fire regime that has prevailed over the last few decades would not threaten its existence. Indeed, under that regime, community 1a of the high dunes has been expanding, as evidenced by the large eucalypts growing within it and near its margins, and the wide band around it in which a rainforest understory is rapidly developing.

Community 1b, which grows in some small sheltered depressions among the foredunes, is stable.

The only conceivable threat to the survival of the vine forests could come from a wildfire of a ferocity unprecedented since European settlement, and that would only happen if there were total neglect of fire management. Severe fire would kill the margin of the rainforest, and its complete destruction would occur if there was continual attrition along that margin under the impact of repetitive severe fires.

The vine forest of the high dune is currently in an expanding phase, and it would seem that it is quite capable of colonising the deeper red stained sands of the older and higher dunes, i.e., much of the eastern part of what is mapped as community 2a. Given current trends, it is likely to double its area within a few decades. Given that, and the stability of the vine forests within the dunes, there would not appear to be any justification for special management measures to protect these forests. Indeed, any attempt to buffer them with a protective fire exclusion area could actually increase the chance of marginal damage to them in a severe wildfire, by increasing the fuel load around them.

9.2 Open forest Communities 2a, 2c, 2d

These have a ground cover of mixed grasses, sedges, bracken, and *Xanthorrhoea latifolia* commonly present. The shrub layer varies from absent to densities where, in patches, they exclude the ground cover. Its height directly reflects the recent fire history of any particular location.

The dominance of grasses and sedges in the ground cover of most of this Broad Vegetation Type in the Conservation Area indicates a long-standing past regime of regular fire. Frequent fires are generally mild fires, and the available evidence from the nature of the shrub cover and the relative paucity of fire scarring of the larger trees, indicates that hot fires have been an uncommon event in this type in recent decades.

It is known from observations of equivalent forest types in eastern Queensland that regular fires at intervals of no longer than 5-6 years will maintain a grassy ground cover. With fire exclusion beyond that, shrubs, particularly allocasuarinas, tend to dominate, and will eventually form an understory with heights of some species reaching the sub-canopy, which will exclude the ground cover. There is clear evidence from this area that rainforest species can invade and develop in the understory of this type, but the passage to a vine forest understory that can exclude fire is likely to be decades long. The end point of such a change would be the loss of this vegetation type as eucalypts cannot regenerate without a period of bare ground and high light levels.

The grassy forests of this type will burn readily as soon as there is sufficient fuel to carry a light ground fire. Where the ground cover is excluded by the development of a dense understory, only a wind-driven fire under severe conditions can reverse the situation.

Whilst the broad parameter of the way this type is shaped by fire, as described above, are known, its reactions to varying season and intensity of fire are complex at smaller scales of variation, both in the more subtle levels of change in the nature of the understory and ground cover across the landscape and in micro scale variation from place to place. The competitive balance between grasses and shrubs in the understory can be changed by the season of burning. Shrubs are favoured by fires during dry weather and in the cool season when grasses cannot respond with new growth, but shrubs can quickly regenerate by tapping deeper levels of soil moisture.

Early summer fires when soil moisture levels are high, favour the grasses. The occasional hot fire in accumulated litter under canopy trees is essential to the process by which tree hollows, so

essential as wildlife habitats, develop from fire scars. A fire regime dominated by severe wildfire, however, can lead to extensive loss of large hollow trees which easily ignite and burn down.

9.3 Open forest Community 2b

This represents an area surrounding vine forest type 1a where the understory of the sclerophyll forest is being rapidly invaded by a suite of species from the vine forest. There is incontrovertible evidence from the presence of scattered large bloodwoods within the vine forest that this type will, unless deflected by severe wildfire or invading exotic weeds, eventually surrender to the vine forest.

The presence of this type as a margin to the vine forest is evidence of the long absence of severe wildfire from the surrounding country, and that the long-standing fire regime has been one of frequent mild fires. It also indicates that no special measures are required to protect the vine forest against fire damage.

The presence of exotic weed species, dominantly *Lantana camara* and *Passiflora suberosa*, gives some uncertainty to predictions of the course of evolution of this type to vine forest. While it is unlikely that they will prevent it, they have the potential to slow it down and to eliminate some of the slower growing species. Fire could be used to control these species, but would also prevent the succession to vine forest.

Photos 3 & 4). Vegetation Community 2e. Two views on either side of the boundary with Deepwater National Park showing the dramatic difference in structure with different fire histories in the shrubby woodland. A long unburnt area on the National Park (left) and (right) the same community after a fire estimated as having occurred 2 years earlier.

9.4 Woodland with *Banksia aemula*, Community 2e

Fire interacts with this vegetation type in very different ways from what it does in Broad Vegetation Type 2 above. Its behaviour is determined by the extremely infertile sands on which it grows, which favour the development of sclerophyllous shrubs and, at best, will only support a light ground cover of grasses and sedges. The combustible fuel in this type largely comes from the shrubs themselves and the litter they shed. Thus they are difficult to ignite under mild conditions and, to carry, need to gain much momentum from wind acting on a heavy fuel load. They tend to burn hotly or not at all.

As well as being difficult to ignite, the fuel in this type accumulates slowly as compared to the grassy fuels of Type 2 communities which reach near maximum levels after about 4-6 years and accrete only slowly after that as the contribution from the shrub layer increases. The time period at which maximum fuel accumulation occurs in this type or its equivalent from elsewhere, is unknown, but likely to take a decade or more. Additionally, no matter how long it is unburnt, its very low fertility soils are unlikely ever to support the development of rainforest.

Many constituent species are likely to depend, at least in part, on regeneration from seed after a hot fire breaks seed dormancy or opens woody capsules, and there is a general trend for species diversity to decrease with time since the last fire. Indeed, repetitive mild fires, should these prove possible, would also be likely to decrease diversity by eliminating those species which regenerate by sprouting while contributing nothing to the presence of obligate seeders.

