

Appendix B – Koala Plan of Management

See document



North Byron Parklands

Koala Plan of Management (KPoM)

Prepared for
Billinudgel Property Pty Ltd

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Abbreviations

Abbreviation	Description
BC Act	<i>Biodiversity Conservation Act 2016</i>
BCC KPoM	(Draft) Byron Coast Comprehensive Koala Plan of Management
KPoM	Koala Plan of Management
KSAT	Koala Spot Assessment Technique
Parklands	North Byron Parklands
SEPP44	<i>State Environmental Planning Policy No. 44 (Koala Habitat Protection)</i>

1 Introduction

1.1 Background

Billinudgel Property Pty Ltd have engaged Eco Logical Australia Pty Ltd (ELA) to prepare an individual Koala Plan of Management (KPOM) for North Byron Parklands (Parklands). Parklands is currently operating as a cultural events site under short-term State approval (app. No. MP 09_0028). The existing approvals include a trial period to allow use of the site as a cultural, education and outdoor events venue.

Billinudgel Property Pty Ltd are also seeking to obtain permanent approval to utilise the site as a cultural events centre with a maximum capacity of 50,000 patrons for one large event and a number of smaller events. This KPOM has been prepared to address ongoing management of Koala for the permanent approval.

Historically Koala have been observed sporadically at the Parklands site but after the implementation of the Pacific Highway upgrade no Koala have been sighted on the land. They have been seen in adjacent habitat areas. The most recent surveys were undertaken in September 2016 and found evidence of Koala visitation of at the site (i.e. scats). Under SEPP44 “core koala habitat” means an area of land with a resident population of koalas, evidenced by attributes such as breeding females (that is, females with young) and recent sightings of and historical records of a population. Small areas of the Parklands therefore may meet the definition of Core Koala Habitat under SEPP44 (see below).

1.2 Regulatory requirements

State Environmental Planning Policy No. 44 (Koala Habitat Protection) commenced on the 13th February 1995. It aims to encourage the proper conservation and management of areas of natural vegetation that provide habitat for koalas. This was to ensure persistence of a permanent free-living population over the species’ present range and reverse the current trend of koala population decline by:

- Requiring the preparation of plans of management before development consent can be granted in relation to areas of Core Koala Habitat
- Encouraging the identification of areas of Core Koala Habitat
- Encouraging the inclusion of areas of Core Koala Habitat in environment protection zone

Over subsequent years, reporting requirements such as regular koala monitoring in relation to the SEPP44, were issued by the NSW State Government as part of ongoing approval modifications issued by the Minister for Planning and Infrastructure.

Since the commencement of SEPP44, a number of significant events have occurred of direct relevance to the coastal koala population in the Tweed and Byron Local Government Areas including:

- Koala habitat and population assessments were completed for the Tweed and Byron coastal areas (including the North Byron Parklands site).
- Comprehensive Koala Plans of Management (CKPoM) for Tweed and Byron were prepared by the respective Councils.
- One of the outcomes arising from the Tweed and Byron koala assessments was that the conservation status of koalas along the Tweed Coast and the section of Byron Coast north of the Brunswick River was determined as precarious with wildfire events in 2004 and 2009 identified as major contributing factors to the koala population decline.
- In April 2016, the koala population between the Tweed and Brunswick Rivers east of the Pacific Highway was listed as an Endangered Population under the now repealed NSW *Threatened*

Species Conservation Act 1995 (Biolink 2016). This population is also listed as endangered under the current *Biodiversity Conservation Act 2016*.

- The *Biodiversity Conservation Act 2016* also lists the koalas within the area as a vulnerable species.

In the current approval for development of the site (dated 24 April 2012), several conditions are provided relating to environmental management. Requirement C21 (Updated Koala Plan of Management), of the 2012 (current) approval notes the following requirement:

“The Draft Vegetation Management and Biodiversity Plan – submitted as Appendix M to the Ecological Assessment is to include an updated Koala Plan of Management (KPoM) if a resident population (within the meaning of SEPP 44) of koalas becomes established at the site. The KPoM is to include a contemporary assessment of any existing and/or potential areas of core Koala habitat within the site, and results of further koala surveying efforts. The KPoM must also address the operation of ongoing events carried out at the site and the potential impacts that this will have on areas of core Koala habitat and any existing Koala populations.” (Emphasis added).

As the most recent Koala survey undertaken in 2016 identified Koala visitation of the on the site, this KPoM has been prepared on a precautionary basis.

1.3 Purpose and scope of this report

In the event that further surveys confirm the existence of a resident Koala population (within the meaning of SEPP 44) has become established at the site, this report comprises the updated KPoM required under condition C21, as detailed above. This report will also be applicable to the permanent program of events proposed under the SSD application. It includes:

- Conservation objectives for Koala
- Details of Koala habitat and site usage at the Parklands and in surrounding areas
- An assessment of potential threats and impacts to Koala as a result of the cultural events program held at the Parklands
- Details of management measures that will be implemented to address potential impacts
- A monitoring and adaptive management program

The KPoM specifically addresses Koala habitat on the Parklands site, which includes the following lots:

- Lot 1 DP 1145020
- Lots 46 402, 403 and 404 DP 755687
- Lot 410 DP 755687
- Lots 2 and 12 DP 848618
- Lot 101 DP 856767
- Lot 30 DP 880376
- Lots 100 and 101 DP 1178907
- Lots 101 102, and 107 DP 1001878
- Lot 107 DP 1001878
- Lots 12 and 14 DP 875112

Adjacent lots are also assessed in terms of koala population / core habitat estimates. However, management and mitigation measures are restricted to those areas that are under the property ownership of Billinudgel Property Pty Ltd.

The most current guideline for SEPP44 (Department of Planning 1995) has informed the content of this KPOM. A checklist of required content and its location in this document is provided in Appendix A.

2 Koala at the Parklands and surrounds

2.1 Koala presence 2007 – 2017

Targeted Koala surveys have been undertaken at the Parklands in 2007, 2008, 2013 and 2016 (Biolink 2007, 2008, 2013, 2016), along with nine Event Impact Monitoring (EIM) surveys (North Bryon Parklands 2014a, 2014b, 2015, 2016). Results of these surveys include:

- 2007 – small area of core Koala habitat (3 ha) mapped on site; Koala scats observed at four locations within the Parklands; results suggest use of the site by 1 – 2 Koalas
- 2008 – significantly reduced evidence of activity, such that activity level does not reach the threshold that indicates active, ongoing use by resident animals
- 2013 – no evidence of Koala within the Parklands
- 2016 – evidence of Koala (scats and scratches) at 7 sites, primarily in the north-west corner of the Parklands and within Billinudgel Nature Reserve. Mixed age scats suggest significant, repeat use of sites by Koala individuals with home ranges that encompass the north-west corner of the Parklands (individuals may be coming to the Parklands from the Billinudgel Nature Reserve and/or areas to the west of the Pacific Highway). It is likely that these Koalas have begun using this area of the Parklands within the previous 1 – 3 years
- EIM – no evidence of Koala within the Parklands or surrounds (based on general observations, not targeted survey)

The results of the most recent Koala survey undertaken in 2016 are provided in Appendix B.

2.2 Koala habitat

Approximately 60% of the Parklands property is cattle pasture comprising exotic grasses, dominated by *Setaria sphacelata* (South African Pigeon Grass) and *Paspalum mandiocanum* (Broad-leaved Paspalum). Native vegetation of the site comprises mainly fragmented floodplain forests and hill slope eucalypt forests. Both vegetation types provide potential habitat areas for Koala.

2.2.1 Potential Koala habitat and food trees

Koalas are obligate folivores feeding on species in the genus *Eucalyptus*. The Parklands contains a number of distinct vegetation communities that support a diversity of *Eucalyptus* species, which are largely confined to the better drained hill slopes. Of these, the following food trees have been observed at the Parklands site:

- *E. microcorys* (Tallowwood)
- *E. tereticornis* (Forest Red Gum)
- *E. robusta* (Swamp Mahogany)
- *E. propinqua* (Grey gum)
- *E. tereticornis* x *E. robusta* hybrid

Under SEPP 44, potential koala habitat is defined as:

Areas of native vegetation where the trees of the types listed in Schedule 2 (of SEPP44) constitute at least 15% of the total number of trees in the upper or lower strata of the tree component

At the Parklands, species listed on Schedule 2 of SEPP44 (Tallowwood, Forest Red Gum and Swamp Mahogany) were recorded in 14 of the field sites formally assessed in 2016. The species composition of Schedule 2 species at these sites ranged from 4% - 56%, with a mean of 15% (Biolink 2016), suggesting that these sites should be formally considered potential Koala habitat.

However, for the purposes of this KPoM, potential Koala habitat has been defined more broadly as areas of native vegetation that contain food trees and this is mapped in Figure 1.

2.2.2 Core Koala Habitat

Based on the results of the most recent Koala surveys, small areas of potential Core Koala Habitat have been defined at the Parklands. These are mapped in Figure 2 and are located in the north-west corner of the Parklands site and Billinudgel Nature Reserve.

2.3 Regional context

The (Draft) Byron Coast Comprehensive KPoM (BCC KPoM; Phillips and Jardine 2013) has divided the region into Koala Management Areas (KMA). The Parklands site is located in the North Byron Coast KMA, which encompasses an area of approximately 2,814 ha located to the north of the Brunswick River and includes Billinudgel Nature Reserve and the localities of South Golden Beach, Ocean Shores and Billinudgel.

The importance of the Parklands site in the regional context lies in its connectivity to large areas of Koala habitat within Billinudgel Nature Reserve and adjacent areas to the south. Areas of defined Core Koala Habitat within the Parklands and surrounds are small, and in themselves, not connected. However, the areas of potential Koala habitat provide important linkages between these small areas, both across the Parklands site and more broadly in the region.

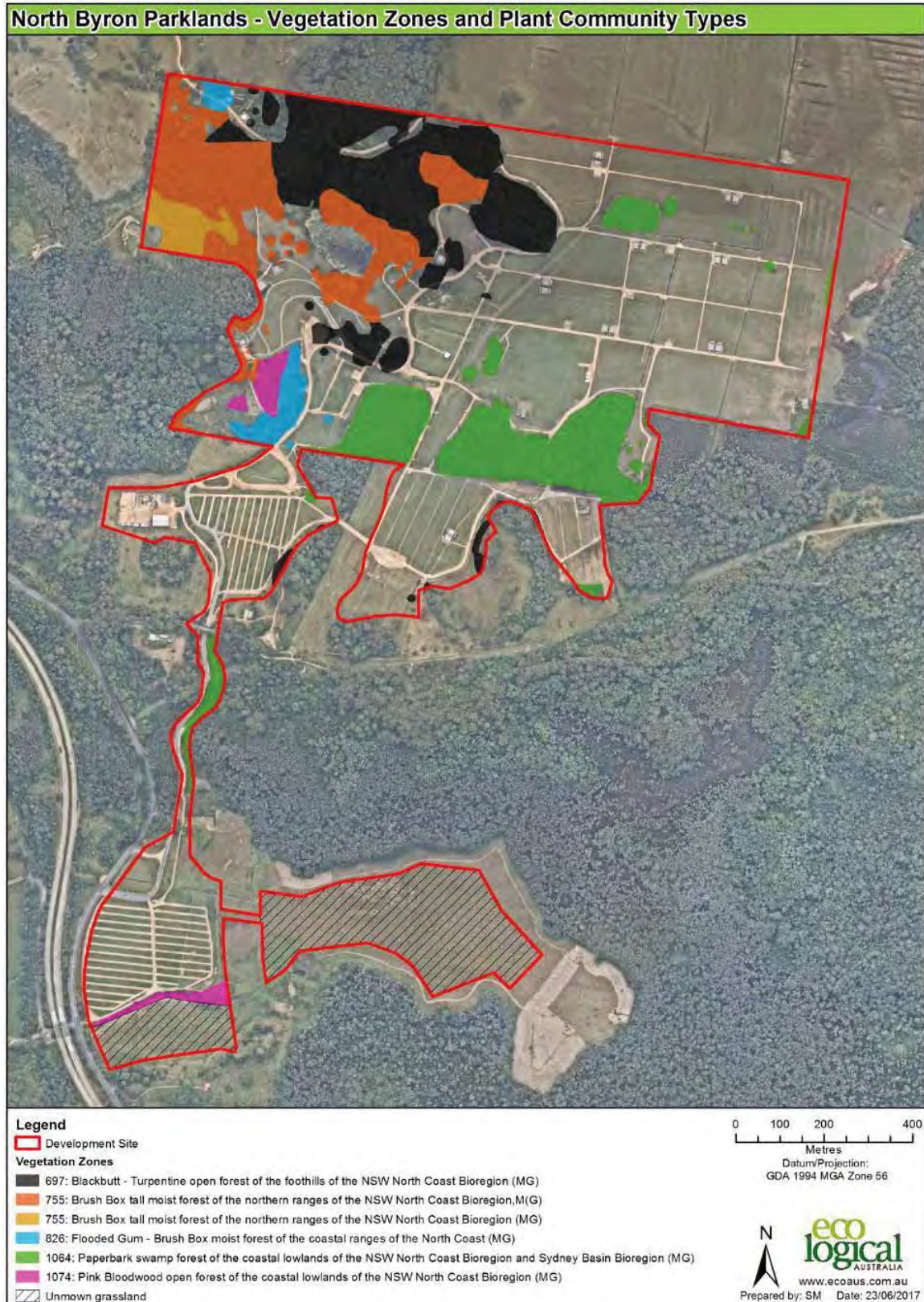


Figure 1: Potential Koala habitat Plant Community Types (from Eco Logical Australia 2017)



Figure 2: Potential Core Koala Habitat (based on results of 2016 survey)

3 Conservation outcomes

As highlighted above, the presence of Koala at the Parklands has been highly variable over time. There is also no evidence of a sustained or sizable population of Koalas on site. Therefore, the conservation outcomes for Koala are focused on the provision of habitat and allowing Koala to use the site freely if and when they may be in the region.

The desired conservation outcomes for Koala are:

- The condition of Koala habitat at the Parklands site will continue to be enhanced via the on-going program of successful vegetation management and bush regeneration
- Events will not prevent the on-going use of the Parkland site by Koala

These outcomes are also consistent with the overarching management aim for the North Byron Coast KMA, which is to recover the important sub-population of the Tweed and Brunswick Coast Population of the Koala (Phillips and Jardine 2013).

4 Potential impacts and threats

No Koala habitat will be cleared as result of the project. All Koala habitat on site will be preserved and protected for the duration of the project. All areas of remnant vegetation within event areas will be fenced during events to prevent disturbance and strict fire management procedures are also implemented. These measures have been in place during the approved trial period. During this time, monitoring has detected no adverse impacts to the native vegetation on site.

Ongoing vegetation management and restoration measures will continue across the site with the objective of improving the ecological condition of the vegetation and therefore its value as Koala habitat over time.

Indirect impacts to Koala are also unlikely. Koalas have moved back into the Parklands area during the approved trial period i.e. the results of the most surveys suggest Koala use of the north-western areas of the Parklands has begun within the last 1 – 3 years. This suggests the ongoing use of the site for events has not precluded the area from providing suitable habitat for Koala.

Key threats to Koala including dog attack and vehicle strike will not be exacerbated by the project. Dogs (apart from restrained assistance and security dogs) are not allowed on site and on site vehicle speed limits are restricted to 25 km/hr.

Koalas will be discouraged from entering event areas due to the erection of temporary fencing and the proposed permanent security fencing (see details within Biodiversity Assessment Report [Eco Logical Australia 2017]). While this fencing may restrict Koala movement, it will be fully closed only for short periods of time at discrete intervals over the year (see Section 5.1). It is also unlikely that Koalas would be seeking to traverse the busy event area. Impacts from more generalised disturbance will be short-lived and contained within the event areas of the Parklands site. There are also large areas of suitable habitat available in the adjacent Billinudgel Nature Reserve and to the west of the Parklands.

5 Impact avoidance and minimisation

5.1 Measures to avoid and minimise impact

The events areas and ancillary infrastructure have been designed to ensure that no Koala habitat will be cleared as result of the project. All Koala habitat on site will be preserved and protected for the duration of the project. This will also ensure that connectivity to large areas of adjacent potential habitat is maintained.

Additionally, the following measures will be implemented at the Parklands to avoid and/or minimise impacts to Koala and their habitat during events:

- No-go zones will be designated, which fence off intact native vegetation. Events are contained within areas that consist of managed exotic pasture with scattered native trees that are protected during events
- Temporary human exclusion fencing closely bordering (within 10 m of) forest blocks within event areas will be provided. All temporary human exclusion fencing used in these locations will be 'fauna-friendly', incorporating a minimum 250 mm continuous gap at the base of the fence or 250 mm square gaps at 10 m intervals along the base of the fence.
- Stringent bushfire management during events for public safety
- Continued police enforcement and deterrence associated with illegal access to events that may result in trampling of vegetation (bearing in mind that the low occurrence results in negligible impacts)
- Event operators shall only operate within the approved event areas
- No activities (including slashing) will occur within the 30m minimum buffer around the southern car parking areas surrounding the Billinudgel Nature Reserve
- All staff and contractors to undertake Parkland's Environmental Induction prior to accessing the site. Documented records shall be maintained covering the environmental induction process

Outside of event times, the proposed permanent security fencing will be opened to allow movement of koalas. That is, every 5th or 6th panel will be on hinges (acting as a gate) and will be permanently open except during events. Each fencing panel is approximately 2.5m long. The fence will also be set 100mm off the ground to allow movement of smaller fauna.

In addition to the above, event-based measures, the following will be implemented at the Parklands to minimise potential impacts to Koala and their habitat during the construction of ancillary infrastructure (associated with permanent approval):

- Clear delineation of the clearing area (approx. 300m²) associated with proposed vehicular access track in the north-west. This will include the establishment of Tree Protection Zones and arborist advice to reduce impacts to surrounding vegetation, which may include Koala habitat
- A pre-clearing survey will be undertaken prior to works associated with the proposed vehicular track in the north-west commencing. If Koalas are found, clearing will not commence until they have vacated the area.
- A qualified fauna spotter catcher will be present during clearing activities.
- Machinery and vehicles that are accessing site to install temporary and permanent infrastructure will adopt the following measures when within the project area:
 - o All machinery onsite should be cleaned for weeds and soil deposit off site.
 - o Minimise soil disturbance during vehicle movement.

- o Promote the hygiene of construction vehicles to minimise spread of weeds and pathogens,
- All staff and contractors to be appropriately inducted on appropriate measures to minimise impacts to biodiversity

5.2 Habitat enhancement

A significant program of bush regeneration and plantings has occurred on site since 2007, with establishment works in most areas complete. To date over 22,000 trees and shrubs have been planted, including Koala food trees.

All planting areas are regularly inspected and weed control undertaken. The majority of these plantings are well established with a greater than 90% establishment rate, and in many areas trees are now in excess of 5 m in height.

The earlier plantings are now developing good quality habitat structure and facilitating native regeneration and an understory. Parklands' ecologists have recorded a wide range of birds and small vertebrate fauna occupying these forest blocks. Most plantings only need once yearly follow up to prevent the establishment of woody weeds such as *Senna pendula* (Easter Cassia) and *Cinnamomum camphora* (Camphor Laurel). The extensive regeneration of eucalypts in the north-western area of Parklands increases the area of available habitat for Koalas

Habitat restoration will continue as an ongoing program of works. Future efforts will be focused in areas of existing vegetation, including potential Koala habitat (see Figure 3). These works will both enhance Koala habitat within and build further connectivity across the Parklands site.

Risk to Koala will be considered as part of the ongoing planning of habitat restoration activities. Results of recent (2016) surveys, suggest Koala habitat improvements should be focused on the areas of recent use in the north-western areas of the Parklands. This will focus and support koala use in that area and not provide encouragement for Koalas to enter the event areas.

Figure 3: Ecological Restoration Plan – green areas will be the focus of ecological restoration

6 Monitoring and adaptive management

Ongoing monitoring of Koala at the Parklands will be undertaken as part of a broader program of monitoring and adaptive management. This project is detailed in Eco Logical Australia 2017a. Parts of the program relevant to Koala are provided below.

6.1 Monitoring objectives

It is predicted that the impacts from the ongoing program of cultural events at the Parklands will be minor and temporary, as evidenced by the results of extensive monitoring undertaken during the trial period. However, to ensure that no unexpected impacts occur as a result of ongoing events and/or the increased capacity and frequency of events, the following monitoring objectives have been developed:

- The condition of threatened species habitat will continue to be enhanced via the on-going program of successful vegetation management and bush regeneration.
- Events will not prevent the on-going use of the Parkland site by threatened fauna species

6.2 Program

Koala monitoring will occur every two years, with the next scheduled monitoring event to occur in 2018. Ideally, monitoring will be linked to surveys being undertaken in the wider region, as guided by the BCC KPoM. Parklands staff will consult with relevant stakeholders at Byron Shire Council prior to each round of monitoring commencing, to seek opportunities for alignment of efforts.

6.3 Method

Koala surveys will be undertaken using the standardised KSAT method, used in previous surveys at the site (see Biolink 2016; Appendix B for details).

Incidental sighting of Koala and monitoring of vegetation condition across the Parklands will also occur during Event Impact Monitoring (see Eco Logical Australia 2017a for details).

6.4 Adaptive management

The monitoring results will be used to assess any adverse impacts Koala. If data analysis indicates a trigger has been exceeded, or is likely to be exceeded, further investigation and risk assessment will be undertaken, and an appropriate response will be prescribed to remediate or prevent further adverse impact. Details of triggers, actions and responses for Koala are provided below.