9.5 Swamp woodland of *Eucalyptus robusta*, Community 2f

This type, under the influence of constantly high soil moisture levels, rapidly accumulates heavy fuel levels. Because the fuel load comes from a mixture of sedges, ferns and shrubs, plus a relatively small contribution from leaf letter which remains suspended above the ground, it is a less dense fuel than that provided by the leaf litter of open forest communities where long absence of fire has allowed shrubs to suppress the ground cover. Because it is well aerated it ignites easily when dry, and in the presence of wind, can support uncontrollable blazes. In the long absence of fire it can accumulate a significant layer of fibrous peat on the surface of the soil, which can continue to burn or smoulder long after the main fire has passed.

9.6 *Eucalyptus tereticornis* (forest red gum) forest and woodland. Community 2g

These restricted communities of the western edge of the Conservation Area have a grassy ground cover with scattered to dense shrubs. The more grassy areas have been maintained by repetitive light fires, while changes in the frequency of fire across the landscape, and time since the last significant fire, are reflected in the varying density of the shrub layer. With the heaviest density of shrub layers, ignition of this type under other than very dry conditions, becomes increasingly difficult. With long exclusion of fire it is likely to suffer heavy invasion by Lantana camara. At that stage it would only ignite under extremely dry conditions.

9.7 Grassy open forest of *Melaleuca quinquenervia*. Communities 3b, 3d

The monospecific nature of the canopy of this type reflects the nature of the poorly aerated soils, of seasonally impeded drainage, on which none but a narrow range of tree and shrub species are capable of establishing. They provide no impediment, however, to the development of a vigorous ground cover, It is likely that fuel accumulation from that ground cover would stabilise after a relatively short interval of time (possibly 4-6 years plus).

It is also likely that this type would support a wide range of fire frequency with little change in its structure. Because of the seasonally impeded drainage, soils supporting this type are likely to remain moist well into the dry season in most years, with parallel long periods of high fuel moisture. It could be inferred that historically the majority of fires burning in it have been late season ones (September-December).

9.8 Tall melaleuca communities (3a, 3c) with a ground cover of ferns and sedges

Melaleuca quinquenervia dominated communities pose some perplexing complexities in their fire ecology, and consequently some difficult management problems.

Melaleuca quinquenervia forest is superbly adapted to resist and recover quickly from mild to moderate fires. It grows where soil moisture levels are high, and consequently the ground cover, providing heavy and well aerated fuels, regenerates rapidly, and quickly reaches maximum fuel levels with a full complement of species, and the thick bark cover provides protection of sensitive tissues from fires of most intensities. In this area, the palm, *Livistona decora*, which is a common understory species, and often forms dense stands, is one of the most fire resistant trees at all stages from small plant to tall tree reaching heights of 25m plus. It is often the first species to reshoot after fire.

As well as the features that allow them to resist fire, *Melaleuca quinquenervia* communities are notable for their propensity to spread fire far and wide, both within themselves and across the landscape. he bark will ignite in even mild fires, carrying flames rapidly to the tree tops. Bits of flaming bark will break off and drift in the wind. In heavy fuel loads, and with a strong wind behind it, severe fire will create updrafts which literally tear the flaming bark from the trees, allowing the wind to carry it kilometres ahead of the main fire front.

As swamps dry out, such heat can be generated in the subsequently available fuel loads that even the thick bark of the melaleuca is no protection, and widespread death of even tall canopy trees can occur. Additionally, thick peat layers are a common feature in the soils of these communities. As they dry out they are capable of igniting and burning for weeks or months, destroying the roots of trees in the process and leading to widespread collapse of the canopy.

The current good condition of the melaleuca forest indicates that the present and past fire regimes have not been destructive. It is obvious, from the size of the trees, that there has been no event during the last century or more, in which fire has entered the swamp when the surface peat layers were dry. The extraction of water from the swamp, however, as is currently occurring, may increase the chance that this will happen, potentially prolonging periodic drying of peat layers during periods of extended drought. There may be an increasing risk of destructive fire episodes, particularly if extraction rates increase dramatically.
There is no indication in the structure of melaleuca forests within the Conservation Area that they have, in any part of them, even in the time span of a century or more, been subject catastrophic fire events as described above, and indeed, similar communities can be found throughout the length of the east coast, from Cape York to northern New South Wales, where evidence of such destruction is rare. It is not an insignificant possibility, however, and a number of cases can be documented, while in some more numerous cases evidence of their past happening can be seen in large stands of even-aged small diameter melaleucas in random patterns among tall mature forests.

A most notable example of destruction of tall melaleuca swamp forest by fire occurred in what is now Woodgate National Park, to the south of Bundaberg, in September 1967. There, over 30 years of fire protection ended in disaster when the consequent fuel build-up was exposed to desiccation during a severe drought and ignited in a strong westerly wind and on a day of extremely low humidity. The aftermath of another event was recorded in the three photos included in this report as Photos 5, 6, and 7. They record sections of Eubenangee Swamp, south of Cairns, where an almost identical community to that mapped as 3a in the Conservation Area was burnt in two separate fires in late 1991 and early 1992.

It is likely that in the long term such events could be viewed as a natural part of swamp forest ecology that creates structural diversity, and by removing the peat layer renews the swamp as a landscape feature by deepening it. The luxury of that view point is acceptable on a very long term basis and where such forests cover large areas and have been little impacted by man’s activities, as on Eastern Cape York Peninsula. It is not, however, one that could be accepted as a serious determinant of management actions in a small Conservation Reserve and a region where such forests are now only remnants of their former extent.

Photo 5 shows a section of forest which escaped the fire and had been unburnt for well over 10 years.

Photo 6 shows a nearby area burnt in late 1992 when the ground surface was covered by 10-20cm of water; recovery was rapid as this photo taken 10 months later shows.

Photo 7 shows the impact of the later fire which occurred during extreme drought, when surface water was gone and the surface of the peat layer was dry. The peat ignited and burnt for months, lowering the soil surface and causing the collapse of the canopy as roots burnt out. The ground cover in the photo is a dense sward of melaleuca seedlings; the sedges and ferns are gone.

9.9 *Melaleuca quinquenervia, Melaleuca dealbata*, and *Livistona decora* on sand. Community 3d

This small community is confined to a single occurrence on sand as a fringing forest to a small sedge swamp. Whilst dramatically different in structure to the sedge swamp any discussion of their fire ecology must treat them as a single unit (see Broad Vegetation Type 13, below).

9.10 Shrublands. Communities 4a, 4b, 4d

While community 4a is obviously an expression of even aged regrowth after an intense fire, it is not clear whether or not the continual rejuvenation of the acacia and/or allocasuarina canopy by fire is part of a cycle that has had long term stability, with the distribution of the community being determined by soil factors. Within a number of areas of this community that were examined, however, there was evidence of the past presence of large trees, suggesting that it may have been derived as a result of destructive fire in a sparse shrubby woodland dominated, from the evidence of regenerating species, by *Corymbia intermedia* and *Banksia integrifolia.*

The nature of community 4b is clearer, with its structure determined by the combined influences of extreme soil drainage, erosion, wind and occasional hot fire. Community 4d occurs where hardpan layers occur at shallow depths in the soil profile, severely limiting its effective depth, and in situations exposed to the full force of salt-laden wind.

The structure and floristics of two of these three communities (4a and 4b) is determined by the passage of irregular hot fires, in which most of the above ground vegetation is consumed. They are communities which generally either burn to the ground over extensive areas, or not at all. Mild fires which would cause patchy canopy scorch and consume some of the litter, are possible, but would tend not to carry very far. A regime dominated by such small mild fires would inevitably change both the structure and floristics of these communities in the long term, most dramatically in Type 4a, where the dominant acacia would senesce and die without being replaced from soil seed stores. It is likely that it would be replaced by allocasuarina if wild fires were infrequent or absent, as that species, although it regenerates extensively from seed after a severe fire, is also capable of germinating and surviving to dominate the canopy in its absence, and in the shade of other species.

The exclusion of fire from community 4a could be accepted as part of a strategy to rehabilitate an original sparse woodland, and would be most likely to be successful where allocasuarinas were rare or absent. The collapse of the acacia canopy would liberate any regenerating species of an original canopy, but it would be a high risk strategy as the chance of a wildfire triggering a mass germination of acacias would be high.

Community 4d is largely shaped by soil factors, although the maintenance of maximum species diversity within it probably requires at least the rare hot fire at intervals of more than 10 years to provide for the regeneration of hard seeded species of short life span.

9.11 Frontal dune Communities 4c, 5b

These communities occupy an unstable land form subject to episodes of erosion and accretion during rare cyclonic events. Although some of the component species in these communities would be maintained there by disturbance, the infrequent disturbance provided by the storm events is probably sufficient for that purpose. Fire is likely to be unnecessary and pose a threat to the stability of the system should it be followed by severe weather. The horsetail she-oak (Casuarina equisetifolia) which occurs on these dunes as scattered groves or individuals, and is capable of colonising them after storm events, is extremely sensitive to fire, and does not readily regenerate after it.

9.12 Grasslands of rocky headlands. Community 5a

These are shaped by soil and exposure, and fire does not appear to be essential for their long-term maintenance. To the contrary, although fire will carry through these grasslands, and would inevitably have been a part of their long term history as at least a rare event, the danger of post-fire erosion and destruction of some sensitive species, notably *Casuarina equisetifolia*, is very real.

9.13 Heath and sedge swamps. Community 5c

Fire would be essential to the maintenance of some of the shrub species in this community, but it is likely that fire at long intervals of 10 years or more would be sufficient for that purpose. It is not known what changes would occur to distributions of the sedge and fern species in this community with the long term exclusion of fire, but they are likely to be insignificant.

The greatest threat to the survival of these communities would come with their ignition at a time when the surface peat layer is dry. The destruction of the peat would lead to a cycle of renewal of the community in a way that could not be predicted, but it should remain a sedgeland, although floristically depauperate, with colonisation by sedges, and eventually shrubs, occurring from its edges inwards.

9.14 Palm Community 6

The palm species *Livistona decora* occurs as scattered clumps and individual trees in all the forest communities of the Conservation Area. Areas where it dominates are relatively small and well scattered. The species is a fire-hardy one at all growth stages and even where its leaves have been killed by fire it quickly resprouts from its growing point, usually within weeks.

Far from being fire-sensitive communities, as is often believed, the palm forests are not only extremely fire resistant, but their leaf litter burns fiercely and does much to promote high intensity fire within the community.

9.15 Regrowth Community 7

Within the Conservation Area these are mostly dominated by species of acacia. They will be subject to the prevailing fire regime of the surrounding country unless special measures are taken to protect them, and this cannot be guaranteed to be the optimum to promote their rehabilitation to a semblance of the original community. Only trial and error based on a good understanding of the regenerative processes within these communities could help to determine that.

10. MONITORING AND ASSESSMENT OF PERFORMANCE

Monitoring: It is a most basic requirement in any land management operations, and hardly needs to be stated, that monitoring to assess the success or otherwise of those operations should be carried out. Given the dearth of experience of fire management in the environments of the Conservation Area, it is vital that the habitat effects of the proposed strategy be assessed.

It is beyond this report, however, to prescribe how it should be done except to say that it is mandatory that the areas burnt each year be mapped as precisely as possible. Given the small size of the area it is suggested that this could be most effectively done by walking transects across the area or following the boundaries of burnt areas. The location of points on the ground could be determined using aerial photos, GPS, or both. This has been undertaken in 2012 and 2013 with fire scar mapping for both years included in Appendix D. This mapping program should be carried into forthcoming years. There has also been the allocation of 8 permanently marked photographic monitoring sites to monitor long term habitats trends that may occur as a response to the prescribed management regime (Appendix E).

Beyond that, the type of monitoring done depends on the type of information required, and the resources available. At the most complex level it could depend on support given to a post-graduate student.

The likelihood of resources being available for monitoring, and the possible methodologies given various levels of resourcing, are beyond my appreciation and I can do nothing more than emphasize its importance.

Performance: The fire management strategy proposed here is based on experience from elsewhere, albeit experience gained in a wide range of environments over a long period of time. Ultimately, however, that strategy should be abandoned or amended if local experience proves it unable to achieve its aims. It can therefore, only be accepted as a "best guess" strategy and a guide to where to begin and the likely resources needed.