Table 1: Koala monitoring outcomes and response

Targeted Group/ Species	Monitoring		Response		
	Methods	Purpose	Trigger	Action	Responsibility
Koala	Sites: As per previous monitoring (see Appendix B) Parameters: Koala occurrence Level of koala activity Condition of habitat Analysis: Comparison of Koala occurrence and activity levels over time. Identification of any damage to habitat over time. Frequency: Every two years.	To monitor any change to the koala population over time, and to investigate whether any adverse changes are a result of events.	Koala presence has been variable over time, but there is evidence of recent activity. If individuals or evidence of presence are not recorded during the biennial koala surveys, further consideration and/or investigation should be undertaken by an experienced ecologist. Evidence of damage to koala habitats should be responded to. Considerations: Koala presence to be assessed in comparison with concurrent surveys of the broader area, as per the Byron Coast Koala Management Plan.	Undertake investigation to determine the extent and cause of trigger exceedance. The prescribed actions will depend on the extent and nature of the impact. For further details see Table 2.	On-site ecologist The Parklands Manager

Responses to monitoring results will be required if any of the trigger values in Table 1 are exceeded. The nature of the response will be scaled according to the extent to which triggers have been exceeded. External factors (e.g. regional population trends, climate variables) will also be considered.

Components of the adaptive management plan are outlined in Table 2 below. Adaptive management will be geared towards determining that the objectives listed above are met.

Table 2: Adaptive management actions for koala and habitat

Monitored parameter	Extent of trigger exceedance	Action
Presence of koala	Absence of individuals and/or no evidence of activity during monitoring	Consult with local koala experts and Byron Shire Council to understand regional drivers of change Review on-site actions to determine if contributing to absence. If so, implement appropriate changes to event or site management protocols Review appropriateness of monitoring extent and frequency. Update as needed Liaise with OEH as appropriate
Changes in vegetation structure, damage, weed invasion in areas of koala habitat	Minor edge effects on vegetation areas e.g. litter, trampling Small-scale weed invasions	Undertake routine vegetation management activities to reduce and remediate impacts
	Vegetation damage e.g. trees damaged, small fire Moderate weed invasions	Review on-site actions to determine if contributing to change. If so, implement appropriate changes to event or site management protocols Prepare and implement rehabilitation plan
	Major vegetation damage e.g. large fire, dieback of vegetation, clearing Extensive weed invasions	Notify OEH Review on-site actions to determine if contributing to change. If so, implement appropriate changes to event or site management protocols Prepare and implement rehabilitation program

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Appendix A – KPoM content requirements

Requirement	Location in this document
Estimate of population size	Section 2.1
Identification of preferred feed tree species for the locality and the extent of resource available	Section 2.2
An assessment of the regional distribution of koalas and the extent of alternative habitat available to compensate for that to be affected by the actions	Section 2.3
Identification of linkages of Core Koala Habitat to other adjacent areas of habitat and provision of strategies to enhance and manage these corridors	Section 2.3 and section 5.2
Provision of detailed proposals for amelioration of impacts on koala populations from any anticipated development within zones of Core Koala Habitat	Section 5
Identification of any opportunities to increase size or improve condition of existing Core Koala Habitat	Section 5.2
The plan should clearly state what it aims to achieve	Section 3
The plan should state criteria against which achievement of those objectives is to be measured	Section 6.4
The plan should also have provisions for continuing monitoring, review and reporting	Section 6

Appendix B – 2016 survey report

North Byron Parklands

SEPP 44 - Koala Monitoring Report



Report to Billinudgel Property Trust

September 2016

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1.0 Introduction

Billinudgel Property Trust has approval from the NSW State Government for use of the North Byron Parklands site at Yelgun (hereafter referred to as the Parklands site) for a maximum of three “cultural” events each year, subject to ongoing monitoring.

Initial surveys undertaken by Biolink in 2007 recorded localised koala use of a section of the Parklands site confined to a relatively small cell (approximately 3ha) of *Core Koala Habitat* (as defined by *State Environmental Planning Policy No 44 - Koala Habitat Protection*) focused on remnant vegetation in the east of the site. As a consequence of this finding, a short-term (12 month) Individual Koala Plan of Management (IKPoM) was prepared which *inter alia* required reassessment of the site prior to commencement of development activity to check for any changes to the area of identified *Core Koala Habitat*. The reassessment (Biolink 2008) documented a decline in the extent of koala activity within the *Core Koala Habitat* area over the intervening 12 month period to the extent that the level of use at that time was considered to be relic and/or transient. No other evidence of koala activity was recorded elsewhere on the site in 2008.

An updated assessment of koala activity at the Parklands site was undertaken by Biolink in 2013 on behalf of Billinudgel Property Trust. However, no koala activity was recorded and no koalas were observed during the 2013 surveys.

Over the time span since the initial baseline survey was undertaken in 2007 a number of significant events have occurred of direct relevance to the coastal koala population in the Tweed and Byron Local Government Areas including:

- i. Koala habitat and population assessments were completed for the Tweed and Byron coastal areas (including the North Byron Parklands site) and Comprehensive Koala Plans of Management (CKPoM) for both areas were prepared and subsequently approved by the respective Councils.

- ii. One of the outcomes arising from the Tweed and Byron koala assessments was that the conservation status of koalas along the Tweed Coast and the section of Byron Coast north of the Brunswick River was determined as precarious with wildfire events in 2004 and 2009 identified as major contributing factors to the koala population decline.
- iii. In March 2012, the koala was listed as a Vulnerable species under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* throughout Queensland, New South Wales and the Australian Capital Territory.
- iv. In April 2016, the koala population between the Tweed and Brunswick Rivers east of the Pacific Highway was listed as an Endangered Population under the New South Wales *Threatened Species Conservation Act 1995*.

This report has been prepared at the request of Billinudgel Property Trust to further investigate for evidence of koala activity at the Parklands site.

2.0 Methods

The survey methodology involved the following components:

A. Investigation of koala records

An updated search of the NSW Office of Environment and Heritage BioNet - Atlas of NSW Wildlife database for koala records within a 10 km x 10 km window focused over the Parklands site.

B. Re-survey of SAT sites

This initially involved the random selection and re-surveying of 18 (i.e. 50%) of the previous 34 SAT survey sites. Additional SAT sites were included where necessary to plot the extent of any recorded koala activity. A 25m radial search for koalas was also undertaken by two ecologists at each of the SAT survey sites.

C. Opportunistic inspection of PKFTs

Opportunistic examinations were undertaken at the base of any preferred koala food trees (PKFTs) that were encountered while undertaking foot-based traverses between individual SAT survey sites..

3.0 Results

A. Investigation of koala records

Koala records were obtained from the NSW NPWS Wildlife Atlas in conjunction with the 2007 baseline survey report for a 10 km x 10 km search area centered over the Parklands site. This earlier search returned 8 records dating from 1986 to 1997 including 1 (1990) located within the Parklands site and another for 1990 from Billinudgel Nature Reserve to the south. The most recent Wildlife Atlas record at that time (1997) was located within 1 km to the west of the Parklands site. Survey work undertaken by Australian Museum Business Services (AMBS) in 1999 for the Yelgun to Chinderah Pacific Highway upgrade produced a further koala record just inside the western boundary of the Parklands site and several others along Jones Road; one of which was subsequently radio-tracked over several months.

An updated search of the BioNet - Atlas of NSW Wildlife database in September 2016 produced a total of 22 koala records for the 10 km x 10 km search area focused on the Parklands site. These included an additional 8 records within 1 km of the site dating between 2004 and 2016 with 1 record (2007) for the central section of the Parklands site and 7 records for the section of Jones Road that forms part of the border between the Parklands site and Billinudgel Nature Reserve: 1 for 2004-2006; 1 in 2012; 2 in 2013; 1 in 2015; and 2 in 2016). The remaining records are located near Mooball to the north, Wooyung to the northeast and Billinudgel, New Brighton and Ocean Shores to the south.

B. Re-survey of SAT sites

Field surveys were undertaken over 5 days in September 2016 (September 8, 9, 15, 16, 22). A total of 26 SAT survey sites were undertaken including 18 randomly selected sites, plus 8 others that were undertaken to assist in

identifying the extent of recorded koala activity at the site. Two of the initial randomly generated sites (BPT48 and BPT53) were excluded during the field surveys due to high water levels and were replaced by two additional randomly-selected sites. A new SAT site (BPT64) configured to the survey grid was established in an area of recent koala food tree plantings to the southwest of site BPT17. Figure 1 illustrates the locations and site numbers for the SAT survey sites.

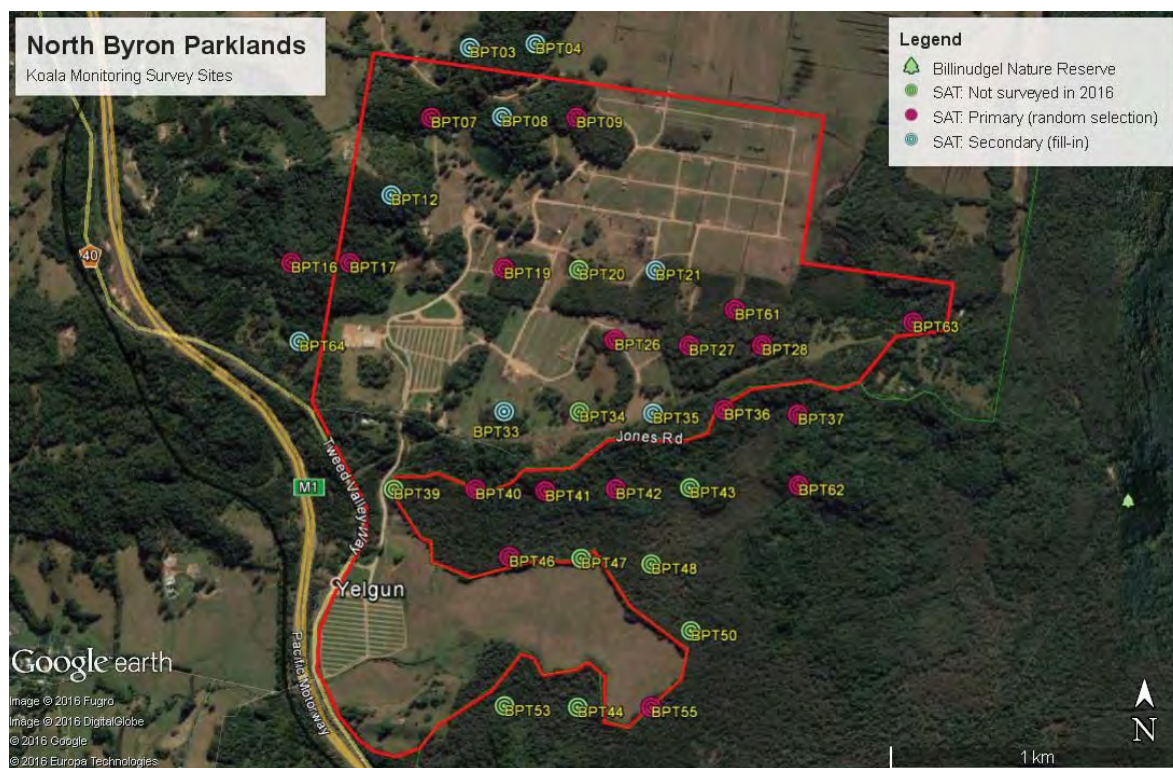


Figure 1. Grid-based koala monitoring SAT survey sites for the North Byron Parklands study area indicating sites surveyed in 2016.

Koala faecal pellets were recorded at 7 of the 26 SAT sites (see Table 1). Activity levels that were considered significant (i.e. $\geq 10\%$ in upland areas on low-nutrient substrates and $\geq 22.52\%$ in lowland areas and other sites on high-nutrient substrates, falling into the 'Medium (normal) use' or 'High use' categories indicative of utilisation by resident koalas with established home ranges) and therefore indicative of *Core Koala Habitat* were recorded at 4 sites; BPT08 (30%-High), BPT17 (30%-High), BPT62 (16.67%-High) and BPT12 (10%-Medium); refer to Phillips & Callaghan (2011).

Table 1. Koala activity levels recorded for baseline SAT surveys in 2007 compared to 2016 survey results. Percentage representation of Preferred Koala Food Trees (PKFT) at each site and the age-class of pellets (old, mixed age, fresh) observed in 2016 are also shown. *Note:* significant koala activity levels (i.e. high or medium use) are bolded.

SAT sites	2007 Activity (%)	2016 Activity (%)	2016 Pellet age-class	2016 Proportion PKFT (%)
BPT03	0	0	-	13.33
BPT04	0	6.67	Mixed Age	3.33
BPT07	0	0	-	0
BPT08	0	30	Mixed Age	16.67
BPT09	0	0	-	13.33
BPT12	0	10	Old	26.67
BPT16	0	0	-	0
BPT17	0	30	Mixed Age	3.33
BPT19	0	0	-	0
BPT20	0	NS	NS	NS
BPT21	0	0	-	0
BPT26	0	0	-	0
BPT27	13	3.33	Old	13.33
BPT28	0	0	-	6.67
BPT33	0	0	-	43.33
BPT34	0	NS	NS	NS
BPT35	0	0	-	6.67
BPT36	0	0	-	0
BPT37	0	3.33	Fresh	0
BPT39	0	NS	NS	NS
BPT40	0	0	-	6.67
BPT41	4	0	-	0
BPT42	0	0	-	3.33
BPT43	0	NS	NS	NS
BPT44	0	NS	NS	NS
BPT46	0	0	-	10
BPT47	0	NS	NS	NS
BPT48	0	NS	NS	NS
BPT50	0	NS	NS	NS
BPT53	0	NS	NS	NS
BPT55	0	0	-	6.67
BPT61	30	0	-	6.67
BPT62	43	16.67	Mixed Age	23.33
BPT63	NS	0	-	0
BPT64	NS	0	-	16.67

The distribution and significance category for the koala activity that was recorded by the 2016 SAT surveys is illustrated in Figure 2. The areas of koala activity are represented by 250 m x 250 m cells consistent with the survey grid size. The highest recorded koala activity levels were associated with sites BTP08 and BTP17 in the northwestern corner of the Parklands site. These sites recording mixed age koala pellets including fresh pellets (i.e. deposited in recent weeks) and old pellets, suggesting repeated use over the

past several months. Mixed age pellets were also recorded at BPT04 and BPT62. The single koala pellet recorded at BPT37 was assessed as being in the fresh age-class. The koala pellets recorded at sites BPT12 and BPT27 were all classed as old, suggesting that these sites have not been used by koalas in recent months.

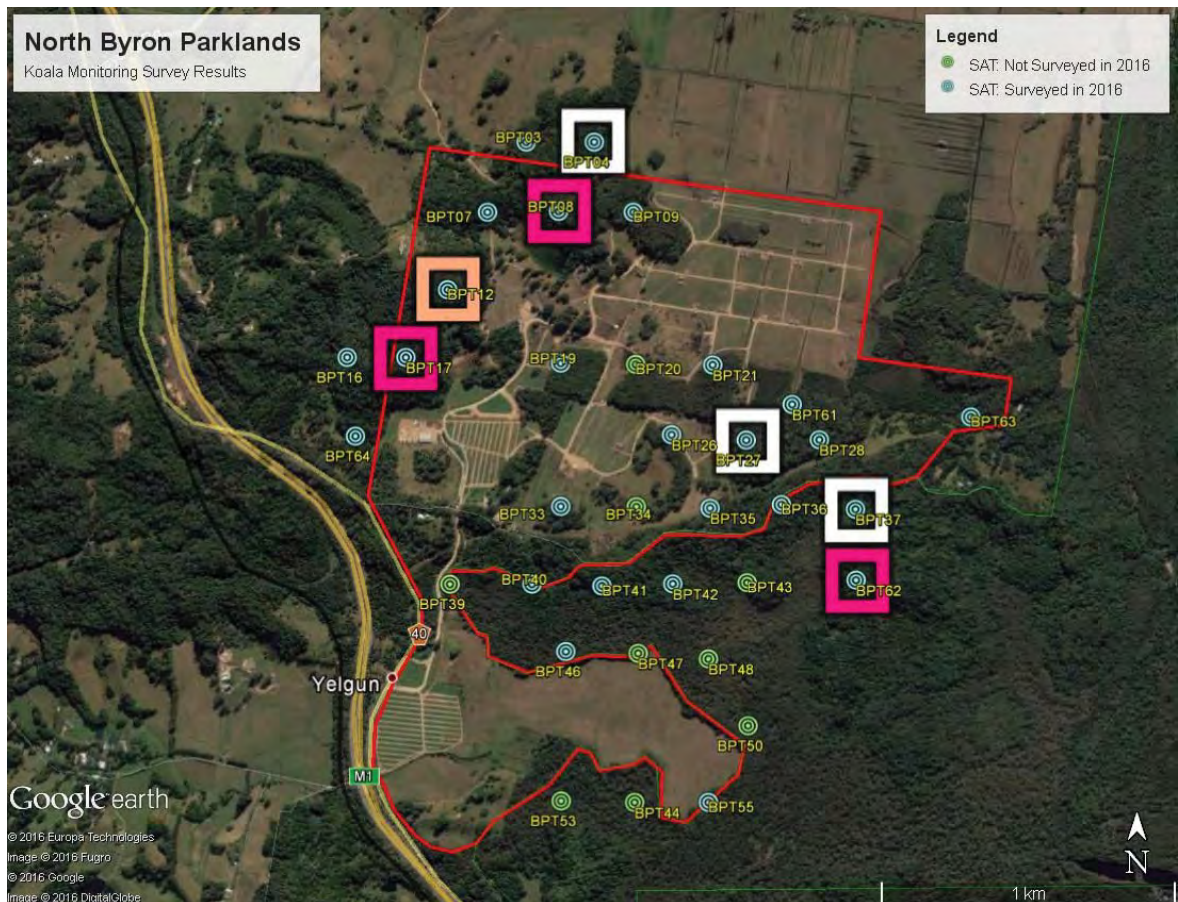


Figure 2. Grid-based koala monitoring SAT survey sites for the North Byron Parklands study area highlighting 250 m x 250 m cells where koala faecal pellet activity was recorded in 2016. Crimson squares = high use, orange = medium (normal) use, white = low use; Refer to Philips & Callaghan (2011).

Seventeen of the re-surveyed SAT sites contained one or more preferred koala food trees with combined proportional representation ranging from a low of 3.33% at sites BPT04, BPT17 and BPT42 to a high of 43.33% at BPT33 (mean representation for the 17 sites = 12.94%, SD = 10.4%), see Table 1.

Note: Known **preferred koala food trees** that have been recorded at the Parklands site include; tallowwood *E. microcorys*, forest red gum *E. tereticornis*, swamp mahogany *E. robusta*, grey gum *E. propinqua* and the naturally occurring *E. tereticornis* x *E. robusta* hybrid.

No koalas were observed during the 25 m radial searches at SAT sites nor during foot and vehicle traverses of the Parklands site.

C. Opportunistic inspection of PKFTs

One additional koala pellet was observed underneath a forest red gum during opportunistic inspections of preferred koala food trees on route between BPT27 and BPT28 at 551722 E 6850049 N ($\pm 18\text{m}$).

4.0 Discussion

The 2016 koala monitoring surveys recorded a significant level of use in the northwestern corner of the North Byron Parklands site. No evidence of koala activity was recorded for this area during earlier baseline and/or monitoring surveys (Biolink 2007, 2008 & 2013). Prior to the current survey, the most recent recorded observation of a koala on the northwestern fringe of the Parklands site was from 1999 during surveys for the Yelgun to Chinderah Pacific Highway upgrade. Hence, we are confident that the return of koala activity to the northwestern section of the site has only occurred during the last 1 – 3 years.

Spatial shifts and fluctuations in koala activity may occur over time within a given area as a consequence of natural population dynamics or they may occur as a result of factors such as recent or historical habitat loss and disturbance, landscape fragmentation, and/or increased mortality due to wildfire events, dog attack, vehicle-strike and disease. The decline trend within the broader koala population in the coastal lowlands of Tweed and Byron LGAs was recognized by the recent (April 2016) listing of the koala population between the Tweed and Brunswick Rivers east of the Pacific Highway as an Endangered Population under the NSW *Threatened Species*

Conservation Act 1995. The Final Determination report by the NSW Scientific Committee indicates that historically koalas were consistently recorded in the Billinudgel Nature Reserve and makes note of the suggestion by Phillips and Hopkins (2012) that recent declines and paucity of koala records for this area are likely to be a consequence of recent high fire frequency. The NSW Scientific Committee report concluded that the koala population between the Tweed and Brunswick Rivers east of the Pacific Highway is facing a very high risk of extinction in the near future.

The baseline survey report (Biolink 2007) speculated that the cell of *Core Koala Habitat* in the southeastern section of the site may have been located at the periphery of a larger cell of significant activity to the south in Billinudgel Nature Reserve; however, ongoing monitoring (Biolink 2008, 2013) has indicated that the activity within the Nature Reserve is localised and does not appear to extend into other areas of high-quality koala habitat further to the east.

It is possible that dispersal-aged sub-adult koalas may have traversed to the northwestern corner of the Parklands site from Billinudgel Nature Reserve in the southeast. A moderate level of support for this possibility is provided by continued koala activity at BPT62 (16.67%) within the Nature Reserve, albeit lower than that recorded in 2007 (43%), together with BioNet records of koala sightings on Jones Road (adjoining the Parklands site) between 2004-2006 and 2016. However, it is more likely that koalas may have dispersed into this location from the west by using the nearby fauna overpass and/or other nearby underpass structures to cross the Pacific Highway.