It can be judged to have failed in some aspects, and to need amendment, in the following events:

- More than 80% of blocks 3 and 4/4a burn (separately considered) in single fire events (Based on the minimum area of 20% likely to burn in any one year in patch burning operations.)

- In any year more than half of the area not covered by prescribed burns is burnt by one or more wildfires.

- It is found not possible to burn most of the swamp blocks 1 & 2 separately considered, after a 6 year period, or suitable conditions for burning do not present themselves within a 2 year time span after a decision to burn is made.

- Infrastructure damage is suffered from a prescribed burn or wildfire.

- Monitoring indicates adverse changes in habitat as a result of burning.

- Community support and co-operation with the strategy is not forthcoming, and pre-burning preparations cannot be adequately carried out.

- An effective co-ordination of the strategy, with a long term commitment to it cannot be achieved.

- If reserve or conservation area management fails to give the exigencies of the strategy the highest priority of all work when conditions for burning are right.

It cannot be emphasized enough that no fire management strategy can work without skilled staff to carry it out. It is critical that all those involved in the field operations have long term tenure in their work so that they can be continually learning on the job.
On-ground fire management is not work that should involve casual volunteers.

11. OPERATIONAL SAFETY ISSUES AND APPROPRIATE BUILDING DESIGN

This proposed strategy prescribes on-ground operations that are potentially hazardous, most particularly if those involved are inexperienced. It is beyond the scope of this report to deal with those matters or the broader field of Work Place Health and Safety. It is assumed throughout that all operations will be carried out according to the dictates of industrial legislation and the Fire and Rescue Act, 1990.

The fire management strategies of this plan are designed to achieve the maintenance of existing habitats and to minimise the chance of any fires on the Conservation Reserve or Commonlands entering adjacent private lands. With regard to rural residential properties to the west and north of the Conservation Reserve, it is suggested that their occupants take complementary action to increase their own security. Considering the varied interests involved, the varying nature of landscape and vegetation from property to property, the need for compliance with relevant state legislation, and the need for all adjoining residents to be fully aware of proposed actions on the Conservation Lands, it would be highly desirable for all parties to seek the appointment of a skilled co-ordinator with considerable local knowledge and respected by the community.

In other residential lands covered by a Body Corporate it is assumed that that body will undertake an appropriate coordinating role and is recommended that the BC seek professional advice regarding the protection of residences within the scheme.

12. REFERENCES

Specht, R.L. (1970), Vegetation. In “The Australian Environment”. Ed. G.W. Leeper. Melbourne University Press: Melbourne

Underwood, R.J. (2004), Iraq, bushfires and the precautionary principle. In “The Forester”, Institute of Foresters of Australia.

Webb, L.J. (1978). A general classification of Australian rainforests. Aust. Plants 9(76) 349-63.

13. APPENDICES

Appendix A. Recommendations for protection of houses within the residential development area.

It should be stated upfront within this section that:

1. BHA has no control over or responsibility for fire mitigation in land parcels that are privately owned.
2. The onus for fire mitigation falls on Lot owners and the Body Corporate is responsible for issues of compliance in relation to development codes.

Hence, recommendations contained within the FMP should be regarded as recommendations rather than statutory issues in regard to compliance.

As identified in the current FMP, with increasing residential development the wildfire hazard within the residential areas will change in nature, generally in the direction of decreasing risk. In response to this, adopted mitigation in residential areas has shifted to a defensive one involving green buffer promotion coupled with physical reduction in flammable ground covers through slashing and mowing. The most important points that are relevant to the changed situation since the plan was first written are presented here. This involves reiteration of much that is currently recommended; more emphasis on some aspects, and some changes.

Wind driven fires: The possibility of wind driven canopy fires that could threaten residential areas is slight but the greatest contribution that can be made to reducing that possibility to a vanishingly small level is the management of the Conservation Reserve as is proposed in the Fire Management Plan, and as it is currently being implemented. With current and proposed management of Commonlands within the residential area, and the nature of present and proposed development, the threat to houses will most likely come from moderate intensity fires that would be relatively easily controlled. An exception to this would be any fires in the small sedge swamp and adjacent palm communities, referred to in Section 2 above (Vegetation Types 5c&3d) and any fires in the closed shrub land community mapped as Vegetation Type 4c. A strategy to remove the risk of the former involves green buffer establishment and mowing, but there is no possible strategy that can remove the destructive potential of any fire that enters the latter community in a worst case scenario.

The closed shrublands of Type 4c, average about two metres in height, and would only burn in severe conditions that would consume the entire community, with potential flame heights of 6m. They are extremely difficult to burn with a mild prescribed fire, so that a strategy to reduce fuel within them is unavailable. The only course available is to manage the surrounding common and public lands to reduce the risk of fire entering them.

As additions and amendments to the guidelines already contained in the Fire Management Plan, the following is provided:

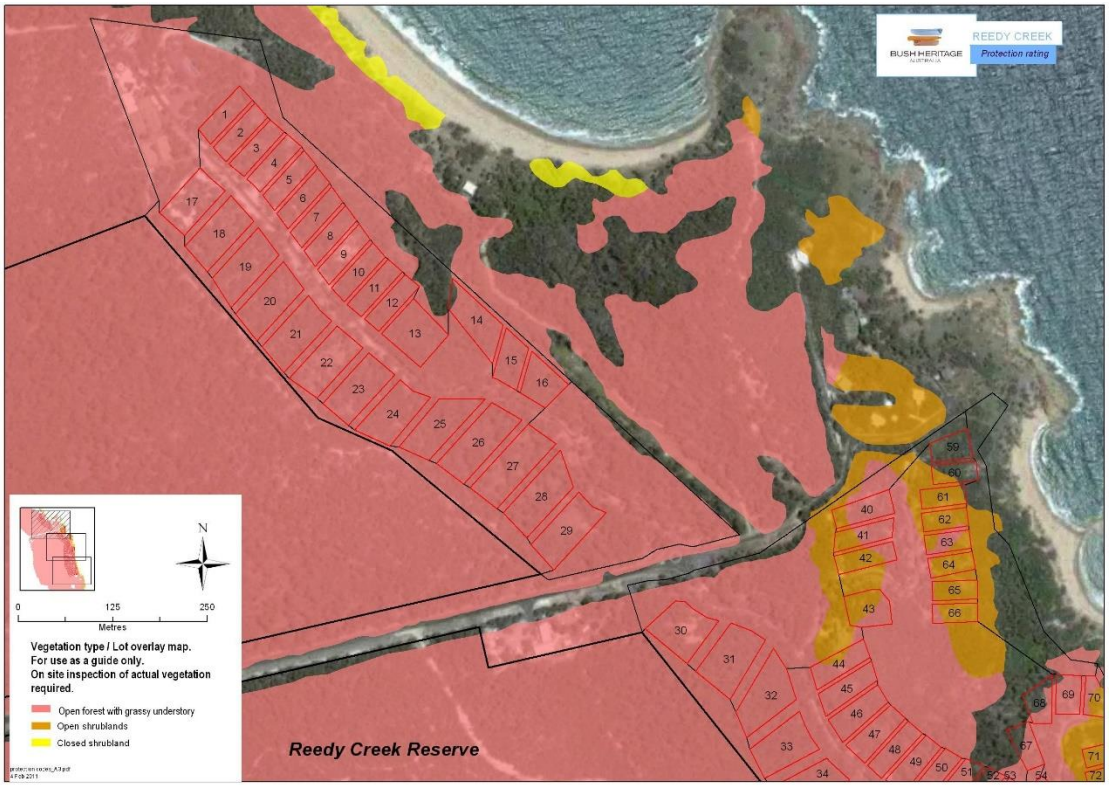
- Fuel reduction burning is no longer recommended within the residential areas nor adjacent Commonlands.
- Where the vegetation surrounding a house is tall open forest (Types 2a, 2c, 2d) with a grassy ground cover a buffer of 20m width should be regularly mowed, by any method, and any shrubs and small trees (except those species of vine forest affinities) removed. Any hollow trees in that buffer should also be removed.

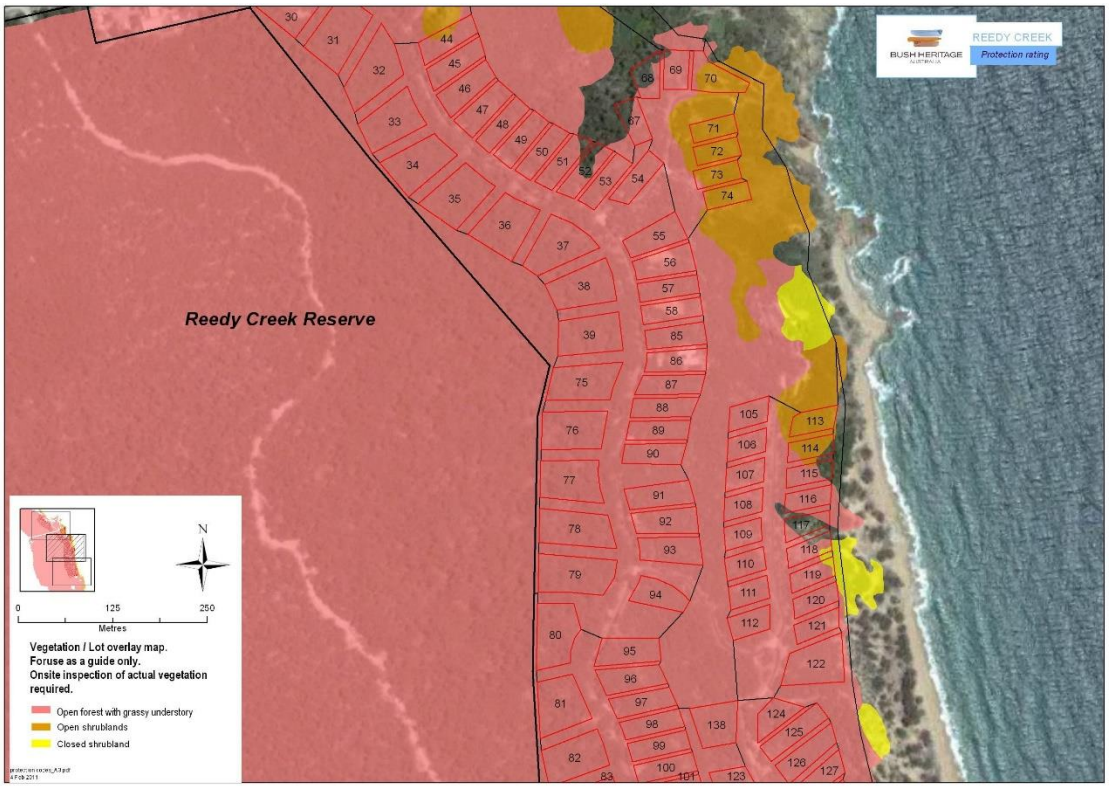
- Mowing can, with advantage, be continued beyond the 20m buffer, but trees and shrubs should not be removed. Instead, their development should be encouraged in order to suppress the ground cover. Under most circumstances fires do not ignite or easily spread in the litter that develops under dense stands of shrubs, particularly casuarinas and acacias. In addition, these stands have a vital function in reducing wind velocities thus altering the behaviour of any fires that might start, making them more controllable.
- Open shrublands on steep slopes (Vegetation Type 4c), should be treated with particular care. They should be removed within 10m horizontal distance of a house and either replaced with dense plantings of fire resistant shrubs and small trees (local vine forest species only), or a low creeping ground cover (such as couch grass) should be encouraged. Any other exotic grass species should be eliminated by spraying. Outside the buffer zone of 10m this vegetation type should be managed to promote maximum density of trees and shrubs; a strategy which, by reducing wind velocity within the community, and eliminating grasses and tall sedges, will eventually reduce the capacity of fires to ignite and carry. Vital to this strategy is the elimination of any exotic grass species, or lantana, which thrive in openings and clearings and burn easily and hotly.
- Closed shrubland (Type 4c) should be treated in the same manner as open shrubland, except that beyond the 10m zone, because of the total suppression of ground cover, there is no need for management of the community.
- Bare sand within a few metres of the footprint of the building should be covered only with materials that will not burn (pebbles, gravel, cement, etc.) Mulch should not be used.
- Strategic planting of belts of fire resistant trees (local vine forest species) near property boundaries, should be encouraged as per the current green buffer strategy.