Irrespective of where the koalas have come from, their presence in the far northwestern corner of the Parklands site, and presumably some of the adjoining habitat to the west of the site, is of interest given that the 2016 surveys affirmed a sustained overall decline of significant koala activity in the southeast. Future koala monitoring surveys directed by Byron Shire Council under the Byron Coast Comprehensive Koala Plan of Management (CKPoM) may help to establish the current distribution and status of koalas within Billinudgel Nature Reserve. Our understanding is that recent broader koala

monitoring surveys undertaken by Byron Shire Council has not shown any evidence of a substantial population recovery north of the Brunswick River.

5.0 Recommendations

Future surveys would be [useful/informative](#) to establish whether the areas of koala activity [we have detected](#) in the northwestern corner of the Parklands site are sustained. It would also be of value to consider extending the monitoring survey westward towards the Pacific Highway in this location (subject to approval from adjoining property owners) in order to establish the full extent of the koala activity. With this in mind we suggest the following:

1. Koala monitoring surveys at the North Byron Parklands site should be ongoing and ideally timed to coincide with biennial monitoring surveys for the Byron Coast CKPoM.
2. The koala monitoring surveys should be extended onto additional adjoining properties to the west of the North Byron Parklands site towards the Pacific Highway.
3. Further koala habitat tree planting and restoration programs should be considered for the northwestern periphery of the North Byron Parklands site to help focus and support koala use in that area.

6.0 References

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Appendix C – Habitat Restoration and Tree Planting Details

Table 34: Habitat Restoration and Tree Planting Details

Polygon*	Type	Treatment	% Complete	Area (Ha)	Actions
1	MP	R	100	0.809	Complete – Now in maintenance phase
2	H	P	100	0.582	Complete – Now in maintenance phase
3	H	R	100	1.370	Complete – Now in maintenance phase
4	MP	P	100	5.321	60 native trees to be planted along northern boundary and road D (20m apart)
5	MP	P	0	0.551	20 native trees along northern boundary (every 20m and 20m off fence) Scheduled December 2017
6	H	R	100	1.461	complete
7	H	R	100	0.320	complete
8	MP	R	100	0.721	complete
9	MP	P	0	0.975	25 native trees along northern boundary (every 20m and 20m off fence) Scheduled December 2017
10	H	R	100	1.726	Complete
11	H	R	100	0.436	Complete – Now in maintenance phase
12	MP	P	100	0.687	8 native trees
13	MP	P	100	1.016	12 native trees
14	MP	P	100	0.165	15 native trees
15	MP	P	100	0.802	15 native trees along access road
16	MP	R	100	1.254	complete
17	MP	P	75	1.495	15 native trees along drainage line Scheduled December 2017
18	H	P	100	0.092	200 native trees
19	MP	P	100	0.353	8 native trees along access road
20	H	R	100	0.138	complete
21	MP	P	100	0.883	15 native trees along drainage line

22	MP	R	100	2.983	complete
23	MP	P	100	0.091	8 native trees along access road
24	MP	R	100	0.259	Complete
25	H	P	100	0.315	Complete - Now in maintenance phase
26	H	P	100	1.929	100 native trees west of treed hill
27	MP	R	100	0.783	complete
28	H	P	100	0.560	In-fill existing plantings - 100 native trees
29	MP	P	100	0.355	Complete - Now in maintenance phase
30	MP	R	100	0.306	Complete - Now in maintenance phase
31	MP	R	100	0.840	Complete
32	MP	P	100	0.279	30 native trees north of forest block
33	H	P	100	1.252	1,000 native trees – completed
34	H	P	100	0.863	Complete - Now in maintenance phase
35	H	P	100	2.292	Complete - Now in maintenance phase
36	H	P	100	4.459	Complete - Now in maintenance phase
37	H	P	100	0.248	100 native trees south of RMS drain
38	H	P	100	2.118	100 native trees to supplement existing plantings
39	H	P	100	2.471	3,50 native trees planted in clusters plus slash grasses in strips and rip and expose topsoil to promote regrowth
40	H	P	100	5.524	1,500 native trees planted in clusters plus slash grasses in strips and rip and expose topsoil to promote regrowth
41	H	P	100	1.835	350 native trees planted in clusters plus slash grasses in strips and rip and expose topsoil to promote regrowth
42	H	I	Ongoing	0.270	As part of the ongoing habitat restoration program
43	H	I	Ongoing	0.494	As part of the ongoing habitat restoration program
44	H	E	Ongoing	1.531	As part of the ongoing habitat restoration program
45	H	I	Ongoing	1.132	As part of the ongoing habitat restoration program
46	H	I	Ongoing	0.450	As part of the ongoing habitat restoration program
47	H	I	Ongoing	1.084	As part of the ongoing habitat restoration program
48	H	I	Ongoing	2.496	As part of the ongoing habitat restoration program

49	H	I	Ongoing	0.272	As part of the ongoing habitat restoration program
50	H	E	Ongoing	11.548	As part of the ongoing habitat restoration program
51	H	I	Ongoing	3.014	As part of the ongoing habitat restoration program
52	H	I	Ongoing	2.719	As part of the ongoing habitat restoration program
53	H	I	Ongoing	1.107	As part of the ongoing habitat restoration program
54	H	I	Ongoing	1.389	As part of the ongoing habitat restoration program
55	H	I	Ongoing	2.451	As part of the ongoing habitat restoration program
56	H	I	Ongoing	0.898	As part of the ongoing habitat restoration program
57	H	I	Ongoing	0.351	As part of the ongoing habitat restoration program
58	H	E	Ongoing	10.650	As part of the ongoing habitat restoration program
59	H	E	Ongoing	8.436	As part of the ongoing habitat restoration program
60	H	E	Ongoing	5.564	As part of the ongoing habitat restoration program
61	H	I	Ongoing	2.200	As part of the ongoing habitat restoration program
62	H	I	Ongoing	0.663	As part of the ongoing habitat restoration program
63	H	I	Ongoing	0.076	As part of the ongoing habitat restoration program
64	H	I	Ongoing	5.459	As part of the ongoing habitat restoration program

* See **Figure 10** for polygon numbers.

H = Habitat

R = Regeneration

MP = Managed Parklands

I = Improved (i.e. weed removal)

P = Plantings

E = Existing

Appendix D - Additional Biodiversity Impacts – Importance of habitat within 1km of the project

Table 35: Species predicted to occur within 1km of project area

Common Name	Importance of habitats < 1km of project area	Bionet Search (10 x 10 km)	Byron LGA
Scientific Name			
Amphibians			
Wallum Froglet <i>Crinia tinnula</i>	Known from non-reserve pastoral lands in the far northeast, but not recorded in Bionet records for BNR. BNR habitats within the 1km buffer area are potentially suitable, but the species is not recorded, and therefore these habitat are unlikely to be important for this species.	5	200
Wallum Sedge Frog <i>Litoria olongburensis</i>	Not recorded in Bionet records for BNR, or for 10km by 10km search area. Habitats within the 1km buffer area are largely unsuitable, and therefore unlikely to be important for this species.	0	40
Birds			
Barred Cuckoo-shrike <i>Coracina lineata</i>	This species is a mobile rainforest frugivore, exploiting fruits, especially figs, as they become ripe across the landscape. There is one unconfirmed record from within the project area. Areas within the 1km buffer are unlikely to constitute important habitat for this species.	1	27
Black Bittern <i>Ixobrychus flavicollis</i>	Reedy and sedge-dominated understory within swamp sclerophyll forest are potential shelter and foraging habitat for this species, which is more usually found along streams or close to permanent water. Habitats < 1km of the project boundary area are not likely to be important for this species.	1	77

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Common Name Scientific Name	Importance of habitats < 1km of project area	Bionet Search (10 x 10 km)	Byron LGA
Comb-crested Jacana <i>Irediparra gallinacea</i>	Recorded within the study area from a large dam in 2007, but not since, this species is dependent upon permanent freshwater wetlands with floating surface vegetation. Areas within the 1km buffer do not constitute important habitat for this species.	3	20
Eastern Grass Owl <i>Tyto longimembris</i>	The Eastern Grass Owl is known from within the development site and from the 1km buffer area: in tall closed grasslands in the south. It may breed in this area and therefore there is important habitat for the species within the 1km buffer area.	2	27
Eastern Osprey <i>Pandion cristatus</i>	Recorded within the study area during an event in 2015, this is a highly mobile and wide-ranging species which forages over shorelines, rivers and estuaries. It may occasionally take fish from a large dam within the study area or from larger drains in agricultural areas in the buffer area. Areas within the 1km buffer do not constitute important habitat for this species.	11	80
Marbled Frogmouth <i>Podargus ocellatus</i>	Obligate rainforest species. The extensive swamp sclerophyll forest, and agricultural lands of the 1km buffer area are generally unsuitable for this species. Habitats < 1km of the project boundary area are not likely to be important for this species.	2	37
Marbled Frogmouth <i>Podargus ocellatus</i>	Obligate rainforest species. The extensive swamp sclerophyll forest, and agricultural lands of the 1km buffer area are generally unsuitable for this species. Habitats < 1km of the project boundary area are not likely to be important for this species.	2	37
Pale-vented Bush- hen <i>Amaurornis moluccana</i>	Reedy and sedge-dominated understory within swamp sclerophyll forest are potential shelter and foraging habitat for this species. Habitats < 1km of the project boundary area are not likely to be important for this species.	1	213

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Common Name Scientific Name	Importance of habitats < 1km of project area	Bionet Search (10 x 10 km)	Byron LGA
Rose-crowned Fruit-Dove <i>Ptilinopus regina</i>	Rainforest frugivore likely to exploit seasonally available fruits, mobile and wide-ranging. The extensive swamp sclerophyll forest, and agricultural lands of the 1km buffer area are generally unsuitable for this species. Habitats < 1km of the project boundary area are not likely to be important for this species.	41	270
Square-tailed Kite <i>Lophoictinia isura</i>	Recorded within the study area in 2003, but not since, this is a highly mobile and wide-ranging species which may forage over the forested habitats within the buffer area. Home range is reported to be ~50km ² . Areas within the 1km buffer do not constitute important habitat for this species.	1	16
White-bellied Sea-Eagle <i>Haliaeetus leucogaster</i>	The White-bellied Sea-eagle breeds annually at a site in the far southeast but ~200m outside the buffer area, and is regularly recorded in surveys at one transect. Also seen over the NBP property. Areas within the 1km buffer do not constitute important habitat for this species.	17	53
White-eared Monarch <i>Carterornis leucotis</i>	This species is a rainforest canopy insectivore and has been recorded within the study area and in the 1 km buffer area transect surveys. While it is likely to occur within the large forest blocks in the buffer area, it has also been recorded from plantings adjoining large forest blocks. Areas within the 1km buffer are unlikely to constitute important habitat for this species.	10	222
Wompoo Fruit-Dove <i>Ptilinopus magnificus</i>	Rainforest frugivore likely to exploit seasonally available fruits, mobile and wide-ranging. The extensive swamp sclerophyll forest, and agricultural lands of the 1km buffer area are generally unsuitable for this species. Habitats < 1km of the project boundary area are not likely to be important for this species.	2	99
Mammals			
Common Planigale <i>Planigale maculata</i>	The Planigale is not a species which can be detected from hair samples, so the presence and extent of distribution of the Common Planigale in the 1km buffer area is unknown. It was not detected in pitfall surveys and Elliot trapping effort in NBP. Tall closed grasslands and adjacent swamp sclerophyll forest in the south of	1	45

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Common Name Scientific Name	Importance of habitats < 1km of project area	Bionet Search (10 x 10 km)	Byron LGA
	the site are suitable potential habitat. In the absence of survey data, the importance of habitats in the 1km buffer for this species cannot be determined.		
Koala <i>Phascolarctos cinereus</i>	Koala populations in coastal parts of the Byron LGA have declined in recent years, and specific targeted surveys in NBP have failed to find any Koalas, but have recorded scats in the western part of the property. Forests in the 1km buffer contain important Koala habitat and numerous Koala preferred Feed trees. Assuming that a small number of Koalas remain within BNR, habitats in the 1km buffer are likely to be important for these individuals.	133	1961
Bats			
Common Blossom- bat	Forested habitats within the 1km buffer are forage habitat for this species with abundant winter flowering eucalypts and paperbarks.	3	40
<i>Syconycteris australis</i>	Byron coastal floodplain contains similar resources on a large scale and so the buffer area is unlikely to be important habitat for this species.		
Grey-headed Flying-fox <i>Pteropus poliocephalus</i>	Forested habitats within the 1km buffer are forage habitat for this species with abundant winter flowering eucalypts and paperbarks. Food resources are also present in the agricultural lands. Byron coastal floodplain contains similar resources on a large scale and so the buffer area is unlikely to be important habitat for this species. A camp site reported in 2007 and located in or close to the 1km buffer was found to be unused when surveyed. A permanent maternity camp in Brunswick Heads Nature Reserve has been abandoned since ~2009.	7	202
Large-eared Bat <i>Chalinolobus dwyeri</i>	Recorded from call detection within the project area, this is a cave dwelling species, also found roosting within fairy martin nests. Records in the study area are associated with a large permanent freshwater dam and may indicate bats coming to drink at this site. Forested areas in the 1km buffer area comprise forage habitat for this	3	4

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Common Name Scientific Name	Importance of habitats < 1km of project area	Bionet Search (10 x 10 km)	Byron LGA
	species, but, in the absence of roost habitat, e.g. cliffs, caves, mines, do not represent important habitat for this species.		
Migratory birds			
Fork-tailed Swift <i>Apus pacificus</i>	A wide-ranging and mobile species which does not breed in Australia, the Fork-tailed Swift was not recorded in the Bionet Atlas search of a 100km ² area centred on the project area, but may occur at times within 1km of the project area. Habitats within 1km of the study area are unlikely to be important for this species.		21
Oriental Cuckoo <i>Cuculus optatus</i>	A wide-ranging and mobile species which does not breed in Australia, the Oriental Cuckoo was not recorded in the Bionet Atlas search. This species has been recorded once in four years of bird surveys within 1km of the project area. Habitats within 1km of the study area are unlikely to be important for this species.		9
White-throated Needletail <i>Hirundapus caudacutus</i>	A wide-ranging and mobile species which does not breed in Australia, there were 11 records of the White-throated Needletail in the Bionet Atlas search. This species has been recorded occasionally in four years of bird surveys within 1km of the project area. Habitats within 1km of the study area are unlikely to be important for this species.		172
Black-faced Monarch <i>Monarcha melanopsis</i>	The Black-faced Monarch was not recorded in the Bionet Atlas search, but has been recorded in bird surveys within 1km of the project area. Habitats within 1km of the study area are unlikely to be important for this species.		155
Spectacled Monarch <i>Monarcha* trivirgatus</i>	The Spectacled Monarch was not recorded in the Bionet Atlas search, but has been regularly recorded in bird surveys within 1km of the project area. Habitats within 1km of the study area are unlikely to be important for this species.		223

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Common Name Scientific Name	Importance of habitats < 1km of project area	Bionet Search (10 x 10 km)	Byron LGA
Satin Flycatcher <i>Myiagra cyanoleuca</i>	The Satin Flycatcher was not recorded in the Bionet Atlas search, but has been recorded in bird surveys within 1km of the project area. Habitats within 1km of the study area are unlikely to be important for this species.		X
Rufous Fantail <i>Rhipidura rufifrons</i>	The Rufous Fantail was not recorded in the Bionet Atlas search, but has been recorded in bird surveys within 1km of the project area. Habitats within 1km of the study area are unlikely to be important for this species.		276
Latham's Snipe <i>Gallinago hardwickii</i>	Latham's Snipe was recorded in the Bionet Atlas search, but has been not been recorded in bird surveys within 1km of the project area. Habitats within 1km of the study area are unlikely to be important for this species.	2	25
Eastern Osprey <i>Pandion cristatus</i>	The Eastern Osprey was not recorded in the Bionet Atlas search, but has been recorded in within the project area. Habitats within 1km of the study area are unlikely to be important for this species which is more likely to utilise seashore and canal habitats to the east and southeast.	11	80
Invertebrates			
Mitchell's Rainforest Snail	Bionet search results report 1 record from BNR and 2 records from the 10km X 10km search area. During bird surveys within and just outside the buffer area in BNR an additional 5 records of Thersites shells have been discovered since 2016.		
Thersites mitchellae	Extensive swamp sclerophyll forests with tall saw-sedges, logs and an interface with Brushbox dominated rainforest constitute suitable habitat for the species within the 1km buffer area and elsewhere in BNR. Two of the five recent records were from ~200m east of the 1km buffer line. In the absence of systematic survey identifying the species current distribution within BNR, and acknowledging the Critically Endangered status of this species, it is likely that habitat within the 1km buffer is important for this species.	2	157

Table 36: Hollow Dependant Species within 1km of project area

Hollow dependent species		Importance of habitats < 1km of project area	Bionet Search (10 x 10km)	Byron LGA
Common Name	Scientific Name			
Birds				
Brown Tree creeper	<i>Climacteris picumnus victorinae</i>	Recorded in 2017 in transect surveys in the far northeast of the 1km buffer area, this insectivorous species nests in tree hollows. It was not recorded in previous surveys, and only one record exists in the Bionet atlas for the Byron LGA. Considered a sedentary species, therefore forest within the 1km buffer area may be important habitat for this species.	0	1
Little Lorikeet	<i>Glossopsitta pusilla</i>	Recorded once flying over a transect in the far northeast of the 1km buffer area, this is a mobile and widely ranging species, moving in response to the availability of blossom. Hollows in the limb or trunk of smooth-barked eucalypts are preferred. The absence of additional records from transect surveys in and close to the 1km buffer area over 4 years indicates that the species is not resident in this area. The hollow-bearing resource within the 1km buffer area is meagre and widely dispersed with ~40% of hollows in rough-barked trees, so the buffer area is unlikely to be important habitat for this species.	1	11
Masked Owl	<i>Tyto novaehollandiae</i>	Recorded once in the study area prior to 2007, this species, if present, is likely to forage over the 1km buffer area. No suitable large hollow-bearing tree for nesting was located during a search of the area, therefore the buffer area is unlikely to be important habitat for this species.	5	18

Hollow dependent species		Importance of habitats < 1km of project area	Bionet Search (10 x 10km)	Byron LGA
Common Name	Scientific Name			
Sooty Owl	<i>Tyto tenebriosa</i>	No suitable large hollow-bearing tree for breeding was located during a search of the 200m buffer area. The 1km buffer area does not contain important habitat for this rainforest species.	3	90
Bats				
Eastern Bentwing-bat	<i>Miniopterus schreibersii oceanensis</i>	Forested habitats within the 1 km study area constitute potential foraging habitat for the species, but large mature trees with hollows are rare in the buffer area. The buffer area is considered unlikely to be important habitat for this species.	11	34
Eastern False Pipistrelle	<i>Falsistrellus tasmanensis</i>	Recorded regularly in low numbers from call detection at a large permanent freshwater dam in the project area, this species roosts in the hollow trunks of eucalypt trees. Forested habitats within the 1 km study area constitute potential foraging habitat for the species, but large mature trees with hollows are rare in the buffer area. The buffer area is considered unlikely to be important habitat for this species.	1	3
Eastern Freetail-bat	<i>Mormopterus norfolkensis</i>	Recorded regularly in low numbers from call detection at a large permanent freshwater dam in the project area, this species roosts in the hollow spouts of large mature trees, and in buildings. Forested habitats within the 1 km study area constitute potential foraging habitat for the species, but large mature trees with hollows are rare in the buffer area. The buffer area is considered unlikely to be important habitat for this species.	7	11
Eastern Long-eared Bat		Forested habitats within the 1 km study area constitute potential foraging habitat for the species, but large mature trees with hollows	7	112

Hollow dependent species		Importance of habitats < 1km of project area	Bionet Search (10 x 10km)	Byron LGA
Common Name	Scientific Name			
	<i>Nyctophilus bifax</i>	are rare in the buffer area. The buffer area is considered unlikely to be important habitat for this species.		
Golden-tipped Bat	<i>Kerivoula papuensis</i>	Forested habitats within the 1 km study area constitute potential foraging habitat for the species, but large mature trees with hollows are rare in the buffer area. The buffer area is considered unlikely to be important habitat for this species.		
Greater Broad-nosed Bat	<i>Scoteanax rueppellii</i>	Forested habitats within the 1 km study area constitute potential foraging habitat for the species, but large mature trees with hollows are rare in the buffer area. The buffer area is considered unlikely to be important habitat for this species.	2	7
Little Bentwing-bat	<i>Miniopterus australis</i>	Recorded from call detection at various sites within the project area, this is a cave dwelling species, which also occasionally roosts in hollow trees. Forested habitats within the 1 km study area constitute potential foraging habitat for the species, but large mature trees with hollows are rare in the buffer area. The buffer area is considered unlikely to be important habitat for this species.	46	205
Northern Free-tailed Bat	<i>Mormopterus lumsdenae</i>	This species (previously <i>Mormopterus beccarii</i>) was not recorded from the project area. The buffer area is considered unlikely to be important habitat for this species.	1	K
Southern Myotis	<i>Myotis macropus</i>	The Southern Myotis is also known as the Fishing Bat and takes prey from the surface of permanent waterbodies. Roost habitats include caves, hollow trees, in bridge drains, mines and in vegetation. The absence of permanent freshwater forage habitat, and paucity of	11	226

Hollow dependent species		Importance of habitats < 1km of project area	Bionet Search (10 x 10km)	Byron LGA
Common Name	Scientific Name			
		preferred roost habitats mean that habitat within the 1km buffer is unlikely to be important for this species.		
Yellow-bellied Sheath-tail-bat <i>Saccolaimus flaviventris</i>		Recorded regularly in low numbers from call detection at a large permanent freshwater dam in the project area, this is a large insectivore which roosts in large tree hollows. Forested and open habitat within the 1 km study area constitute potential foraging habitat for the species, but roost trees with large hollows are rare in the buffer area. The buffer area is considered unlikely to be important habitat for this species.	3	5

Appendix E – Additional Biodiversity Impacts – Location and Measurements of Hollow-bearing Trees

No	Easting	Northing	Species	dbh (cm)	stems	ht (m)	Tru hol	Bra hol	L/S/D	date
1	550956	6849082	M qui	56	1	22	1	0	L	8/2/17
2	550956	6849082	M qui	30	1	22	1	0	L	8/2/17
3	550947	6849016	M qui	70	2	20	1	1	D	8/2/17
4	550874	6848960	E rob	65	1	17	1	1	L	8/2/17
5	550901	6848837	L sua	120	1	20	1	1	L	8/2/17
8	551308	6848836	E obo	80	1	18	1	1	L	8/2/17
9	551085	6849507	E rob	96	1	22	2	1	S	14/2/17
10	550924	6849492	M ell	18	1	15	0	1	D	14/2/17
11	550936	6849760	C cam	150	4	20	0	5	L	14/2/17
12	551105	6849677	E pil	130	2	24	0	2	L	14/2/17
13	551226	6849722	E pil	95	1	15	0	1	L	14/2/17
14	551288	6849774	E pil	95	1	20	0	1	L	14/2/17
15	551672	6849855	E pil	50	1	12	0	5	D	14/2/17
16	551704	6849890	E pil	65	1	22	0	1	L	14/2/17
17	551749	6849950	E pil	75	1	25	1	2	L	14/2/17
18	550549	6850319	L con	48	1	10	1	0	D	17/2/17
19	550549	6850319	L con	100	3	18	1	0	L	17/2/17
20	550284	6850116	E gra	50	1	12	0	1	L	17/2/17
21	550284	6850116	E gra	85	1	18	1	1	L	17/2/17
22	550451	6850693	E acm	70	1	16	0	2	L	17/2/17
23	550462	6850678	E ter	95	1	14	1	0	S	17/2/17
24	550462	6850678	E ter	70	1	14	1	0	L	17/2/17

North Byron Parklands Cultural Events Site – Biodiversity Assessment Report

No	Easting	Northing	Species	dbh (cm)	stems	ht (m)	Tru hol	Bra hol	L/S/D	date
25	550496	6850684	L con	75	1	16	1	0	L	17/2/17
26	550456	6850664	E acm	70	1	18	1	0	L	17/2/17
27	550481	6850656	E acm	85	1	18	1	0	L	17/2/17
28	550529	6850691	L con	110	2	16	1	0	L	17/2/17
29	550430	6850490	E pro	65	1	22	0	1	L	17/2/17
30	550448	6850432	E pro	55	1	20	0	2	L	17/2/17
31	550680	6849907	E pil	115	1	22	0	1	L	20/2/17
32	550768	6849966	E pil	125	1	20	0	3	L	20/2/17
33	551996	6850165	E ter	94	1	9	1	0	D	20/2/17
34	551783	6850150	E acm	60	1	18	1	0	S	20/2/17
35	551783	6850150	E acm	65	1	18	0	1	L	20/2/17
36	551749	6850194	E acm	66	1	20	0	1	L	20/2/17
37	551782	6850208	E acm	75	1	20	1	1	L	20/2/17
38	551744	6850215	E acm	85	1	15	1	1	D	20/2/17
39	551726	6850209	E acm	75	1	22	0	1	S	20/2/17
40	551737	6850000	E acm	18	1	5	1	0	D	20/2/17
41	551753	6850147	L sua	50	1	18	0	2	L	20/2/17
42	551550	6850114	E spp.	35	1	10	1	0	D	20/2/17
43	551555	6850127	E acm	90	1	16	0	2	D	20/2/17
44	551555	6850127	E pil	95	1	24	0	2	L	20/2/17
45	551555	6850132	E acm	48	1	17	0	1	L	20/2/17
46	550692	6848928	E gra	48	1	12	0	2	L	20/2/17

Appendix F – Summary of Monitoring Results

See document



Summary of ecological surveys and monitoring at North Byron Parklands 2007 – 2017

Prepared for
Byron Venue Management Pty Ltd

September 2017



DOCUMENT TRACKING

Item	Detail
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Approved by	Ailsa Kerswell
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Template 29/9/2015

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Abbreviations

Abbreviation	Description
Parklands	North Byron Parklands
OEH	NSW Office of Environment and Heritage
EIM	Event Impact Monitoring
SITG	Splendour in the Grass
FF	Falls Festival
TSC Act	NSW <i>Threatened Species Conservation Act 1995</i>
EPBC Act	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>

1 Introduction

The North Byron Parklands site (Parklands) was acquired by the current owners in late 2006. Since then, nine major music festival events have been held between 2013 and 2017 (five Splendour in the Grass and four Falls Festival events).

Over the last 10 years, numerous ecological surveys and flora and fauna monitoring have been undertaken at the Parklands and in the adjacent Billinudgel Nature Reserve. This work has been primarily to detect impacts on fauna and flora and to support the environmental approvals for operation of the site (pre-2012) and to comply with regulatory requirements (post-2012) associated with Event Impact Monitoring (EIM). The results of these surveys are reported across numerous documents.

1.1 Purpose and scope

The purpose of this report is to provide a consolidated summary of the ecological surveys and flora and fauna monitoring that has occurred at the Parklands and adjacent sites. It provides a summary of the methods and results of each survey conducted by Dr Mark Fitzgerald (with support from Biolink Consultants, EarthProcess Ecological Services, Sandpiper Ecological Surveys and Wildlife Services). It also analyses trends over time for key datasets to assess any cumulative impacts, which is a task that has not been undertaken to date.

The report is focused on two key types of survey:

- EIM – flora and fauna monitoring undertaken before, during and after each of the nine events held to-date; and
- Other ecology surveys – the collection of other ecological surveys that have been undertaken at the Parklands since 2007, including biennial fauna surveys.

This report has been prepared via review of the individual reports prepared for each survey and monitoring event, and includes an analysis of the data reported therein. Complete data for the most recent EIM undertaken for Splendour in the Grass 2017 is not yet available and has therefore not been included in this summary. No analysis of primary data has been undertaken.

1.2 Background to event impact monitoring (EIM)

The NSW Department of Planning and Environment's approval conditions for the Parklands requires preparation and implementation of a Flora and Fauna Monitoring Program under Consent Condition C20, to monitor and assess the impact of the project on flora and fauna within and adjacent to the site. This program was developed by Billinudgel Property Trust and finalised in 2013. It has been implemented as required.

A key component of the Flora and Fauna Monitoring Program is the EIM. The EIM focuses on key groups of flora and fauna with the intention of identifying:

- Any ecological impacts as a results of events particularly on fauna within the site and Billinudgel Nature Reserve
- Requirements to ensure there are no significant impacts on the function of the Marshall's Ridge Wildlife Corridor
- Measures to ensure there are no significant impacts on threatened species and communities
- Presence of Eastern Grass Owl (*Tyto longimembris*)

Additional survey requirements for the Flora and Fauna Monitoring Program under Consent Condition C20 include biennial fauna monitoring. This has been undertaken in 2014 and was scheduled in 2016, however these surveys have been deferred until Spring 2017.

2 Methods

2.1 Development of this report

This report has been developed using results provided in the following individual survey and/or monitoring reports:

- Performance Report #1 – #4 Appendices B1 Environmental Performance Report and B2 Results and Analyses of Event Impact Monitoring Data (North Byron Parklands 2014a, 2014b, 2015, 2016)
- Preliminary Results: Event Impact Monitoring Falls Festival 2016-17 (Fitzgerald 2017)
- August 2007 Fauna Survey of (Fitzgerald 2007)
- February 2009 Fauna Survey of North Byron Parklands (Fitzgerald 2009)
- North Byron Parklands Biennial Fauna Survey (Fitzgerald 2014)
- North Byron Parklands Flora and Fauna Rehabilitation Program (Fitzgerald 2016)
- Yelgun Koala Survey and Koala Plan of Management (Biolink 2007)
- Yelgun Koala Survey Koala Habitat Reassessment (Biolink 2008)
- North Byron Parklands SEPP No. 44 Koala Survey and Habitat Reassessment (Biolink 2013)
- North Byron Parklands SEPP No. 44 Koala Monitoring Report (Biolink 2016)

Data review has been undertaken using reported data only, and therefore statistical analyses were not possible. No review or analysis of primary data has been undertaken.

The primary focus of this report has been on the EIM results. These surveys were specifically designed to detect any impact of events on the target flora and fauna groups. Each survey has employed a consistent methodology, therefore allowing a comparison of data over time. Results of other surveys are also reviewed, although in less detail.

2.2 Survey and monitoring method summary

Numerous surveys have been undertaken within the study area from 2007 to 2017, including nine EIM events and seven other surveys. Sampling methods for EIM and other surveys are summarised below, with full details available in the documents listed above. Monitoring locations are presented in Figure 1 and Figure 2.

2.2.1 Event impact monitoring (EIM)

The monitoring methods for EIM were developed and approved as part of the Flora and Fauna Monitoring Program (2013) and are summarised in Table 1 below. This program has been implemented during the nine events listed in Table 2.

Table 1: Summary of survey and monitoring methodology across the study area (2007 – 2017)

Target Group	Sampling Methodology
Vegetation	Vegetation condition and changes before and after each event recorded at 27 permanent photo-points across the Parklands
Forest Birds	Monthly samples (ten X 20 minute / 200m transects) taken before, during and after each event over three consecutive days between December to February, and from June to August or September (2017). Sampling events are undertaken by three experienced observers. Two impact sites are within the Parklands; two are in BNR and 6 control sites are all located within Billinudgel Nature Reserve
Forest Birds – plantings	Birds monitored at two sites in established (~10 year old) native plantings in the Marshall's Ridges area – commenced 2015
Waterbirds	20-minute point counts of waterbirds around the 2 ha constructed dam on-site recording species and abundance since 2007
Eastern Grass Owl	Targeted survey and call playback each July during event years – 2013, 2014, 2015, 2016, 2017
Terrestrial Mammals	Ten hair funnels deployed at each of 5 locations at 20 m intervals along a bird transect. The sampling for four nights before, during and after each event.
Terrestrial Fauna	Two sand traps were deployed (within an area of 20 m ²) on three nights before, during and after each event at eight locations along tracks. Traps raked the night before sampling and checked each morning. Sand traps were abandoned in 2015 due to regular washouts. Two motion sensor wildlife cameras deployed in the Marshall's Ridges area to monitor fauna presence – commenced 2015.
Microchiropteran Bats	Three locations sampled by Anabat call detectors. Anabats deployed for three nights before, during and after each event. Two locations are within the event area (Large dam and Miniopterus dam) and the third nearby within Billinudgel Nature Reserve.
Flying-foxes	Incidental survey whilst ecologist on site during events
General Fauna	Incidental road kill observations
Koala	Targeted searches (KSAT) and habitat assessments – 2007, 2008, 2013, 2016

Note: Minor methodology changes have been made during the life of the project.

Table 2: List of events monitored, including number of patrons

Event	Monitoring dates	Number of patrons per day
Splendour in the Grass 2013	Before: June; During: July; After: August & September (2017)	25,000
Splendour in the Grass 2014		27,500
Splendour in the Grass 2015		30,000
Splendour in the Grass 2016		32,500
Splendour in the Grass 2017 ⁺		32,500
Falls Festival 2013-14	Before: December; During: January; After: February	15,000
Falls Festival 2014-15		17,500
Falls Festival 2015-16		20,000
Falls Festival 2016-17		22,500

+ Results not yet available

2.2.2 Other surveys

A number of other surveys have been undertaken at the Parklands. Prior to 2013, these were to support the environmental approvals process. Subsequent surveys have been undertaken as part of the approvals requirements. This is primarily the 2014 biennial fauna survey. A summary of these surveys and the method employed is provided in Table 3.

Table 3: Summary of other surveys undertaken at the Parklands

Survey type	Year	Methods employed	Reference
Fauna survey	2007	Anabat detection Bird survey (incl. call playback) Drift fence and pitfall traps Elliot traps Flying-fox census Frog survey Harp trapping Incidental observations incl. of tracks, scats, diggings and remains Reptile survey Spotlighting	Fitzgerald 2007
Fauna survey	2009	As per 2007 fauna survey above	Fitzgerald 2009
Fauna survey	2014	Anabat detection Bird survey incl. call playback Elliot traps Frog survey	Fitzgerald 2014

		Harp traps Sand traps Spotlighting Waterbird surveys Incidental observations incl. of tracks, scats, diggings and remains	
Koala survey	2007	Analysis of historical records Site assessment – habitat quality and koala searches (KSAT)	Biolink 2007
Koala survey	2008	Site assessment – habitat quality and koala searches (KSAT)	Biolink 2008
Koala survey	2013	Site assessment – habitat quality and koala searches (KSAT)	Biolink 2013
Koala survey	2016	Site assessment – habitat quality and koala searches (KSAT)	Biolink 2016

2.3 Survey effort

The surveys described above have resulted in extensive survey effort for target species and species groups at the Parkland since 2007. The tables below provide details of total survey effort (Table 4), effort during targeted fauna surveys (Table 5) and effort during EIM (Table 6).

Table 4: Total fauna survey effort 2007 – 2017, including general fauna survey, targeted Koala survey and all Event Impact Monitoring (8 events for which results are available)

Target fauna group	Method	Total survey effort
Mammals	Elliot trapping	1,125 trap nights
	Hair tube sampling	5,000 tubes
Koala	Koala Spot Assessment Technique (KSAT)	97 assessments
	Habitat assessment and incidental observations	27 days
Reptiles	Pitfall traps	75 traps days
Reptiles and amphibians	Targeted habitat searches	13 days
Mammals and reptiles	Sand traps and motion cameras	420 nights
Nocturnal species	Spotlighting	59 nights
Microbats	Harp netting	26 trap nights
	Anabat deployment	255 nights
Forest birds	Timed bird census	270 hours
Water birds	Timed bird census at dam	11.2 hours
Owls and cryptic birds	Call playback	33 sessions

Table 5: Total fauna survey effort during general fauna surveys 2007, 2009, 2014

Target fauna group	Method	Total survey effort
Mammals	Elliot trapping	1,125 trap nights
Reptiles	Pitfall traps	75 traps days
Reptiles and amphibians	Targeted habitat searches	13 days
Nocturnal species	Spotlighting	11 nights
Microbats	Harp netting	26 trap nights
	Anabat deployment	21 nights
Owls and cryptic birds	Call playback	25 sessions

Table 6: Total fauna survey during Event Impact Monitoring (8 events for which results are available)

Target fauna group	Method	Total survey effort
Mammals	Hair tube sampling	5,000 tubes
Mammals and reptiles	Sand traps and motion cameras	420 nights
Nocturnal species	Spotlighting	48 nights
Microbats	Anabat deployment	255 nights
Forest birds	Timed bird census	270 hours
Water birds	Timed bird census at dam	11.2 hours
Eastern Grass Owl	Call playback	8 sessions

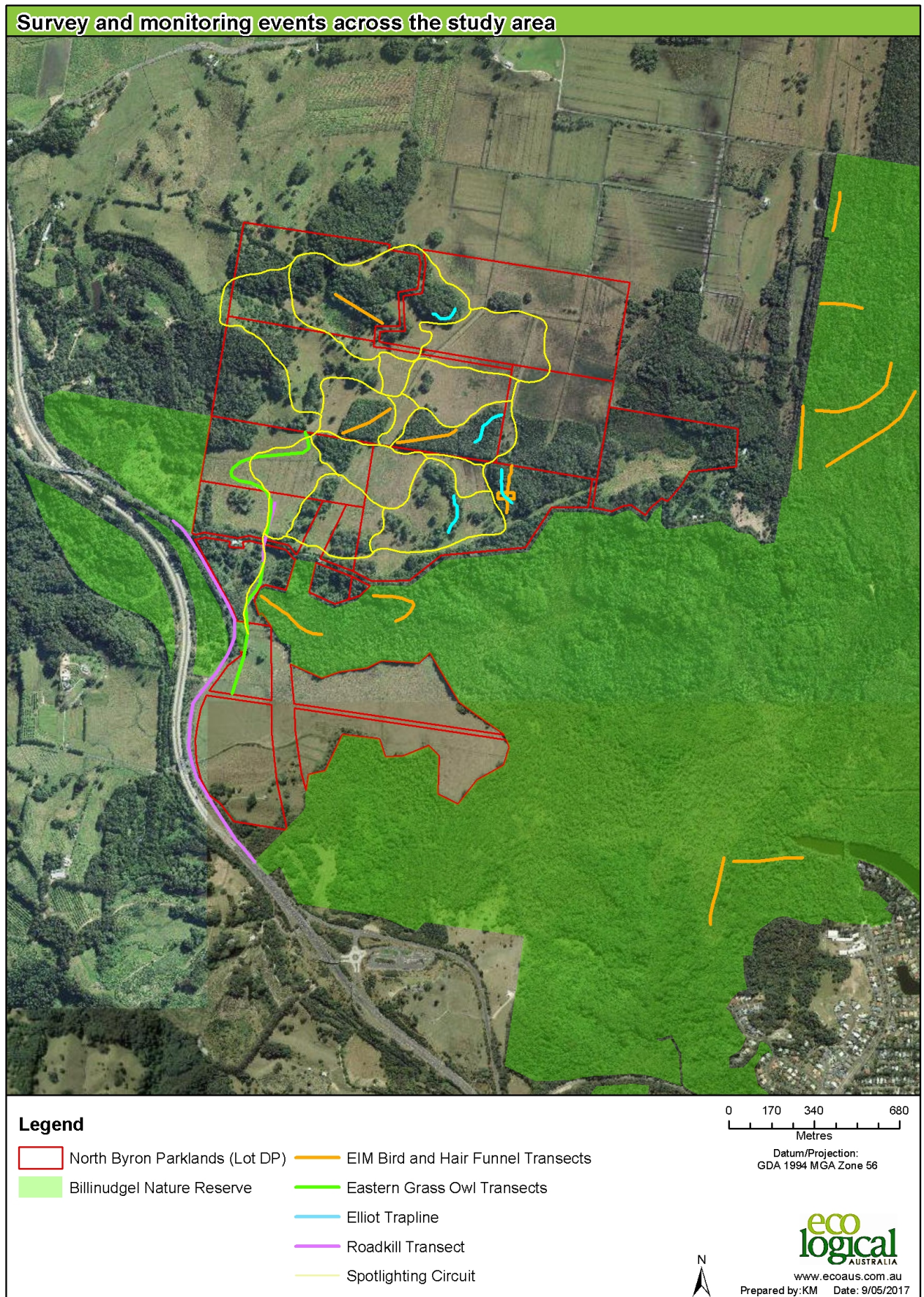


Figure 1: Transect survey and monitoring locations within the Parkland and surrounds



Figure 2: Survey and monitoring locations within the Parklands and surrounds

3 Results

The following section provides a summary of the main ecological results from the various surveys and monitoring events conducted within the study area from 2007 to 2017.

3.1 Event impact monitoring (EIM) 2013 – 2017

EIM has been undertaken for each of the nine events held at the Parklands to date (2013 – 2017). The consistent conclusion across all EIM surveys has been that there were no significant adverse effects on any flora or fauna group as a consequence of events held at the Parklands. Minor negative ecological effects observed during and immediately after events included limited sediment movement, littering and trampling of grasses within the event area and avoidance of illuminated areas by mobile fauna. These impacts were temporary and reversible at the conclusion of events.

Overall, EIM data highlight the natural variability of the fauna assemblages (particularly bird and microbat). The main driver of this variability appears to be seasonal movements of species and local patterns of food resource abundance, primarily blossom in swamp sclerophyll forest and fruit crops in both native and exotic species (e.g. Camphor Laurel).

Table 7 provides a summary of the results of the EIM at each event. Results and trends for birds, microbats and flying foxes are presented and discussed in more detail in the subsequent sections. These groups have been focused on because they:

- Are the most prevalent on site
- Contain threatened species
- Have the greatest potential to be impacted by events.

Table 7: Summary of EIM results for each event

Group	SITG 2013	FF 2013-14	SITG 2014	FF 2014-15	SITG 2015	FF 2015-16	SITG 2016	FF 2016-17
Vegetation	No impact to remnant forest vegetation; improvements in specific areas due to bush regeneration activities; minor tramping of grass within event area (areas recovered soon after)							
Threatened flora species	Individuals retained and condition maintained; Rough-shelled Bush Nut (<i>Macadamia tetraphylla</i>) experiencing some impact from historical competition from Camphor Laurel and Mango Trees, though this is unrelated to the SITG and FF events and has been addressed by Parklands' bush regeneration team							
Forest birds	No difference in abundance or diversity across before-during-after events							
Water birds (@ dam)	No difference in abundance or diversity across before-during-after events; low abundance during SITG 2013 due to patrons swimming in the dam (this practise has ceased in subsequent events)							
Microbats	No difference in abundance or diversity across before-during-after events							
Flying foxes (within event areas)	Absent	Present (5 – 7 individuals)	Absent	Present (2 individuals)	Present (2 – 5 individuals)	Absent	Present (3 – 5 individuals)	Absent
Mammals (hairtube results)	No difference in abundance or diversity across before-during-after events; species detected include Dog, Rat, House Mouse, Northern Brown Bandicoot, Antechinus, Possum							
Mobile fauna (sand trap, motion camera)	Technique had limited effectiveness; demonstrated connectivity within and across the site maintained; species detected include Dog, Rat, Cane Toad, Fox, Water Dragon, Brushtail Possum, Northern Brown Bandicoot, Swamp Wallaby, Scrub Turkey, Lace Monitor							
Road kill (incidental obs)	Primarily cane toads, also reptiles: Pink-tongued Skink, Bearded Dragon, Yellow-faced Whip Snake							
Threatened fauna species	2 microbat spp. 2 bird spp.	7 microbat spp. 1 – 3 bird spp. (report unclear)	5 microbat spp. 3 bird spp.	8 microbat spp. 1 bird spp.	3 microbat spp. 2 bird spp.	5 microbat spp. 3 bird spp.	4 microbat spp. 0 bird spp.	5 microbat spp. 2 bird spp.