Table A provides a summary of the vegetation types that occur within Land Parcels within the residential area with recommended management actions.

Table A. Management recommendations for individual lots.

Vegetation Type - Treatment	**Land Parcels**
Vegetation type - Open forest with grassy understory (Vegetation Communities 2a, 2c, 2d). • **4m from footprint-** Remove <u>all</u> combustible material including mulch and wood chip. Bare sand or soil, concrete, pebbles, rock, paving. • Over rooves and within 4m of eves of buildings- remove all vegetation • **4 to 20m buffer zone -** Native grasses should be regularly brushcut or mown, fallen limbs and accumulations of fine fuels removed. Small, immature trees and regrowth of combustible species should be removed. Dead hollow trees removed. Mature eucalypts and wattles retained. Rainforest affiliated species of low combustibility should be planted and maintained especially between buildings and the direction of likely fire attack. • **Beyond 20m-** Regular mowing of grasses and removal of light fuels an advantage but no trees or shrubs removed.	1 – 29 40 – 43 in part 44in part 45- 58 63 in part 66in part 67– 69 70 in part 75 - 84 85 – 104 105 – 112 114 in part 115 - 128 129 - 136 137 – 150 151 - 172
Vegetation type - Open shrublands on steep slopes (Vegetation Communities 4b, 4d). • **To 4m from footprint-** Remove <u>all</u> combustible material including mulch and wood chip. Bare sand or soil, concrete, pebbles, rock, paving.	40 – 43 in part 60 – 66 in part 70 – 74 113 114 in part
Vegetation Type - Treatment	**Land Parcels**
• **4 to10m from footprint -** Measured horizontally from building, all trees and shrubs of high combustibility removed, subsequent regrowth should also be removed. Cleared zone should be densely planted with low growing species of low combustibility (local vine forest species), or low growing ground cover of low combustibility (pigs face, snake vine). • Grasses should be regularly mown or brushcut. Eliminating exotic grassy weed species is critical (Guinea grass, Signal grass, African Love grass, etc.). • Beyond 10m manage to promote maximum density of shrubs and trees for shading out grasses and limiting wind velocity.	
Vegetation type - Closed shrublands. • Recommendations are the same as Open shrublands above, except that, existing closed canopy will negate need for suppressing grasses and ground cover beyond 10m buffer zone.	118 – 119 in part 165 -166 in part


REEDY CREEK
Protection rating
BUSH HERITAGE AUSTRALIA
Reedy Creek Reserve
N
0
125
250
Metres
Vegetation type / Lot overlay map.
For use as a guide only.
On site inspection of actual vegetation required.
Open forest with grassy understory
Open shrublands
Closed shrubland


REEDY CREEK
Protection rating
BUSH HERITAGE AUSTRALIA
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0
125
250
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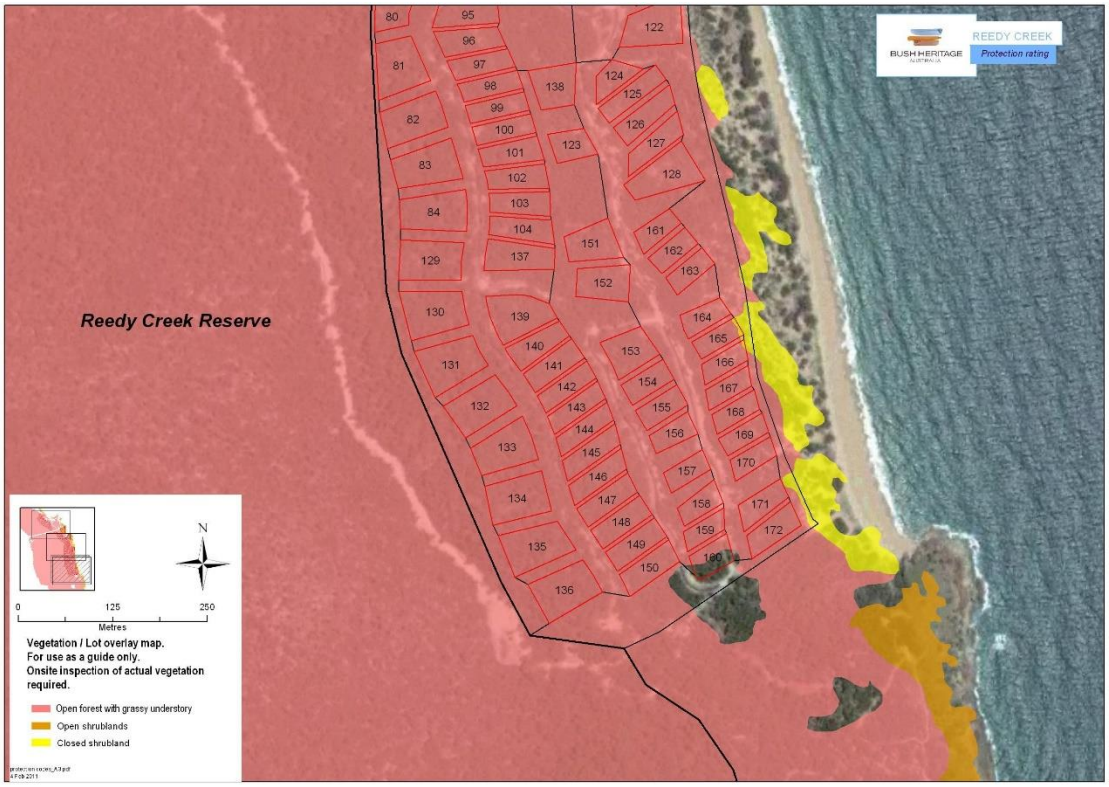
Vegetation / Lot overlay map.
Foruse as a guide only.
Onsite inspection of actual vegetation required.
Open forest with grassy understory
Open shrublands
Closed shrubland



Fire breaks around houses: There are two basic options for creating a fire break to protect houses adjacent to the wattle or other shrub dominated communities being:

1. Cut and remove shrubs and trees (see discussion below).
2. Manually cut and remove the wattle on private lots (if the Body Corporate feels the current level of risk cannot be tolerated and ensure ongoing mowing maintenance of private lots to control grassy fuels).