3.1.1 Birds

Forest birds

The forest bird assemblage at the Parklands and adjacent monitoring areas is diverse and has been monitored consistently across all nine events. The monitoring sites are within the Parklands event areas and in the adjacent areas of Billinudgel Nature Reserve. Bird communities at the sites within the event area have the potential to be disturbed during events. Each EIM survey result demonstrated no significant differences in bird diversity, abundance or community structure before, during or after events (North Bryon Parklands 2014a, 2014b, 2015, 2016; Fitzgerald 2017).

Across all EIM surveys there were between 73 and 86 species and up to 4023 individuals recorded (sum across all survey transects, Table 8). Surveys associated with SITG 2016 recorded the highest number of individuals to date. While overall diversity and abundance has fluctuated over time, there is no consistent trend of decline in either parameter (Figure 3). This result suggests the combined program of events since 2013 has not impacted on regional forest bird communities over time.

Table 8: Summary of forest bird diversity and abundance at each event

Index	SITG 2013	FF 2013-14	SITG 2014	FF 2014-15	SITG 2015	FF 2015-16	SITG 2016	FF 2016-17
Diversity (# species)	86	84	80	73	83	82	80	85
Abundance (# individuals)	3246	2077	3164	1740	2979	2455	4023	2566

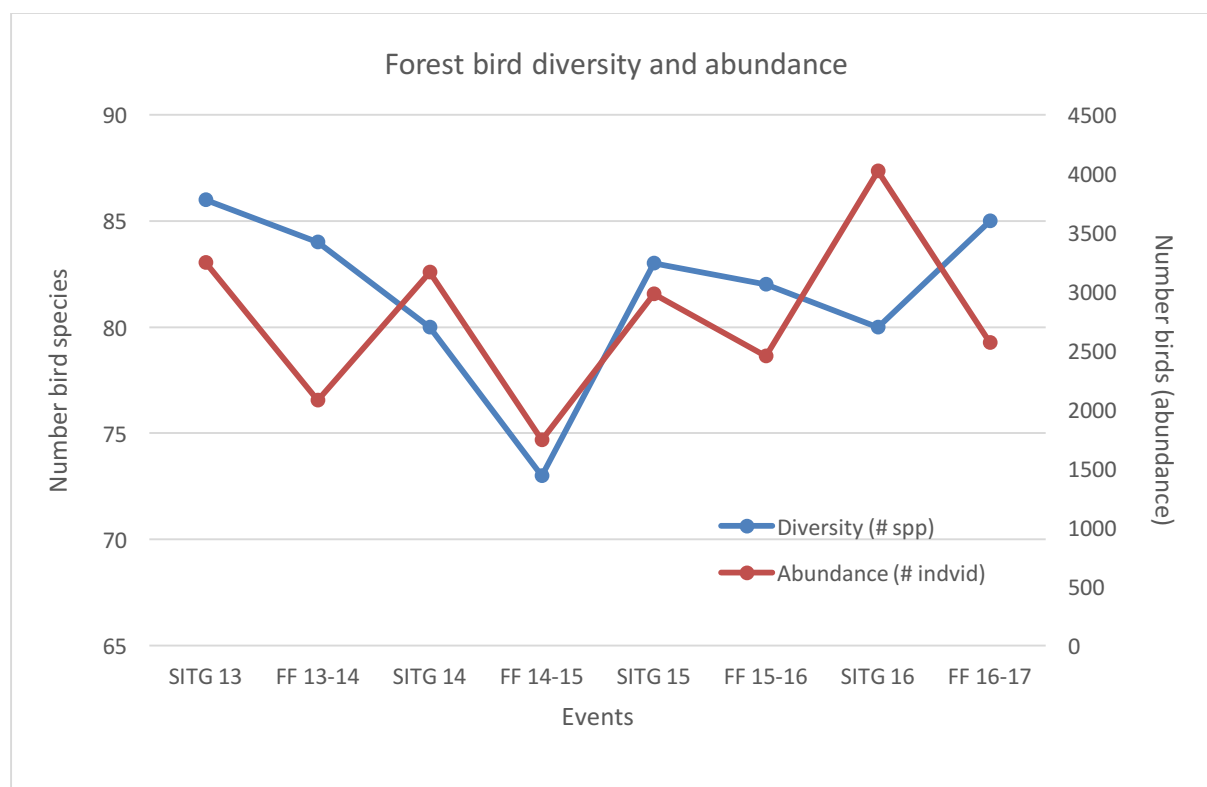


Figure 3: Forest bird diversity and abundance trends over time (2013 – 2017)

There is data available to directly compare bird monitoring data before and after events commenced at the Parklands. Species and abundance data from forest block A (native vegetation block surrounded by event area) was collected over 12 samples prior to SITG 2013 and 44 samples subsequent to this first event. Data show no differences in either the number of birds (abundance) or the number of species (diversity) over time (Figure 4).

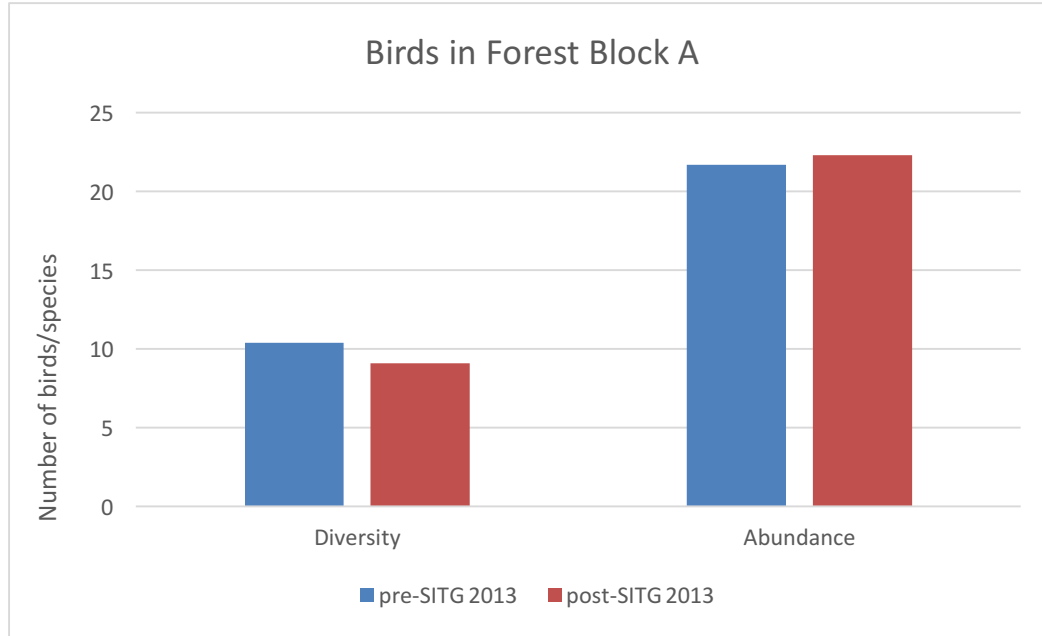


Figure 4: Forest bird species and abundance in Forest Block A before and after the commencement of events

Water birds

The water bird assemblage at the Parklands dam has been monitored over time since 2007. The dam is within the event area and the waterbird population has the potential to be disturbed during events. Monitoring over time, include during EIM surveys has demonstrated no impact on the waterbird population that is attributable to individual events except during SITG 2013 when patrons swam in the dam (North Byron Parklands 2014a, 2014b, 2015, 2016; Fitzgerald 2016, Fitzgerald 2017).

Across all surveys there were between 2 and 10 species and up to 62 individuals recorded (per survey, Figure 5). While overall diversity and abundance has fluctuated over time, there is no consistent trend of decline in either diversity or abundance (Figure 5). Additionally, when aggregated across surveys from before and after the commencement of events at the Parklands, the data show both higher diversity and abundance of waterbirds since commencement of events in 2013 (Figure 6). These results suggest the combined program of events since 2013 has not impacted on water bird communities over time. It should be noted that the low abundance coincident with SITG 2013 (first grey block on Figure 5) was a direct result of patrons swimming in the dam, and this practise that has since ceased.

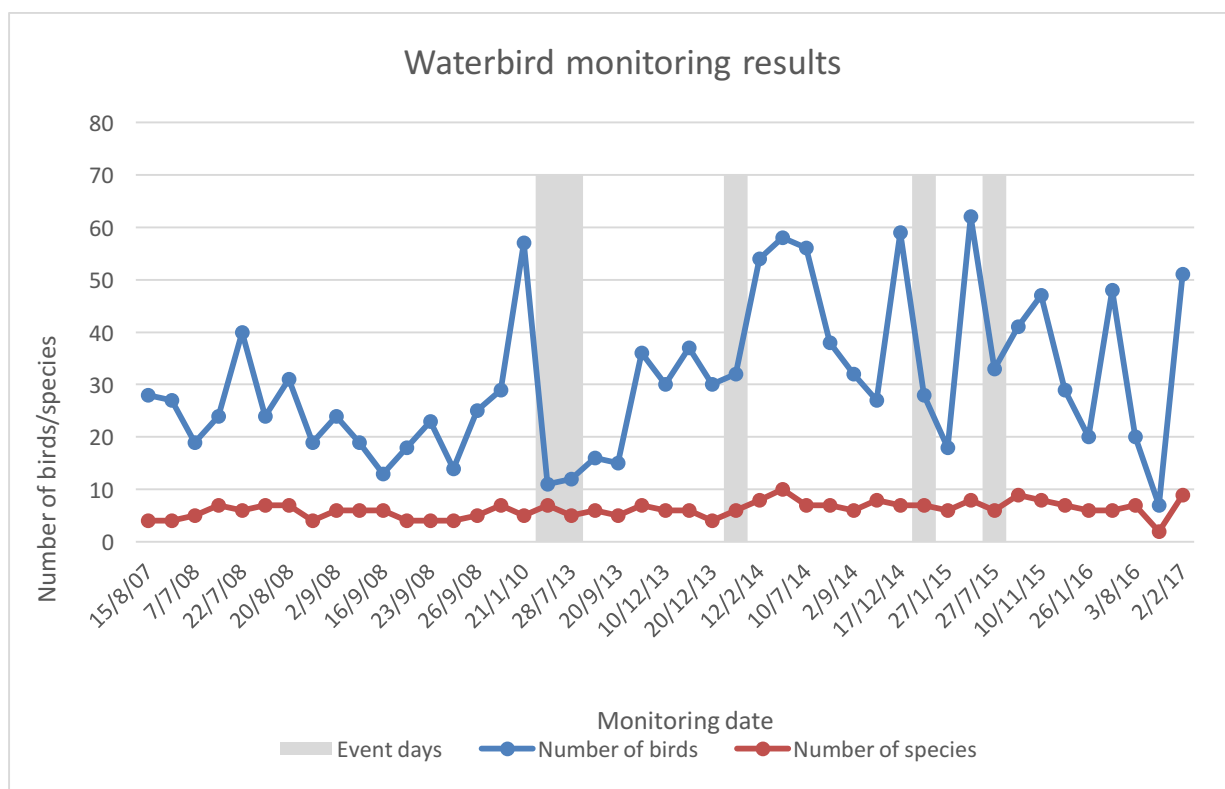


Figure 5: Water bird diversity and abundance over time (grey bars are monitoring data from during events)

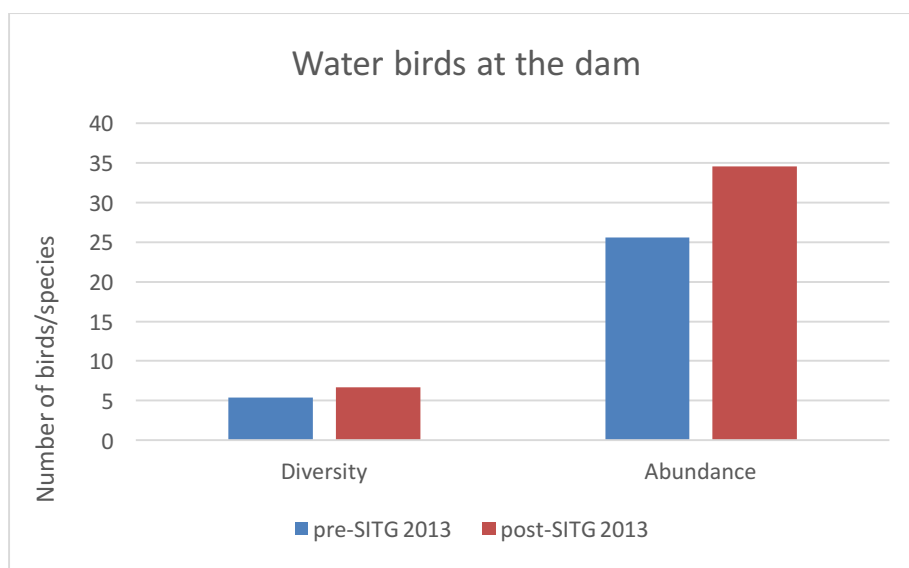


Figure 6: Water bird diversity and abundance before and after the commencement of events

Threatened bird species

Threatened bird species have not been specifically targeted during the EIM, rather their presence recorded along with that of all other species (with the exception of the Eastern Grass Owl – see below).

- Brown Treecreeper (*Climacteris picumnus victorae*)
- Bush Stone Curlew (*Burhinus grallarius*)
- Eastern Grass Owl (*Tyto longimembris*)
- Eastern Osprey (*Pandion cristatus*)
- Little Lorikeet (*Glossopsitta pusilla*)
- Rose-crowned Fruit Dove (*Ptilinopus regina*)
- White-eared Monarch (*Carterornis leucotis*)
- Wompoo Fruit Dove (*Ptilinopus magnificus*)

There is insufficient data at an individual event level to undertake an analysis of whether threatened birds are impacted during single events. However, given that the majority of records are from outside the event area, and there is no evidence that events are impacting the general bird communities, it seems reasonable to conclude individual events are not impacting on these species.

Table 9: Summary of threatened bird species abundance at each event

[illegible]

NB: Bush Stone Curlew was recorded after SITG 2017, however full results from the associated EIM are not currently available and therefore this event is not included in the table above.

Eastern Grass Owl

Targeted surveys for the Eastern Grass Owl (*Tyto longimembris*, listed as vulnerable on the TSC Act) were undertaken in July each year for five years (2013 – 2017) and in September 2014 as part of the biennial fauna survey. This species was first recorded in the main event area (north of Jones Rd) in 2007, but not since. A pair of Eastern Grass Owls responded to call play back in July 2016 in the exotic grassland in the south of the Parklands. This was the first observation of these species within the site since 2007. Further responses from a single Eastern Grass Owl were also recorded in July 2017, at the same site.

3.1.2 Microbats

All microbat species

The microbat assemblage at the Parklands and adjacent monitoring areas is diverse and has been monitored consistently across all nine events. Microbat assemblages are monitored via bioacoustic recordings (i.e. Anabat call detectors), with the number of calls recorded providing a proxy for abundance. The microbat monitoring sites are within the Parklands event areas (primarily the large dam) and in the adjacent areas of Billinudgel Nature Reserve. Microbats at the large dam within the event area have the potential to be disturbed during events, primarily due to lighting impacts. EIM survey results demonstrated no significant differences in microbat diversity, abundance or assemblage structure before, during or after events, except for Falls 2016-2017 when a record of >4000 calls for one species/category before the event was recorded at the large dam (North Byron Parklands 2014a, 2014b, 2015, 2016, Fitzgerald 2017).

Across all EIM surveys there were between 16 and 21 species¹ and up to 7061 individual calls recorded (sum across transects, Table 10). The most recent winter surveys (associated with SITG 2016) recorded fewer calls than previous surveys, however, this was attributed to equipment malfunction rather than an ecological effect. Conversely, the most recent summer surveys (associated with FF 2016-17) recorded the highest number of calls to date.

While overall diversity and abundance has fluctuated over time, there is no consistent trend of decline in either the number of species recorded or the total number of calls (Figure 3). This result suggests the combined program of events since 2013 has not impacted microbat assemblages over time.

Table 10: Summary of microbat diversity and abundance at each event

Index	SITG 2013	FF 2013-14	SITG 2014	FF 2014-15	SITG 2015	FF 2015-16	SITG 2016	FF 2016-17
Diversity (# species)	16	21	18	18	19	20	20	20
Abundance (# calls)	762	5070	2336	2743	4805	3614	1367	7061

¹ Or species groups if calls could not be attributed to only one species, as commonly occurs in microbat call analysis

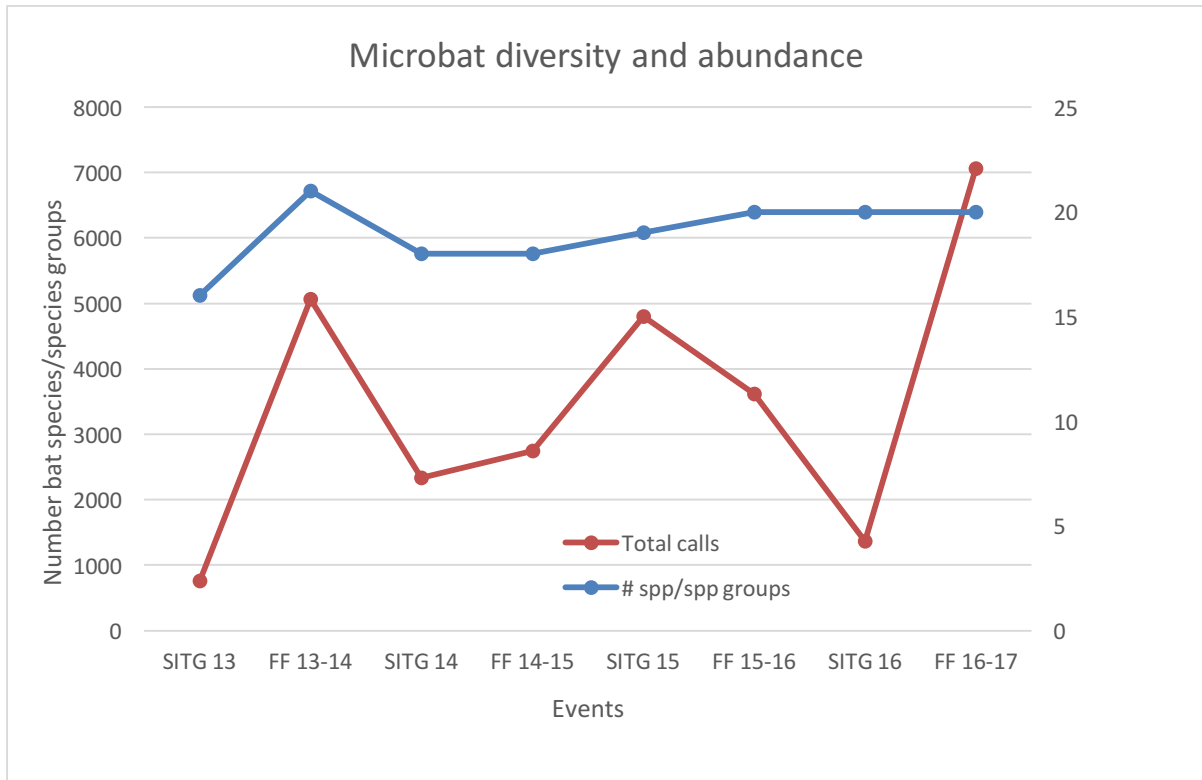


Figure 7: Microbat diversity and abundance (using calls as a proxy) trends over time (2013 – 2017)

Threatened microbats

Threatened microbat species have not been specifically targeted during the EIM, rather their presence recorded along with that of all other species. Eight threatened species have been recorded during EIM surveys. All are listed as vulnerable within the NSW TSC Act and one is also listed as vulnerable on the EPBC Act. The species include:

- Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis*)
- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)
- Eastern Freetail-bat (*Mormopterus norfolkensis*)
- Golden-tipped Bat (*Kerivoula papuensis*)
- Large-eared Pied Bat (*Chalinolobus dwyeri*) – EPBC Act vulnerable species
- Little Bent-wing Bat (*Miniopterus australis*)
- Southern Myotis (*Myotis macropus*)
- Yellow-bellied Sheathtailed Bat (*Saccolaimus flaviventris*)

There is sufficient data for the two most common species (Little Bent-wing Bat and Southern Myotis) at an individual event level to undertake analysis of whether threatened microbats are impacted during events. Figure 8 shows the numbers of calls from each of these species recorded before, during and after six events. These data come from anabats located at the dam wall, the site most likely to be impacted by event-related disturbances. Results for the Little Bent-wing Bat show higher numbers of calls recorded in the month after most events, with similar numbers of calls before and during. Conversely, results for the Southern Myotis show higher numbers of call during most events, with similar numbers of calls before and after. This latter result suggests increased predation on insects that are attracted to event lighting in and around the dam, which is key foraging habitat for this species (OEH 2017). Collectively, the results demonstrate no adverse impact associated with events and are consistent with those from the broader microbat assemblage data (as discussed above).