To be useful on flat country or gentle slopes such a strategy would have to involve clearing a strip with a width of approximately twice the height of the vegetation. That would require clearing a minimum width of 20m (as indicated by the fuel reduced buffer proposed above) and a maximum width of 30m. On steep slopes regular removal of leaf litter and ground cover beyond the 10m horizontal distance buffer previously recommended for minimal security would be useful. However, removal of small trees should be avoided as this will affect the windbreak effect of the existing canopy shape, enabling much faster upslope wind speeds, further increasing the chance of fires reaching the crown.

Dealing with Wattle / Shrub Stands: If wattle stands are removed in close proximity to housing, the fire danger will only be reduced temporarily, as after such clearing, regrowth wattle will have increased branching at lower levels. Once ignited, regrowth would be more likely to develop a crown fire. If a decision is taken to commit the work time and expense to such wattle removal, the sites will require permanent maintenance, to gain a slight reduction in fire risk.

In one good wet season, open areas can develop a large bulk of fuel from exotic grasses and weeds. This, combined with increased wind velocity in open areas,

could provide a more difficult to manage fire situation than pertains to dense forest or shrubbery with ground litter reduced. In the situation of managing wattle fuel loads by fire, the canopy cover suppresses grass and the community is an effective windbreak. Once grass and weeds mix with regrowth in manually cleared areas, they would be difficult to control until heavy shade is re-established – at which time of course, it would be time to remove the shrubs again.

It is critical that co-ordinated action be taken by all residents in the area. No protective strategy will work if there is a weak link in the defensive barrier established adjacent to any residence. It is suggested, therefore that the proposed program, particularly as defence against potential disaster is its primary motivation, be carried out with the assistance (as required) of the State Emergency Service or its delegate.

Hence the following actions are proposed:

1. Fuel removal should be done manually, or with a brush-cutter. Vegetative material from cleared shrubs and grasses should be removed from the site directly after cutting. Particular effort should be taken to protect any small rainforest trees during this operation. Within the cleared area arising from these operations, any hollow trees should be removed. There must be no flammable material touching or underneath buildings.

2. It will be in the residents' interests to develop as dense a canopy as possible in the areas adjacent to their properties. Apart from preserving existing canopy trees and shrubs (hollow trees excepted) the seedlings of any species from the vine forest should be protected. The reason for this is that the most easily managed ground cover is leaf litter which can be raked and mulched or removed. Additionally, fires burning in leaf litter can be easily controlled, especially in the absence of wind. Dense vegetation, by suppressing grass and weed growth, providing a moister environment as compared to open areas, and limiting local wind speed increases the potential to control all fires other than intense winddriven ones that consume the canopy.

3. Continued burning of Block 4b on an annual basis as a buffer to western portions of the residential area. Green buffer plantings should be expanded wherever possible around the internal fire break margins within the residential areas concentrating on areas of greatest risk (most often in areas adjacent to lands outside the control of BHA).

Appendix B. General comments on operational procedures

Permits to complete hazard reduction burns detail the following requirements:

- No burning to be undertaken when winds are forecast to exceed 11 kph.
- Bare earth fire breaks are in place that are > 4m width prior to burning.
- 2 capable persons must be present and a 4 X 4 slip on unit must be able to access the site prior to burning.

As additional recommendations:

- Ignition should always be undertaken at a time of day of decreasing hazard, i.e., falling temperatures, falling wind speed, and rising relative humidity. This criterion generally precludes operations before about 2.00pm.
- Attempts to burn breaks along fire lines should not be persisted with if it is obvious that the planned burn will not consume most of the available fuel or cover a strip of sufficient width. For this reason, the recommendation to burn breaks every two years in Block 3 is based on a perceived need to guarantee sufficient fuel for the operation. In the case of the latter, the likelihood that it will be more difficult to achieve a burn in Community 2c than in Community 2a because of its generally denser canopy is acknowledged in the proposed three year cycle. If breaks cannot be burnt, operations dependent on them, other than on-going patch burning, should be postponed for one year.

Appendix C. Vegetation Communities of Reedy Creek Conservation Reserve

Vegetation Communities of Reedy Creek Conservation Area Agnes Waters

Environmental Mapping and Management
David Stanton Phone: 3411 9072 Email: stantdvd@aol.com

Legend

- Conservation Reserve
- 1a, Simple notophyll vine forest of older high dune system
- 1b, Low simple notophyll vine thicket of younger frontal dune system
- 2a, Tall open forest. Corymbia intermedia dominant
- 2ax, Tall open forest. Corymbia intermedia dominant (disturbed)
- 2b, Tall open forest. Corymbia intermedia dominant with a developing vine forest understorey
- 2c, Low open forest of Corymbia intermedia and Corymbia tessellaris.
- 2cx, Low open forest of Corymbia intermedia and Corymbia tessellaris (disturbed).
- 2d, Tall woodland and open forest of Corymbia tessellaris
- 2e, Low sparse woodland of Corymbia intermedia with a sub-canopy of Banksia aemula
- 2f, Swamp woodland of Eucalyptus robusta
- 2g, Tall open forest and woodland of Eucalyptus tereticornis
- 3a, Tall swampy open forest of Melaleuca quinquenervia
- 3b, Medium grassy open forest of Melaleuca quinquenervia
- 3bx, Medium grassy open forest of Melaleuca quinquenervia(disturbed)
- 3c, Tall swampy woodland and open woodland with Melaleuca quinquenervia
- 3d, Medium open forest of Melaleuca quinquenervia, Livastona decipiens, Melaleuca dealbata
- 4a, Closed shrubland of Acacia julifera
- 4b, Groved mallee shrubland with Corymbia intermedia, Corymbia tessellaris and Xanthorrhoea latifolia
- 4bx, Groved mallee shrubland with Corymbia intermedia, Corymbia tessellaris and Xanthorrhoea latifolia (disturbed)
- 4c, Low closed shrubland of the frontal dune system
- 4d, Low groved heath and shrubland of the older high dune system
- 4dx, Low groved heath and shrubland of the older high dune system (disturbed)
- 5a, Grassland of exposed rocky headlands with emergent Casuarina equisetifolia and Pandanus tectorius
- 5b, Grassland and shrubland complex of the frontal dune system
- 5bx, Grassland and shrubland complex of the frontal dune system (disturbed)
- 5c, Swamp and wet heath communities with dominant Gahnia sieberiana
- 6, Tall open forest of Livastona decipiens
- 7, Regrowth communities dominated by acacia spp.
- Cl, Cleared areas
- R, Unvegetated basement rock
- Hatched areas represent disturbed vegetation communities.