Figure 8: Before, during and after event call data for Little Bent-wing Bat and Southern Myotis at the dam (note – there were 2572 calls from Little Bent-wing Bat during SITG 2015, however this has been reduced on the figure for scaling purposes)

A longer-term analysis of the collective dataset of threatened microbats further supports the conclusion that events have not negatively impacted microbat assemblages. Several microbat species have been recorded during multiple EIM surveys and while call abundance has fluctuated over time, there are no evident trends on an ongoing decline (Table 11, Figure 9, Figure 10). This demonstrates the ongoing use of the Parklands and surrounds during 2013 – 2017 and over the course of the events held to date.

Table 11: Summary of threatened microbat abundance (calls) during each event

Species	SITG 2013	FF 13-14	SITG 2014	FF 14-15	SITG 2015	FF 15-16	SITG 2016	FF 16-17	Total count	# events present
Little Bent-wing Bat	217	356	489	356	2723	140	392	171	4844	8
Large-eared Pied Bat	-	1	10	1	-	-	-	1	13	4
Eastern Freetail-bat	-	25	22	25	62	59	9	160	362	7
Southern Myotis	-	623	133	622	139	863	46	158	2584	7
Eastern False Pipistrelle	1	4	-	4	-	1	-		10	4
Yellow-bellied Sheath-tailed Bat	-	4	-	4	-	-	-		8	2
Golden-tipped Bat	-	5	-	5	-	4	-		14	3
Eastern Bent-wing Bat	-	-	21	6	-	-	53	18	98	4
Total calls	218	1018	675	1023	2924	1067	500	508	7933	
Total spp	2	7	5	8	3	5	4	5	8	

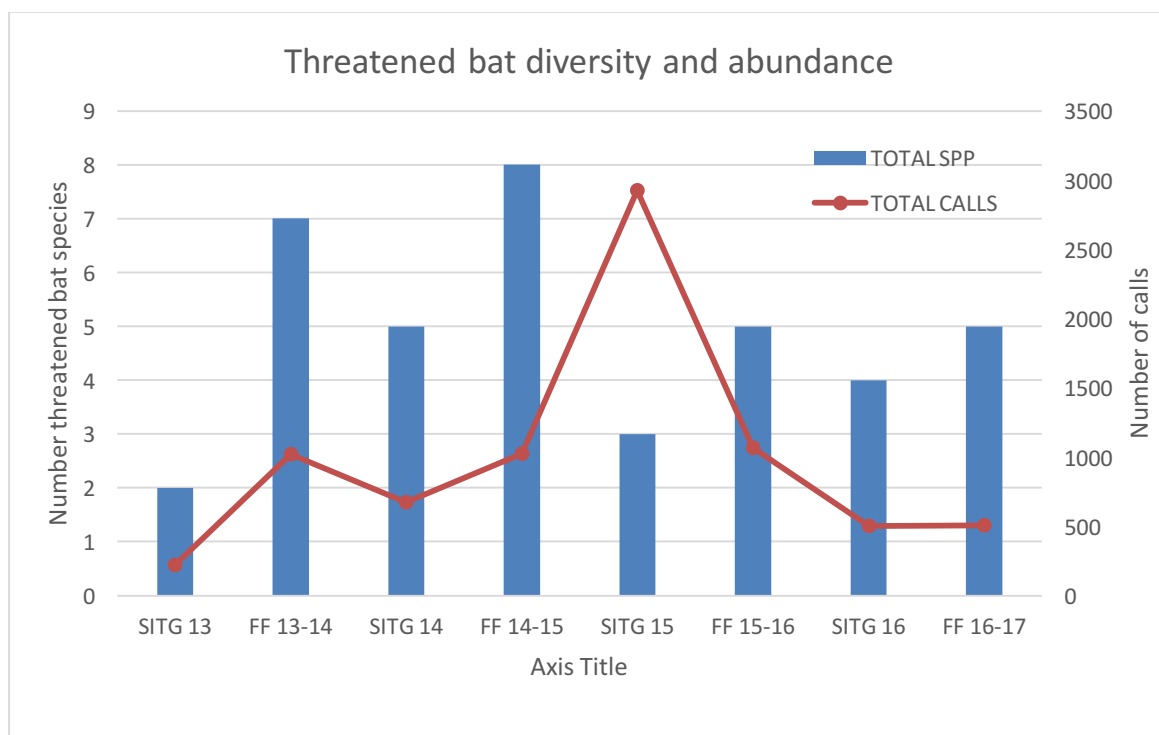


Figure 9: Diversity and abundance (number of calls) of threatened microbat species over time

THIS IS WRONG: >7000 BAT CALLS FOR FALLS 2016-2017

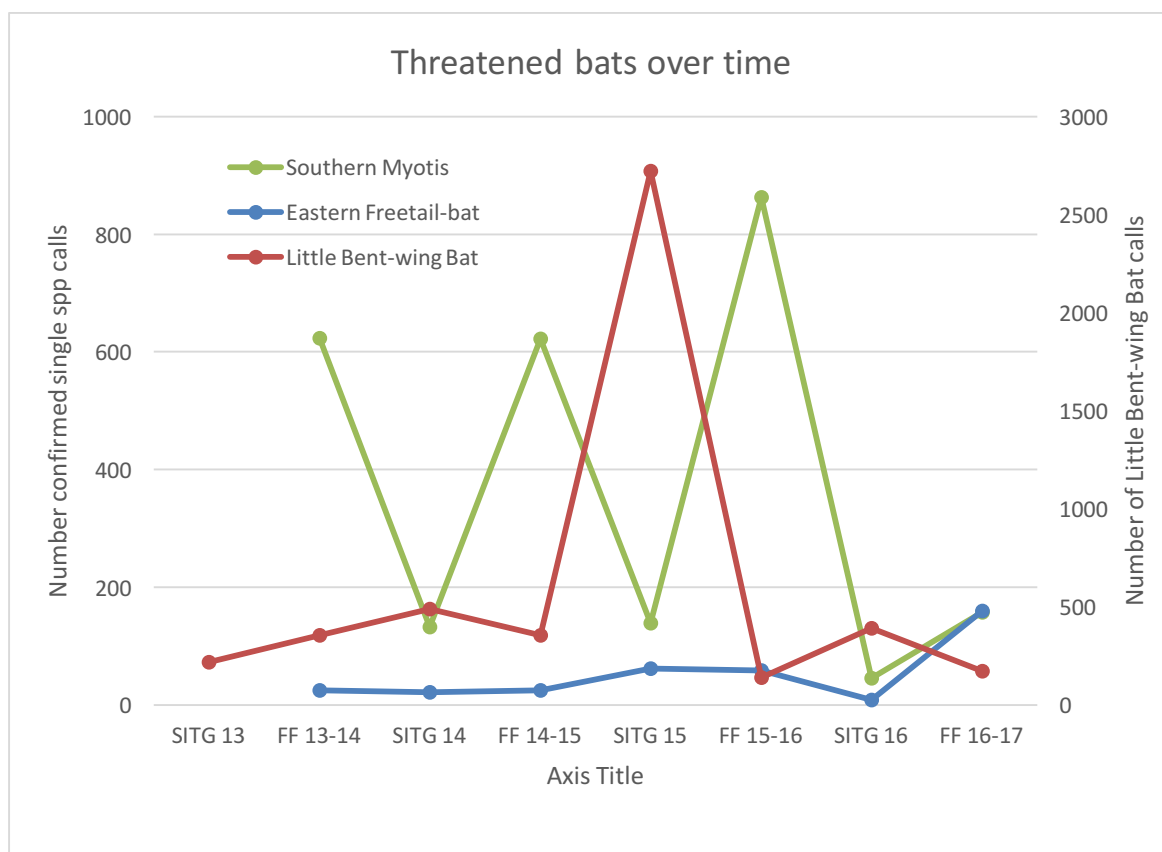


Figure 10: Abundance (number of calls) of three most common threatened microbat species over time (note – Little Bent-wing Bat data on secondary axis)

3.1.3 Flying foxes

Flying fox observations have been largely incidental sightings from during event monitoring. Flying foxes have been observed on site during four of the nine events held to date and numbers observed at the site during each event has been low (Table 12). Event abundances are consistent with numbers observed during fauna surveys in 2009 and 2014 (Mark Fitzgerald, pers comm. 2017). Events at the Parklands have not coincided with any large blossom events (i.e. times of highly abundant food resources) and the closest maternity camp (at Brunswick Heads Nature Reserve) for Black and Grey-headed Flying Foxes was abandoned in 2011. Both these factors are likely to be the drivers behind low flying fox numbers of site.

Table 12: Summary of flying fox abundance at each event

Index	SITG 2013	FF 2013-14	SITG 2014	FF 2014-15	SITG 2015	FF 2015-16	SITG 2016	FF 2016-17	SITG 2017
Flying fox numbers	0	5 – 7	0	2	2 – 5	0	3 – 5	0	0

3.2 Other surveys 2007 – 2017

Numerous other surveys have been undertaken at the Parklands between 2007 and 2014. Most have been associated with fauna. The results of these surveys are discussed by fauna group below (Table

13), with particular focus on comparisons over time. Surveys prior to 2013 provide a pre-event baseline, while surveys after this time were undertaken to detect any impact of events on local fauna communities (specifically the 2014 biennial fauna survey).

Table 13: Summary of fauna surveys 2007 – 2014

Fauna group	Summary of results
Forest birds	Bird species diversity was similar across all fauna survey years. When summed across all transects at all sites diversity was 70 species in 2007; 63 species in 2009 and 68 species in 2014.
Water birds	Water bird diversity (8 species) and abundance (27 individuals) was within the range of variability recorded during EIM. Water bird surveys were not undertaken in 2007 and 2009.
Threatened bird species	Three threatened bird species were recorded prior to events commencing – Comb-crested Jacana (<i>Irediparra gallinacea</i> , TSC Act vulnerable), Eastern Grass Owl and Rose-crowned Fruit Dove. None of these species were recorded in the 2014 fauna surveys, however both the Eastern Grass Owl and Rose-crowned Fruit Dove have been recorded during EIM. The Comb-crested Jacana has not been recorded on site since 2007. The reason for this is unclear, however it is unlikely to be related to events as events began in 2013. The species was absent well before the first event was held and suitable habitat remains on site at the dam that continues to be well utilised by a range of other water bird species.
Frogs	Frog species diversity has varied over time with records of 8 species in 2007; 12 species in 2009 and 6 species in 2014. No threatened frogs have been recorded on site.
Reptiles	Reptile species diversity has varied over time with records of 4 species in 2007 (winter); 0 species in 2009 (summer) and 5 species in 2014 (winter). No threatened reptiles have been recorded on site.
Mammals (general)	Mammal species diversity has varied over time with records of 17 species in 2007; 15 species in 2009 and 13 species in 2014. The lower diversity in 2014 was due to an absence of possum and bandicoot in this survey. Both species were regularly detected during EIM. One threatened mammal (Grey-headed Flying Fox) has been recorded on site. Mammals recorded on site include exotic species: Black Rat, House Mouse, Dog and Red Fox.
Microbats	Nine species of microbat were captured during harp trapping in 2007, 2009, 2014. This included four threatened species (Common Blossom Bat, Eastern Long-eared Bat, Eastern Bent-wing Bat and Little Bent-wing Bat. Both Bent-wing Bats were also regularly detected in EIM surveys, whilst the Common Blossom Bat (<i>Syconycteris australis</i>) and Eastern Long-eared Bat (<i>Nyctophilus bifax</i>) detected only during harp trapping (2007 and 2014). There were fewer bats captured in 2014, however this is attributed to poor trap placement rather than a true reflection of decreased abundance. Anabat survey was different in the pre-event (2007, 2009) surveys versus the 2014 surveys and data cannot therefore be compared. Bat assemblages during all surveys were comprised of similar species to those detected during EIM, with Little Bent-wing Bat being the most commonly recorded species.

Flying foxes	Flying fox numbers declined over time, with numerous Grey-headed and Black Flying Foxes observed in 2007, with only single number of individuals observed subsequently. This decline is attributed to the abandonment of the maternity camp in Brunswick Heads Nature Reserve, as well as a lack of foraging resources (blossom) on site during survey periods.
Koala	Targeted Koala surveys of the site were undertaken by Biolink in 2007, 2008, 2013 and 2016. 2007 – small area of core Koala habitat (3 ha) mapped on site; koala scats observed at four locations within the Parklands; results suggest use of the site by 1 – 2 Koalas 2008 – significantly reduced evidence of activity, such that activity level does not reach the threshold that indicates active, ongoing use by resident animals 2013 – no evidence of Koala within the Parklands 2016 – evidence of Koala (scats and scratches) at 7 sites, primarily in the north-west corner of the Parklands and within Billindugel Nature Reserve. Mixed age scats suggest repeat use of sites by Koala individuals with home ranges that encompass the north-west corner of the Parklands EIM – no evidence of Koala within the Parklands or surrounds (based on general observations, not targeted survey)

3.2.1 Birds of the plantings

Planting of local native forest flora species has been ongoing at the Parklands since 2007. Plantings have taken place within degraded farmland areas across the site and in areas adjacent to Billinudgel Nature Reserve. The total area of replanting is 10.7 ha. These areas have filling in gaps in vegetation and have joined previously fragmented areas. Plantings now support a range of native fauna.

Forest birds have been specifically surveyed in two established planting locations. Over four surveys, 161 birds across 31 species have been recorded. This includes two threatened species (NSW TSC Act) – Rose-crowned Fruit Dove (1 sighting) and White-eared Monarch (4 sightings) – which were observed in ~10 year old stands of native plantings located south of Jones Road.

4 Discussion and conclusion

The overall survey and monitoring results to date indicate that the cultural events at the North Byron Parklands site and adjacent Billinudgel Nature Reserve have caused only very minor, temporary and reversible impacts on the ecological attributes of this locality, including threatened species, populations and communities. Increased light and noise levels are an inevitable occurrence associated with events, and these factors will impact on local fauna movements and site usage during the period of each event. However comprehensive EIM has shown that once these factors cease to operate and the site returns to pre-event conditions, fauna presence and habitat values return to baseline conditions. Moreover, there are no evidence of declines in any environmental values at the Parklands, indicating no cumulative effects of holding multiple events.

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Appendix G - Flora and Fauna Monitoring and Adaptive Management Plan

See document



North Byron Parklands: Flora and Fauna Monitoring Program and Adaptive Management Plan

To be implemented from commencement of permanent approval

Prepared for
North Byron Parklands

October 2017



DOCUMENT TRACKING

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Template 29/9/2015

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Abbreviations

Abbreviation	Description
EEC	Endangered Ecological Community
EIM	Event Impact Monitoring
FF	Falls Festival
NBP	North Byron Parklands
OEH	NSW Office of Environment and Heritage
PCT	Plant Community Type
SITG	Splendour in the Grass
TEC	Threatened Ecological Community
TSC Act	NSW Threatened Species Conservation Act

1 Introduction

1.1 Project description

1.1.1 Location

North Byron Parklands (Parklands) is located on Tweed Valley Way and Jones Road in the Yelgun Valley within the Byron Shire local government area. The access road leading from the site northwards to Wooyung Road is located within Tweed Shire.

The total Parklands comprises an area of 229.34 ha. Within this, an area of approximately 134 ha will be directly utilised for events, with approximately 95 ha preserved or rehabilitated as natural bushland habitat.

The site forms a natural amphitheatre comprising a low lying and level central plain surrounded by steep rising hillsides on the northern, western and southern sides of the site. The Billinudgel Nature Reserve is immediately south and east of the site.

1.1.2 Overview of the project

The Parklands is currently operating as a cultural events site under short-term state approvals. The current approvals are for a trial period and allow the use of the site for cultural, education and outdoor events, including ancillary camping and car parking, the construction of temporary event infrastructure (completed), a permanent spine road (completed) and vegetation rehabilitation works within the site (underway). Current approval is for a maximum of three events per year, over a combined maximum of 10 event days (plus up to 10 minor community event days).

Billinudgel Property Pty Ltd, as the owners and operators of the site, is seeking to obtain permanent approval to utilise the site as a cultural events centre with a maximum capacity of 50,000 patrons for one large event and a number of smaller events (see below). The increased utilisation of the site will be implemented in multiple phases, with staged increases in maximum event size over several years. The gradual increase in site utilisation will allow any potential impacts to be monitored and appropriate modifications to events to be implemented. The proposed events and staging are:

- Splendour in the Grass event (up to an ultimate 50,000 patrons over a maximum of 5 days), subject to meeting KPIs for the following patron capacity scenarios:
 - o Increase from current 35,000 to 42,500 subject to meeting KPIs
 - o Increase from 42,500 to 50,000 subject to meeting KPIs
- Falls Festival Byron (up to 35,000 patrons & maximum of 5 days)
- Three event days with up to 25,000 patrons (cumulative or separate)
- Five community events with up to 5,000 patrons (cumulative or separate)
- Corresponding bump in and bump out time (up to 21 days in; 14 days out).
- 2 one-day community events up to 1,500 patrons (not-for-profit/educational)

In total, there will be a maximum of 20 event days per annum.

The proposal also incorporates the construction of several new buildings and infrastructure. The proposed buildings include a new conference and associated accommodation, bus shelters and amenities blocks. The proposed infrastructure includes a security fence, water tank, internal roads and site enhancements, potable water supply works, toilet and water treatment facility works and environmental works.

1.2 Previous ecological surveys and monitoring

Numerous surveys have been undertaken within the development site from 2007 to 2017, including nine Event Impact Monitoring (EIM) events and seven other surveys. This includes:

- Performance Report #1 – #4 Appendices B1 Environmental Performance Report and B2 Results and Analyses of Event Impact Monitoring Data (North Byron Parklands 2014a, 2014b, 2015, 2016)
- Preliminary Results: Event Impact Monitoring Falls Festival 2016-17 (Fitzgerald 2017)
- August 2007 Fauna Survey of (Fitzgerald 2007)
- January 2009 Vegetation Assessment and Monitoring (Kooyman 2009)
- February 2009 Fauna Survey of North Byron Parklands (Fitzgerald 2009)
- North Byron Parklands Biennial Fauna Survey (Fitzgerald 2014)
- North Byron Parklands Flora and Fauna Rehabilitation Program (Fitzgerald 2016)
- Yelgun Koala Survey and Koala Plan of Management (Biolink 2007)
- Yelgun Koala Survey Koala Habitat Reassessment (Biolink 2008)
- North Byron Parklands SEPP No. 44 Koala Survey and Habitat Reassessment (Biolink 2013)
- North Byron Parklands SEPP No. 44 Koala Monitoring Report (Biolink 2016)

A summary of all surveys that have been undertaken within the Development Site is provided in the 'Summary of Ecological Surveys and Monitoring Byron Parklands: 2007 – 2017' (Eco Logical Australia 2017b).

The overall survey and monitoring results to date indicate that the cultural events at the North Byron Parklands site and adjacent Billinudgel Nature Reserve have caused only very minor, temporary and reversible impacts on the ecological attributes of this locality, including threatened species, populations and communities. Increased light and noise levels are an inevitable occurrence associated with event, and these factors will impact on local fauna movements and site usage during the period of each event. However comprehensive EIM has shown that once these factors cease to operate and the site returns to pre-event conditions, fauna presence and habitat values return to baseline conditions. Moreover, there are no evidence of declines in any environmental values at the Parklands, indicating no cumulative effects of holding multiple events.

1.3 Purpose of this report

The purpose of this report is to provide a monitoring and adaptive management program that will be implement from the time of permanent approval for activities at the Parklands onwards. This program will continue to monitor the impacts of the program of cultural events and in particular, determine if the proposed increase in patron number and event days is having an impact that is greater than that currently experienced.

It is not anticipated that the ongoing and slightly increased event schedule will alter the severity or duration of current impacts. In order to ensure this is the case, and as a component of an adaptive management strategy, annual monitoring of vegetation and key fauna will be undertaken. This Flora and Fauna Monitoring Program and Adaptive Management Plan was developed in order to monitor and detect any increased impacts, and to provide additional monitoring and/or investigation measures to ameliorate these. This plan has been developed as a part of the NSW environmental approvals process.

A key component of the Flora and Fauna Monitoring Program and Adaptive Manage Plan is the Event Impact Monitoring (EIM). The EIM focuses on key groups of flora and fauna with the intention of identifying any adverse ecological impacts to threatened species and EECs as a result of events within

the site and Billinudgel Nature Reserve. It is proposed that the EIM continue in the long-term with some modifications (detailed below).

1.4 Review of monitoring program

This Flora and Fauna Monitoring and Adaptive Management Plan is designed to be implemented for a period of ten years. After this period, this plan should be reviewed and updated where necessary.

2 Biodiversity values

2.1 Biodiversity values

Numerous reports document the biodiversity values of the site, including the results of monitoring and survey as well as the outcomes of the Framework for Biodiversity Assessment (FBA; Eco Logical Australia 2017a) undertaken to support the application for permanent approval of events. Overall biodiversity values of the site include:

- There are six Plant Community Types (PCTs) present within the Parkland site, along with large areas of pasture (cleared land / exotic pasture grassland)
- Four plant communities listed as Endangered Ecological Communities (EECs) under the TSC Act or Threatened Ecological Communities (TEC) under the EPBC Act are present within and/or immediately surrounding the Parklands
- Habitats present within the development site are generally in moderate to good condition. There are large tracts of vegetation, which are connected to patches of vegetation in the region. Within 1 km of the site there are areas of high ecological value
- Threatened and migratory species are known to occur on site including both Commonwealth and NSW-listed species. Most commonly, these include flora, birds and microbats.

A summary of the threatened ecological communities and threatened/migratory species is provided in Section 2.1.1 – 2.1.2 below. Full details of the results of survey and Event Impact Monitoring are available in Eco Logical Australia (2017b).

2.1.1 Threatened Ecological Communities

Four plant communities listed as Endangered Ecological Communities (EECs) under the TSC Act or Threatened Ecological Communities (TEC) under the EPBC Act are present within and/or immediately surrounding the Parklands. These are described in **Table 1**.

Table 1: EECs and TECs within and/or immediately adjacent to the development area

EEC Name	Area within development site (ha)	Notes
Swamp sclerophyll forest on coastal floodplains of the NSW north coast bioregion	12.28	Represented in Vegetation Zone 5, although a large patch of this EEC exists within the adjacent SEPP14 Wetland / Billinudgel Nature Reserve.
Sub-tropical floodplain forest of the NSW north coast bioregion	3.3	Represented in Vegetation Zone 4 and 6. Patches also exist to the south of the development site.

EEC Name	Area within development site (ha)	Notes
Lowland rainforest of the NSW north coast bioregion	0	This area also meets the definition of Lowland Rainforest of Subtropical Australia Ecological Community, which is listed as critically endangered under the EPBC Act. A small patch (0.75 ha) of Lowland Rainforest occurs to the west of the site though is outside of the project area. This patch of Lowland Rainforest is surrounded by other native vegetation and grassy areas that provide a buffer between the event area and the TEC of ~30 m at its minimum.
Coastal Cypress Pine of the NSW north coast bioregion	0	Outside and immediately adjacent to the development area boundary.

2.1.2 Threatened and migratory species and populations

Flora

There are eight threatened flora species that are known to occur within or adjacent to the Parklands. These include:

- Stinking Cryptocarya (*Cryptocarya foetida*)
- Davidson's Plum (*Davidsonia jerseyana*)
- Rusty Rose Walnut (*Endiandra hayesii*)
- Green-leaved Rose Walnut (*Endiandra muelleri* subsp. *bracteata*)
- Pink Nodding Orchid (*Geodorum densiflorum*)
- Rough-shelled Bush Nut (*Macadamia tetraphylla*)
- Slender Marsdenia (*Marsdenia longiloba*)
- Durobby (*Syzygium moorei*)

Birds

Eight threatened bird species have been recorded during EIM surveys. All are listed as vulnerable on the NSW Threatened Species Conservation Act (TSC Act), with the exception of the Bush Stone Curlew which is listed as endangered. Species include:

- Brown Treecreeper (*Climacteris picumnus victoriae*)
- Bush Stone Curlew (*Burhinus grallarius*)
- Eastern Grass Owl (*Tyto longimembris*)
- Eastern Osprey (*Pandion cristatus*)
- Little Lorikeet (*Glossopsitta pusilla*)
- Rose-crowned Fruit Dove (*Ptilinopus regina*)
- White-eared Monarch (*Carterornis leucotis*)
- Wompoo Fruit Dove (*Ptilinopus magnificus*)

It is noteworthy that several of these records are recent local 'first sightings', which have occurred since the commencement of events at the Parklands. The Brown Treecreeper was first sighted during EIM for Falls Festival 2016-17 and the Bush Stone Curlew was first sighted at SITG 2017. Also, the Eastern Grass Owl was absent from the Parklands from 2007 until recent responses to call playback in July 2016 and 2017.

Microbats

Threatened microbat species have not been specifically targeted during the EIM, rather their presence recorded along with that of all other species. Eight threatened species have been recorded during EIM surveys. All are listed as vulnerable within the NSW TSC Act and one is also listed as vulnerable on the EPBC Act. The species include:

- Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis*)
- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*)
- Eastern Freetail-bat (*Mormopterus norfolkensis*)
- Golden-tipped Bat (*Kerivoula papuensis*)
- Large-eared Pied Bat (*Chalinolobus dwyeri*) – EPBC Act vulnerable species
- Little Bent-wing Bat (*Miniopterus australis*)
- Southern Myotis (*Myotis macropus*)
- Yellow-bellied Sheath-tailed Bat (*Saccolaimus flaviventris*)

Prior to any events, nine species of microbat were captured during harp trapping surveys 2007, 2009, 2014. This included four threatened species (Common Blossom Bat (*Syconycteris australis*), Eastern Long-eared Bat (*Nyctophilus bifax*), Eastern Bent-wing Bat and Little Bent-wing Bat). Both Bent-wing Bats were also regularly detected in EIM surveys, whilst the Common Blossom Bat and Eastern Long-eared Bat were detected only during harp trapping (2007 and 2014).

Koala

Biolink Ecological Consultants have undertaken a number of koala surveys and these are summarised in the review of monitoring data (Eco Logical Australia 2017b). A survey conducted in 2007 by Biolink identified approximately 3 ha of Core Koala Habitat (as defined by SEPP 44). A 12-month Individual Koala Plan of Management (IKPoM) was prepared, which required a reassessment of the habitat to identify any changes, prior to the commencement of development. The reassessment undertaken in 2008 indicated a decline in koala activity with the Core Koala Habitat, to the extent that usage at that time was considered to be "relic and/or transient". No Koala activity was recorded during an additional survey in 2013.

Biolink was again engaged in 2016 to further investigate for evidence of koala activity with the Parklands site. This included 25 km radial searches for koalas at over 26 sites. Opportunistic inspections were also undertaken at the base of preferred koala food trees. The results from the 2016 survey found evidence of koala (scats and scratches) at 7 sites, primarily in the north-west corner of the Parklands and within Billindugel Nature Reserve. Mixed age scats suggest repeat use of sites by koala individuals with home ranges that encompass the north-west corner of the Parklands.

A Koala Plan of Management specific to the Parklands is included in the Biodiversity Assessment Report for the project (ELA 2017).

Migratory species

Migratory species listed under the EPBC Act have not been specifically targeted during the EIM, rather their presence recorded along with that of all other species.

Seven migratory species have been recorded within the project area. These include:

- Black-faced Monarch (*Monarcha melanopsis*)
- Eastern Osprey (*Pandion cristatus*)
- Oriental Cuckoo (*Cuculus optatus*)
- Rufous Fantail (*Rhipidura rufifrons*)
- Satin Flycatcher (*Myiagra cyanoleuca*)
- Spectacled Monarch (*Monarcha trivirgatus*)
- White-throated Needletail (*Hirundapus caudacutus*)

2.1.3 Regenerating ecosystems

Planting of local native forest flora species has been ongoing at the Parklands since 2007. Plantings have taken place within degraded farmland areas across the site and in areas adjacent to Billinudgel Nature Reserve. The total area of replanting is 10.7 ha and has included 22,000 trees. These areas have filling in gaps in vegetation and have joined previously fragmented areas. Plantings now support a range of native fauna.

Forest birds have been specifically surveyed in two established planting locations. Over four surveys, 161 birds across 31 species have been recorded. This includes two threatened species (NSW TSC Act) – Rose-crowned Fruit Dove (1 sighting) and White-eared Monarch (4 sightings) – which were observed in ~9 year old stands of native plantings located south of Jones Road.

2.2 Potential impacts to biodiversity values

This section summarises the predicted impacts of the project and full details are provided in Eco Logical Australia (2017a). The conclusions have been founded in the results of the previous 10-years of survey and monitoring data from the site. In particular, the EIM has been specifically designed and implemented to detect any impacts from running events. The overall survey and monitoring results to date indicate that the events at the Parklands site and adjacent Billinudgel Nature Reserve have caused only very minor, temporary and reversible impacts on the ecological attributes of this locality, including threatened species, populations and communities (Eco Logical Australia 2017b). It is acknowledged that the future proposal will increase both the intensity and duration of events and the impact of this is explicitly considered below.

2.2.1 Direct Impacts relevant to the FBA

Only very minor vegetation clearing / pruning will occur due to the project. This is associated with the widening of an existing track in the north-east of the development site. The clearing area consists of an approx. 1.5m widening (each side) of an existing track for a length of approximately 100m. This results in a clearing area that is approximately 300m² in area and represents an estimated loss of approximately 20 native trees (+/- 10). This clearing area also includes potential pruning of overhanging branches.

There will be no direct impacts to EECs, CEECs or threatened flora. Nor will there be any direct impact to threatened fauna or flora, with exception to an area of exotic grassland, which represents habitat for the Eastern Grass Owl. The Eastern Grass Owl was not recorded in the main event area (north of Jones Rd) in any year; however, the species responded to call playback in July 2016 and July 2017 in the exotic grassland in the south of the parklands. The 2016 observation was the first observation of this species within the site since 2007. Approximately 14.8 ha of potential habitat in the form of exotic grassland will be directly impacted for the construction of the south-eastern carpark.

2.2.2 Indirect Impacts relevant to the FBA

The consistent conclusion across all EIM surveys has been that there are no significant adverse effects on any flora or fauna group as a consequence of events held at the Parklands. Nonetheless, the proposal will result in different impacts to those monitored during the trial period. These predicted indirect impacts are specifically related to:

- The proposed increase in patron numbers
- The increased number of events
- The increased frequency of events
- The maximum number of events days per event, and in aggregate per year
- Use of the conference centre throughout the year
- Minor barrier effects due to the installation of the 1.8m high security fence

With these aspects in mind, the following impacts are identified:

- An increase in the maximum number of patrons from the current scenario (maximum of 35,000 patrons currently to a maximum of 50,000 patrons under the ultimate proposed scenario for SITG) is predicted to result in the following impacts:
 - o The risk of vehicular strike is expected to increase to a small degree during event times due to increased traffic.
 - o The risk of fauna attack by dogs is likely to have a negligible increase during event times.
 - o The risk of fauna entanglement with event infrastructure and trampling is expected to have a negligible increase during event times due to increased foot traffic.
 - o The increases in noise impacts due to the number of patrons is not expected to be significantly different. Additional amplified stages may be established as part of events to cater for additional numbers, which may represent some potential additional noise sources. However, the proposal does not involve any change to existing noise limits, and Parklands will still be required to achieve its approved noise criteria offsite.
 - o Lighting impacts are not expected to increase significantly as the number of powered lights within event areas is determined by event area and not by patron numbers. Nonetheless, if new event areas are established to support additional patrons (e.g. new parking areas), then some additional light impacts may occur. Light spillage is also reduced by use of appropriate technologies.
 - o The risk of vegetation trampling is not expected to be significantly different with increase patron numbers due to effective mitigation measures that are put in place during events. The potential for vegetation trampling is minimised by fencing off areas of native vegetation during events.
 - o Increased numbers of people / vehicle movements on site presents a weed and plant pathogen pathway. However, the site has a long history of disturbance, with over 50 exotic flora species known to occur across the Parklands site and an ongoing program of weed management is in place.
 - o The risk of bushfire is increased during events due to the large numbers of people occupying the site. However, this also poses a significant safety issue for the event patrons and therefore stringent fire management protocols are implemented.
 - o The increases in patron numbers will be staged over several years and will only be increased subject to the meeting of KPIs.

- All else being equal, an increase in the number of events days (excluding community events) from a maximum of 10 (currently) to 13 (proposed) event days per year increases the frequency and duration of all indirect impacts as well as increasing the likelihood of risks (such as vehicle strike and bushfire). Impacts observed during and immediately after events have included limited sediment movement, littering and trampling of grasses within the event area, and avoidance of illuminated areas by mobile fauna. Surveys indicated that these impacts are temporary and reversible at the conclusion of events.
- An increased number of events per year results, on average, in a shorter duration between events and therefore reduced time for recovery from any impacts. Nonetheless, a majority of events will be minor events with much less impact compared to the major events. In addition, there will often be months between events, meaning that will be ample time between events for ecological recovery.
- The maximum number of days per event is proposed to increase from four to five. Any fauna that are dispersed due to indirect impacts are expected to return within timeframes consistent with the current scenario.
- There is a minor risk that the frequency and length of events will tip certain species to leave habitats within the project area; however this risk is considered to be minor given the evidence collected to date, and all events will be monitored against KPIs to identify this kind of potential impact. Such an impact would also be reversible.
- It is proposed that the conference centre and associated accommodation will be used for a range of events such as corporate functions, conferences, celebrations, or health and wellbeing retreats. The conference centre would operate year-round, and cater for up to 180 patrons per day. Accommodation would be provided for up to 60 guests a day in 30 on-site cabins. Impacts are likely to include the following:
 - o Disturbance to species using the dam located adjacent to the conference centre. However, this is expected to be minor and over the longer term habituation may occur.
 - o The level of noise generated at the conference centre is likely to be minimal with most noise generating activities being undertaken within the proposed buildings. Therefore the associated impact to adjacent aquatic and forest habitats likely to be negligible.
 - o Use of the conference centre throughout the year will result in an increase frequency of light impacts, as well an increase in light spillage due to the number of lights at the centre. Light spillage can be managed to reduce spillage into adjacent habitat areas and any light impacts are predicted to be localised and not significant.
- The installation of the 1.8m high palisade security fence will create a potential barrier effect for some wildlife across the site. However, the impact on fauna movement is considered to be negligible as the fence will be designed so that every 5th or 6th panel (approx. 2.5m in length) can be open during non-event times. This is mainly to reduce the barrier effect for macropods and koalas. Furthermore, the fence will be set 100mm off the ground and will also have space between the palisade pales to allow wildlife movement through the fence. This will not hinder movement of small mammals, reptiles, birds or others small wildlife.

3 Monitoring program

3.1 Monitoring objectives

It is predicted that the impacts from the ongoing program of cultural events at the Parklands will be minor and temporary, as evidenced by the results of extensive monitoring undertaken during the trial period. However, to ensure that no unexpected impacts occur as a result of the increased capacity and frequency of events, the following monitoring objectives have been developed:

- The condition of Endangered Ecological Communities and associated threatened species habitat will continue to be enhanced via the on-going program of successful vegetation management and bush regeneration.
- Threatened flora species will continue to be present at the Parklands.
- Events will not prevent the on-going use of the Parkland site by threatened fauna species.

3.2 Target Species/Groups

The target species/groups that will be monitoring include:

- Vegetation and threatened flora condition monitoring – forest blocks and regeneration areas
- Forest birds
- Microchiropteran bat species
- Koala

Based on post-event surveys and baseline monitoring data, it was deemed that the majority of threatened fauna species utilise the site infrequently, sporadically or in low numbers, with the exception of a few species. These species have been identified as having a greater and well-established presence on site, and will therefore be monitored more closely to identify any changes to their populations and their on-going presence on site. A more detailed rationale is provided in **Table 2**. These species include:

- Rose-crowned Fruit Dove
- Little Bent-wing Bat
- Eastern Freetail-bat
- Southern Myotis
- Koala

However, all data recorded will be used to assess for any adverse impacts to site's biodiversity values. Declines in overall measures of diversity (e.g. bird species richness) will also be indicative of any potential adverse impacts to threatened species, including those that use the site sporadically.

Table 2: Summary of fauna surveys 2007 – 2017 and selected targeted species

Group	Summary of results (see Eco Logical Australia 2017b for details and references to full results)	Selected targeted species & other monitoring parameters
Bird species	Across all EIM surveys there were between 73 and 86 species and up to 4023 individuals recorded (sum across all survey transects). Surveys associated with SITG 2016 recorded the highest number of individuals to date. While overall diversity and abundance has fluctuated over time, there is no consistent trend of decline in either parameter. This result suggests the combined program of events since 2013 has not impacted regional forest bird communities over time. Out of the eight threatened species recorded during the EIM surveys, only the Rose-crowned Fruit Dove and the White-eared Monarch have been recorded more than once during surveys; 6 and 4 events out of 8*, respectively. While there is currently insufficient data at an individual level to undertake an analysis of whether these birds are being impacted during individual events, these birds evidentially frequent and/or occupy the site more readily compared to other threatened bird species. All other threatened bird species are considered to be occasional visitors to the site.	• Total bird abundance • Total bird species richness • Rose-crowned Fruit Dove
Frogs	No threatened frogs have been recorded on site.	No target frog species
Reptiles	No threatened reptiles have been recorded on site.	No target reptile species
Mammals (general)	A number of common mammal species have been recorded at the Parklands across all monitoring and survey events, including Northern Brown Bandicoot, Antechinus, Possum and Flying-foxes. Non-native species were also observed. Threatened mammal species observed during these other surveys include Koala and several microbat species. These are discussed below.	• Koala – see below • Microbats – see below
Microchiropteran Bats	Across all EIM surveys there were between 16 and 21 species ¹ and up to 7061 individual calls recorded. The most recent winter surveys (associated with SITG 2016) recorded fewer calls than previous surveys, however, this was attributed to equipment malfunction rather than an ecological effect. Conversely, the most recent summer surveys (associated with FF 2016-17) recorded the highest number of calls to date. While overall diversity and	• Total threatened microbat species richness • Little Bent-wing Bat • Eastern Freetail-bat

¹ Or species groups if calls could not be attributed to only one species, as commonly occurs in microbat call analysis

Group	Summary of results (see Eco Logical Australia 2017b for details and references to full results)	Selected targeted species & other monitoring parameters
	abundance has fluctuated over time, there is no consistent trend of decline in either the number of species recorded or the total number of calls. This result suggests the combined program of events since 2013 has not impacted microbat assemblages over time. There is sufficient data for the two most common species (Little Bent-wing Bat and Southern Myotis) at an individual event level to undertake analysis of whether threatened microbats are impacted during events; these species were recorded at 8 and 7 of the 8 events, respectively. The overall results demonstrate no adverse impact associated with events and are consistent with those from the broader microbat assemblage data (as discussed above). The Eastern Free-tail Bat was also recorded at 7 of 8 events, and while there is insufficient data to assess any impacts to this species during events, this species evidentially has a significant presence on the site when compared to other species. All other threatened microbat species are considered to be occasional visitors to the site.	Southern Myotis
Koala	Targeted Koala surveys of the site were undertaken by Biolink in 2007, 2008, 2013 and 2016. 2007 – small area of core Koala habitat (3 ha) mapped on site; koala scats observed at four locations within the Parklands; results suggest use of the site by 1 – 2 Koalas 2008 – significantly reduce evidence of activity, such that activity level does not reach the threshold that indicates active, ongoing use by resident animals 2013 – no evidence of Koala within the Parklands 2016 – evidence of Koala (scats and scratches) at 7 sites, primarily in the north-west corner of the Parklands and within Billindugel Nature Reserve. Mixed age scats suggest repeat use of sites by Koala individuals with home ranges that encompass the north-west corner of the Parklands EIM – no evidence of Koala within the Parklands or surrounds (based on general observations, not targeted survey)	- Koala occupancy - Koala activity - Consistent with Koala Plan of Management (ELA 2017)

* Results to Falls Festival 2016-17. Data from SITG 2017 not available at the time of preparing this report.

3.3 Program

To reach a maximum capacity of 50,000 patrons (for Splendour in the Grass only), event capacity will increase gradually over two years (refer to **Section 1**). This will allow for monitoring effort to identify any potential impacts to biodiversity. The schedule for monitoring is provided in **Table 3** below². Ongoing monitoring will be geared towards determining that the objectives listed in **Section 3.1** are met. A detailed monitoring methodology is provided in subsequent sections.

Table 3: Schedule of monitoring

Timeframe	Target species/groups	Timing and methodology
Splendour in the Grass (SITG) 'capacity increase' period (from current, to 42,500 then 50,000 patrons)	BACI monitoring of the following elements: - Vegetation and threatened flora condition monitoring – forest blocks and regeneration areas - Forest birds - Threatened microchiropteran bat species	Annual monitoring before, during and after largest event Event increase viable only if no significant new or ongoing impacts detected
First two years of SITG operation at full capacity (50,000 patrons)		Annual monitoring before, during and after largest event Scale back to 2-yearly only if no significant new or ongoing impacts detected
Subsequent and ongoing operation of SITG operation at full capacity (50,000 patrons)		2-yearly monitoring before, during and after largest event
Associated with SITG monitoring	Full floristics of vegetation quadrats in EECs to confirm status and condition (esp. weeds and other edge effects)	Every four years or after any large-scale environmental event e.g. bushfire
Associated with Koala Plan of Management (ELA 2017)	Koala	Every two years per KPOM

3.4 Sites

For continuity of data, monitoring will be undertaken at the existing 'impact' and control sites. The location of vegetation photo fauna monitoring points is identified in **Figure 1**.

² It should be noted that the monitoring program approved under the trial period and associated modifications will continue to operate in its current form until the permanent approval commences.