BICENTENNIAL DRIVE
SPRINGS ROAD
ANDERSON
BOUCH
CT
MOFFETT
COURT
WAY
ROAD
JOBSON
BOUSGAS
DRIVE
WILSON DRIVE

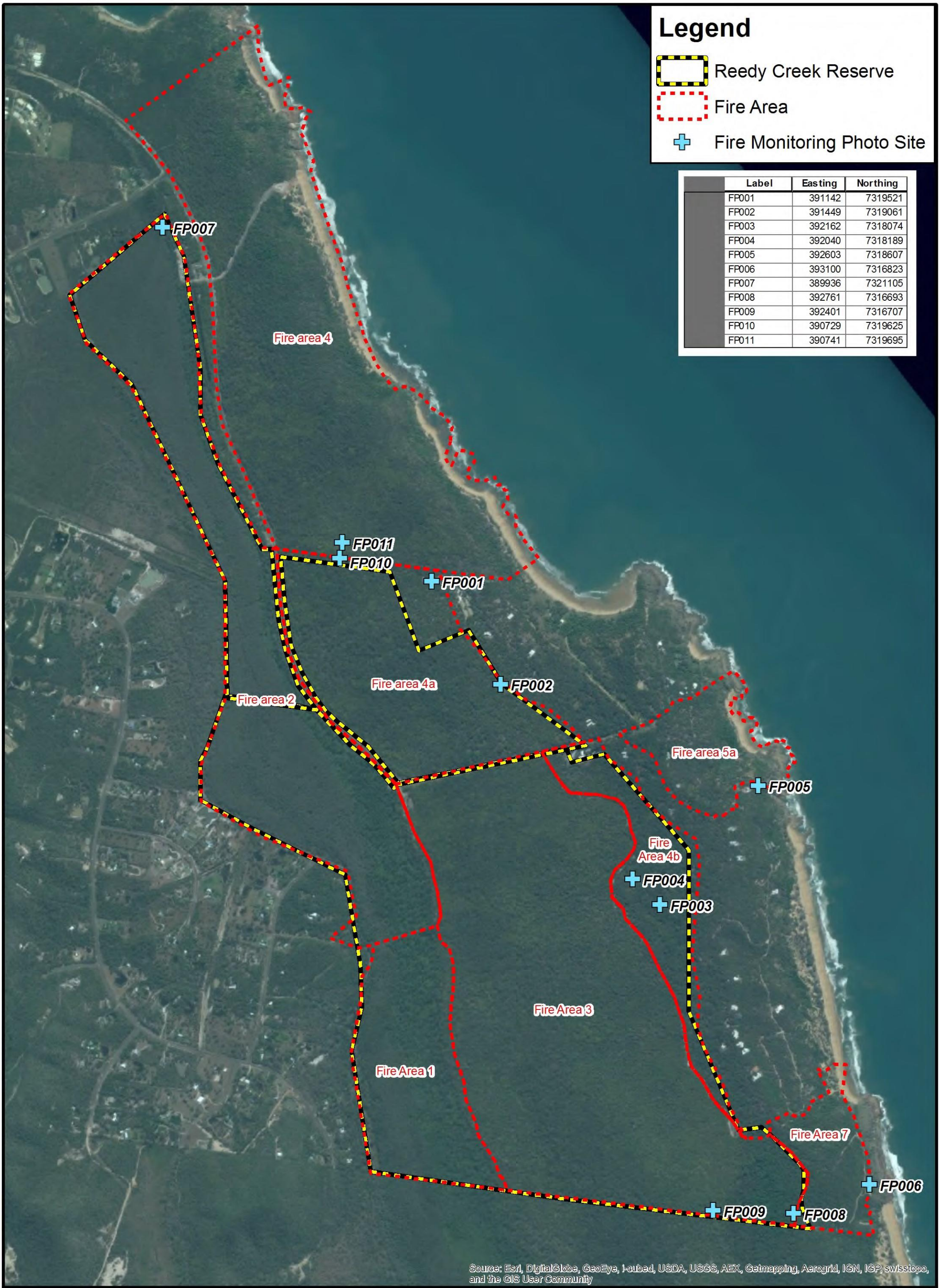
LOT 21
(COUNCIL INFRASTRUCTURE)

DEEP WATER
NATIONAL PARK

0 500 1,000 1,500 2,000
Meters

390000 391000 392000 393000
7322000 7321000 7320000 7319000 7318000 7317000

Appendix E. Photographic Monitoring Point Locations



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	FP002	391449	7319061
	FP003	392162	7318074
	FP004	392040	7318189
	FP005	392603	7318607
	FP006	393100	7316823
	FP007	389936	7321105
	FP008	392761	7316693
	FP009	392401	7316707
	FP010	390729	7319625
	FP011	390741	7319695

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Reedy Creek Reserve Fire Monitoring Photo Sites

Created by Paul Young
Date: 26/06/2014
Path: Z:\REGIONS\NORTH\Reserves\Reedy Creek\Projects\Fire Monitoring Photo Sites.mxd

0 400 800
Meters

Coordinate System: GDA 1994 MGA Zone 56
Scale 1:15,000 @ A3

N

BUSH HERITAGE
AUSTRALIA

Approval

Fire Management Plan (FMP) Reedy Creek Conservation Area - 2019 to 2024

CEO or delegate approval is required.

Name: **Robert Murphy**, Executive Manager North Region

Signature:

Date approved: 15.01.2021