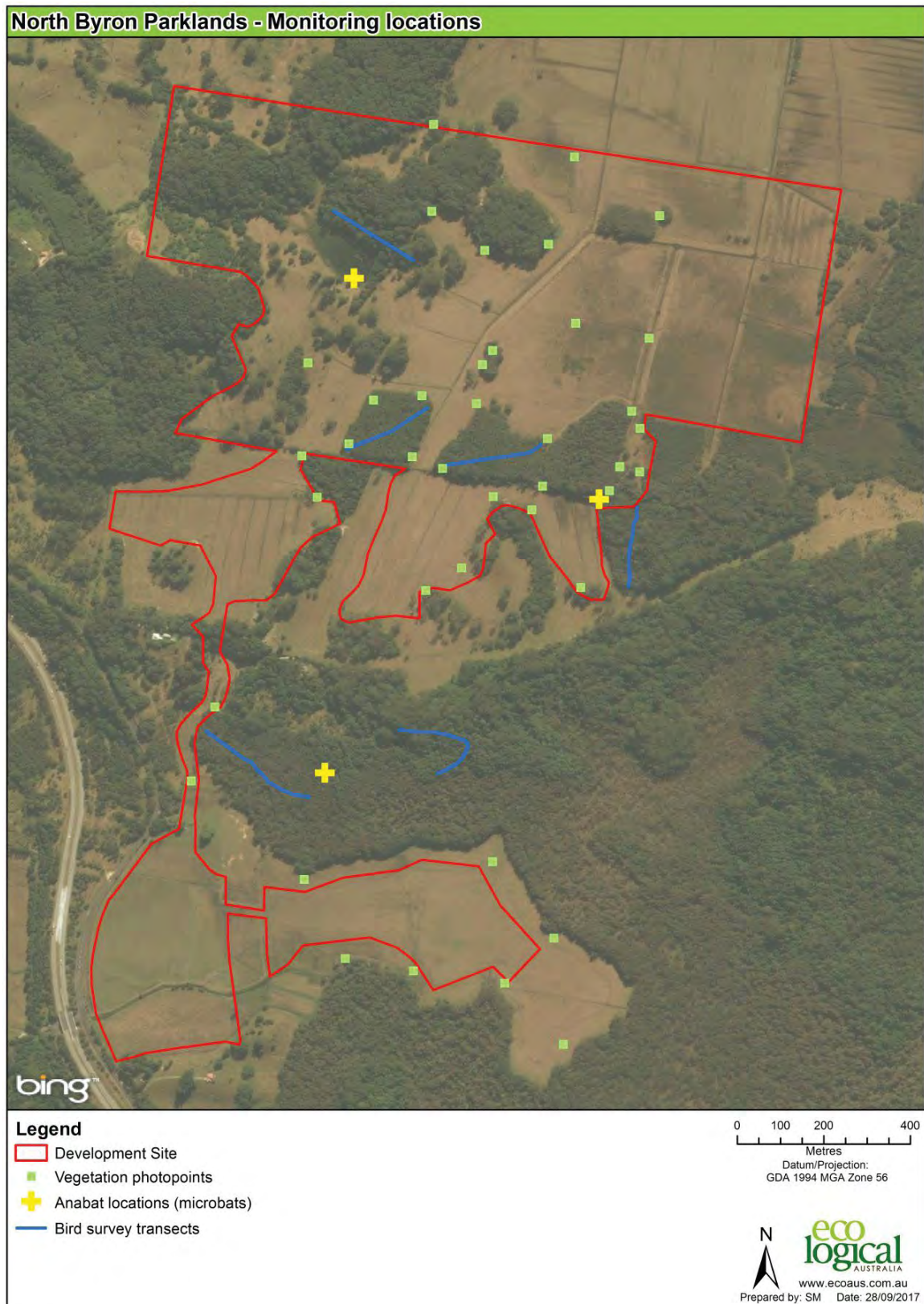


Figure 1: Location of monitoring points

3.5 Method

3.5.1 Summary of EIM survey and monitoring methodology from 2007-2017

Event Impact Monitoring (EIM) monitoring methods used to date were developed and approved as a part of the Flora and Fauna Monitoring Program (2013). These methods were implemented during the nine events that were monitored to date and are summarised in **Table 4**. These methods will be implemented until the current trial approval (incl. modification) terminates (see Fitzgerald 2013a for full details).

Table 4: Summary of EIM survey and monitoring methodology

Target Group	Sampling Methodology to be implemented to end of approved trial period
Vegetation and Flora	Monitoring of 22 permanent vegetation plots (as 20 x 20m quadrats with 10 x10m subplots) to sample the range of native vegetation community types on the site, inclusive of floristic and structural components.
Targeted Flora Sampling	Targeted sampling for threatened flora across the site at known locations whilst undertaking vegetation and fauna surveys. On-going presence and condition to be recorded.
Vegetation	Vegetation condition and changes before and after each event recorded at 27 permanent photo-points across the Parklands.
Forest Birds	Monthly samples (ten x 20 minute / 200m transects) taken before, during and after each event over three consecutive days between December and January, and from June to August. Sampling events are to be undertaken by three experienced observers. Impact sites within the Parklands; control sites within Billinudgel Nature Reserve
Forest Birds – plantings	Birds monitored at two sites in established (~9 year old) native plantings in the Marshall's Ridges area
Waterbirds	20-minute point counts of waterbirds around the 2 ha constructed dam on-site recording species and abundance
Eastern Grass Owl	Targeted survey and call playback each July
Terrestrial Mammals	Ten hair funnels deployed at each of 5 locations at 20 m intervals along a bird transect. The sampling is for four nights before, during and after each event.
Terrestrial Fauna	Two sand traps deployed (within an area of 20 m ²) on three nights before, during and after each event at eight locations along tracks. Traps raked the night before sampling and checked each morning. Two motion sensor wildlife cameras deployed in the Marshall's Ridges area to monitor fauna presence.
Microchiropteran Bats	Three locations sampled by Anabat call detectors. Anabats deployed for three nights before, during and after each event. Two locations are within the event area (dam and flyway) and the third nearby within Billinudgel Nature Reserve.
Flying-foxes	Incidental survey whilst ecologist on site during events
General Fauna	Incidental road kill observations
Koala	Incidental observations during EIM

Note: Minor methodology changes have been made during the life of the project.

3.5.2 Monitoring methods

Extensive monitoring to date has indicated that events at the Parklands caused only very minor, temporary and reversible impacts on the ecological attributes of this locality, including threatened species, populations and communities. Although the size, intensity and duration of events are expected to increase, additional or enhanced adverse impacts to ecological attributes, compared to those already witnessed, are not predicted.

The monitoring methods proposed from the commencement of permanent approval onwards are based on previous monitoring methods to ensure continuity across monitoring years; however, based on the EIM results thus far, the methods have been scaled back, with the primary aim of identifying changes to threatened species populations and EECs in order to trigger further monitoring and management actions where necessary (see **Section 4**). Accordingly, monitoring will focus on target species/groups, as listed in **Section 3.2** and has been focused to address the monitoring objectives detailed in **Section 3.1**.

Table 5: Proposed monitoring methods

Target Group	Monitoring methodology
Vegetation Condition	Photo-point monitoring before and after events consistent with current methodology. Full floristics to be undertaken within EECs every four years, and is to be undertaken as per current methodology.
Forest Birds	In forest areas: Samples before-during-after SITG of ten x 20minute/200m transects undertaken by experienced observers. This is consistent with the current method. In areas of regeneration: As per existing method, forest birds will be monitored at two sites in established (~9 year old) native plantings in the Marshall's Ridges area. Additional sites may be established in new regeneration areas if deemed appropriate. All observations of threatened bird species at the Parklands to be recorded.
Threatened Microchiropteran Bats	As per current method, three locations are sampled by Anabat Call detectors for each event monitored. Two locations are within the event area and the third nearby within Billinudgel Nature Reserve.
Koala	Biennial Koala surveys undertaken consistent with the Koala Plan of Management and contextualised using data from the Byron Coast Comprehensive Koala Plan of Management. Incidental observations of Koala and evidence of use during event based monitoring for birds and microbats (above).

3.6 Data analysis

Previous monitoring effort and data collection was undertaken proceeding, during and following events using the Before-After Control-Impact (BACI) design, to enable evaluation of potential ecological impacts attributable to holding events at the Parklands site. For continuity of data, monitoring will continue the adoption of the BACI design.

Comparison between control and impact sites and through time should be undertaken following each monitoring event. Additionally, trends over time should also be analysed to determine any cumulative declines that are not detectable at a single-event scale.

The following analyses are recommended:

- Analyses for changes in the faunal communities will be made using species richness and abundance data. Summary statistics will be calculated as required to compare to trigger actions (see below).
- For analyses of native vegetation communities, the variables to be analysed will include photo points, species richness and % cover for both native and exotic species.
- Full floristic analyses will be compared to relevant community descriptions (i.e. from Threatened Species Scientific Committee) to determine if the vegetation onsite continues to meet the description of the listed community.
- Comparisons of threatened microbat and bird species before and after events will be made using appropriate statistical analysis (e.g. an ANOVA)
- Comparisons of koala will be undertaken using presence absence records

Results will be assessed against the relative trigger actions outlined in **Table 6**. If data analysis indicates that a trigger has been exceeded (or is likely to be exceeded) an assessment will be made and appropriate responses developed or management measures recommended (see **Section 4.1**).

4 Adaptive management

The monitoring results will be used to assess any adverse impacts to the targeted species/fauna groups (**Section 3.2**) and the associated monitoring objectives (**Section 3.1**). If data analysis indicates a trigger has been exceeded, or is likely to be exceeded, further investigation and risk assessment will be undertaken, and an appropriate response will be prescribed to remediate or prevent further adverse impact (**Table 6**; **Table 7**).

Table 6: Targeted Group/Species Trigger, Action and Response

Targeted Group/Species	Monitoring		Response		Responsibility
	Methods	Purpose	Trigger	Action	
Vegetation	Sites: Those used in previous monitoring (Fitzgerald, 2013a) Incidental sightings of vegetation damage Parameters: Vegetation structure Analysis: Comparison of photos/quadrats between control and impact zones Comparison of photos/quadrats at photo points over time. Frequency: Refer to Table 3.	To monitor any changes in vegetation health and fauna habitat value – including event-related damage to vegetation and increased weed encroachment – from before and after events, and over time. To ensure the enhancement and protection of: - Lowland Rainforest of Subtropical Australia TEC - Swamp sclerophyll forest on coastal floodplains of the NSW north coast bioregion EEC - Sub-tropical floodplain forest of the NSW north coast bioregion EEC - Coastal Cypress Pine of the NSW north coast bioregion EEC - Threatened flora species	Photo analysis comparisons show changes in vegetation structure or show signs of damage from before to after the event (e.g. trampling, litter, etc.). Full floristic monitoring (every four years) shows: - A greater than 10% change in floristic composition (allowing for natural variation due to weather etc.) - A greater than 10% increase in exotic species and/or weed cover in impact quadrats in comparison to control quadrats Incidental sightings of damage to or decline in health of threatened flora species	Undertake investigation to determine the extent and cause of trigger exceedance. This may be done by revegetation team leader and/or an ecologist. The prescribed actions will depend on the extent and nature of the impact. For further details see Table 7 and Table 8.	On-site reveg team leader or ecologist The Parklands Manager

Targeted Group/ Species	Monitoring		Response	
	Methods	Purpose	Trigger	Action
Birds and microbats	Sites: Those used in previous monitoring (Fitzgerald, 2013a). Parameters: Threatened species occurrence Analysis: Comparison of threatened bird and microbat species occurrence between control and impact zones before, during and after events. Comparison of threatened bird and microbat species occurrence over time. With particular focus on: - Rose-crowned Fruit Dove - White-eared Monarch - Little Bent-wing Bat - Eastern Freetail-bat - Southern Myotis Frequency: Refer to Table 3.	To provide baseline data on threatened bird and microbat species before each event To monitor any change to threatened bird and microbat species occurrence during and after events To detect any change to key species and/or assemblages throughout time	Fauna records display a significant decrease in bird or microbat species richness or abundance from before to during and after event. Fauna records display a significant decrease bird or microbat species richness or abundance from between years and/or over time. Target bird or bat species are absent from the site for two consecutive monitoring events. Considerations: - Seasonal conditions - Local patterns of food resource abundance - Climatic variations (dry vs wet) - Seasonal movements - Breeding season	Undertake investigation to determine the extent and cause of trigger exceedance. The prescribed actions will depend on the extent and nature of the impact. For further details see Table 9.
				On-site ecologist The Parklands Manager

Targeted Group/ Species	Monitoring		Response	
	Methods	Purpose	Trigger	Action
Koala	Sites: As per previous monitoring, consistent with the Koala Plan of Management (ELA 2017). Parameters: Koala occurrence Level of koala activity Condition of habitat Analysis: Comparison of Koala occurrence and activity levels over time. Identification of any damage to habitat over time. Frequency: Refer to Table 3.	To monitor any change to the koala population over time, and to investigate whether any adverse changes are a result of events.	Koala presence has been variable over time, but there is evidence of recent activity. If individuals or evidence of presence are not recorded during the biennial koala surveys, further consideration and/or investigation should be undertaken by an experienced ecologist. Evidence of damage to koala habitats should be responded to. Considerations: Koala presence to be assessed in comparison with concurrent surveys of the broader area, as per the Byron Coast Koala Management Plan.	Undertake investigation to determine the extent and cause of trigger exceedance. The prescribed actions will depend on the extent and nature of the impact. For further details see Table 9.
				On-site ecologist The Parklands Manager

4.1 Adaptive management actions

Responses to monitoring results will be required if any of the trigger values in **Table 6** are exceeded. The nature of the response will be scaled according to the extent to which triggers have been exceeded. External factors (e.g. regional population trends, climate variables) will also be considered.

Components of the adaptive management plan are outlined in **Table 7** to **Table 9** below. Adaptive management will be geared towards determining that the objectives listed in **Section 3.1** are met.

Table 7: Adaptive management actions for vegetation communities

Monitored parameter	Extent of trigger exceedance	Action
Changes in vegetation structure, damage, weed invasion	Minor edge effects on vegetation areas e.g. litter, trampling Small-scale weed invasions	Undertake routine vegetation management activities to reduce and remediate impacts
	Vegetation damage e.g. trees damaged, small fire Moderate weed invasions	Review on-site actions to determine if contributing to change. If so, implement appropriate changes to event or site management protocols Prepare and implement rehabilitation plan
	Major vegetation damage e.g. large fire, dieback of vegetation, clearing Extensive weed invasions	Notify OEH Review on-site actions to determine if contributing to change. If so, implement appropriate changes to event or site management protocols Prepare and implement rehabilitation program
Floristics of EECs	Trigger exceeded (>10% change in composition; >10% increase in exotic species) AND community continues to meet definition of EEC	Consider regional drivers of change (e.g. climate) Review on-site actions to determine if the project is contributing to change. If so, implement appropriate changes to event or site management protocols Prepare and implement rehabilitation program
	Trigger exceeded (>10% change in composition; >10% increase in exotic species) AND community no longer meets definition of EEC	Consider regional drivers of change (e.g. climate) Review on-site actions to determine if the project is contributing to change. If so, implement appropriate changes to event or site management protocols Notify OEH Prepare and implement rehabilitation program Consider compensatory measures in discussion with OEH

Table 8: Adaptive management actions for threatened flora species

Monitored parameter	Extent of trigger exceedance	Action
Presence and condition of threatened flora species	One individual of a threatened flora species damaged or health declining Isolated occurrence	Undertake routine vegetation management activities / arboricultural assessment to reduce and remediate impacts
	Several individuals of threatened flora species damaged or health declining Occurring at discrete location within Parklands site	Review on-site actions to determine if contributing to change. If so, implement appropriate changes to event or site management protocols Prepare and implement rehabilitation program. Seek arborist advice if necessary.
	Numerous individuals of threatened flora species damaged or health declining Occurring across the entire Parklands site	Consider regional drivers of change (e.g. climate) Review on-site actions to determine if the project is contributing to change. If so, implement appropriate changes to event or site management protocols Notify OEH Prepare and implement rehabilitation program Seek arborist advice if necessary Consider compensatory measures in discussion with OEH

Table 9: Adaptive management actions for threatened fauna

Monitored parameter	Extent of trigger exceedance	Action
Bird and microbat species richness and abundance	Significant decrease in either richness or abundance after single event compared to before event data	Consider regional drivers of change (e.g. climate, regional population trends) Review on-site actions to determine if the project is contributing to change. If so, implement appropriate changes to event or site management protocols
	Significant decrease in either richness or abundance after single event compared to previous round of monitoring data	Increase frequency of monitoring to include next large event. If trend reversed, no further action. If not, see next row
	Significant decrease in either richness or abundance after two consecutive events compared to before event data Significant decrease in either richness or abundance after two consecutive events compared to previous rounds of monitoring data	Consider regional drivers of change (e.g. climate, regional population trends) Review and address effectiveness of previously implemented changes to protocols Increase frequency of monitoring to include next large event. If trend reversed, no further action. If not, see next row

	Significant decrease in either richness or abundance after multiple consecutive events compared to before event data Significant decrease in either richness or abundance after multiple consecutive events compared to previous rounds of monitoring data	Consider regional drivers of change (e.g. climate, regional population trends) Review and address effectiveness of previously implemented changes to protocols Increase frequency of monitoring to include next large event. If trend reversed, no further action. If not, continue monitoring and commence discussions with OEH. Prepare and implement rehabilitation program Consider compensatory measures in discussion with OEH
Presence of key threatened fauna species: - Rose-crowned Fruit Dove - Little Bent-wing Bat - Eastern Freetail-bat - Southern Myotis	Any of key threatened fauna species are absent from monitoring for two consecutive events	Consider regional drivers of change (e.g. climate, regional population trends) Review on-site actions to determine if the project is contributing to absence. If so, implement appropriate changes to event or site management protocols
	Any of key threatened fauna species are absent from monitoring for three consecutive events Reasons cannot be attributed to regional driver of change	Review on-site actions to determine if contributing to absence. If so, implement appropriate changes to event or site management protocols Increase frequency of monitoring to include next large event. If trend reversed, no further action. If not, see next row
	Any of key threatened fauna species are absent from monitoring for more than three consecutive events Reasons cannot be attributed to regional driver of change	Review and address effectiveness of previously implemented changes to protocols Increase frequency of monitoring to include next large event. If trend reversed, no further action. If not, continue monitoring and commence discussions with OEH Prepare and implement rehabilitation program Consider compensatory measures in discussion with OEH
Presence of koala	Absence of individuals and/or no evidence of activity during monitoring	Consult with local koala experts and Byron Shire Council to understand regional drivers of change Review on-site actions to determine if contributing to absence. If so, implement appropriate changes to event or site management protocols Review appropriateness of monitoring extent and frequency. Update as needed Liaise with OEH as appropriate
Damage to koala habitat	As per Table 7: Changes in vegetation structure, damage, weed invasion	

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Appendix H - Plot and Transect Data

Table 37: Full floristic plot data

Stratum	Form	Species name	Common name	Zone 1			Zone 2			Zone 3			Zone 4			Zone 5			Zone 6			Zone 7			Exotic: No Zone								
				Plot 14		Plot 15		Plot 23		Plot 29		Plot 27		Plot 28		Plot 13		Plot 24		Plot 26		Plot 30		Plot 3		Plot 4		Plot 5		Plot 25		Plot 31	
				C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A
Canopy		<i>Acacia melanoxylon</i>	Blackwood																														
		<i>Araucaria cunninghamii</i>	Hoop Pine									40	4																				
		<i>Casuarina glauca</i>	Swamp Oak																														
		<i>Corymbia intermedia</i>	Pink Bloodwood	<5	6-20	1	1	10	1						60	16	1	1											1	5			
		<i>Eucalyptus acmenoides</i>	White Mahogany		6-20	5	3	30	2																				10	20			
		<i>Eucalyptus grandis</i>	Flooded Gum																		50	4											
		<i>Eucalyptus microcorys</i>	Tallowood		<5				40	3																							
		<i>Eucalyptus pilularis</i>	Blackbutt	51	-			30	4				<5																10	20			
		<i>Eucalyptus propinqua</i>	Small-fruited Grey Gum		<5																												
		<i>Eucalyptus siderophloia</i>	Grey Ironbark		21	-																											
		<i>Eucalyptus tereticornis</i>	Forest Red Gum		50																												
		<i>Lophostemon confertus</i>	Brush Box	6-20			10	3									40	9											15	20			
		<i>Lophostemon suaveolens</i>	Swamp Mahogany																										1	5			
		<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark																														
Mid-storey		<i>Syncarpia glomulifera</i>	Turpentine		6-20		10	8																									
		<i>Acacia disparima</i>	-								40	20	1																				
		<i>Acacia longifolia</i>	Sydney Golden Wattle																														
		<i>Acacia melanoxylon</i>	Blackwood								5	1																					
		<i>Acacia obtusifolia</i>	Blunt Leaf Wattle		1	1	2						1																				
		<i>Acmena smithii</i>	Lilly Pilly																														
		<i>Acronychia imperforata</i>	Logan Apple		<5																												
		<i>Allocasuarina torulosa</i>	Forest Oak										<5																				
		<i>Alyxia ruscifolia</i>	Prickly Alyxia																														
		<i>Araucaria cunninghamii</i>	Hoop Pine																														
		<i>Austromyrtus dulcis</i>	Midgen Berry																														
		<i>Austrosteenisia blackii</i>	Blood Vine																														
		<i>Bursaria spinosa</i>	Blackthorn	<5																													
		<i>Callicarpa pedunculata</i>	Velvet Leaf	1																													

Stratum	Form	Species name	Common name	Zone 1			Zone 2			Zone 3			Zone 4			Zone 5			Zone 6			Zone 7			Exotic: No Zone																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
				Plot 14	Plot 15	Plot 16	Plot 17	Plot 18	Plot 19	Plot 20	Plot 21	Plot 22	Plot 23	Plot 24	Plot 25	Plot 26	Plot 27	Plot 28	Plot 29	Plot 30	Plot 31	Plot 32	Plot 33	Plot 34	Plot 35	Plot 36	Plot 37	Plot 38	Plot 39																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
Mid-storey		<i>Citrus sp.</i>	Citrus	*																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												

Stratum	Form	Species name	Common name	Zone 1				Zone 2				Zone 3				Zone 4				Zone 5				Zone 6				Zone 7				Exotic: No Zone			
				Plot 14		Plot 15		Plot 23		Plot 29		Plot 27		Plot 28		Plot 13		Plot 24		Plot 26		Plot 30		Plot 3		Plot 4		Plot 5		Plot 25		Plot 31			
				C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A	C	A		
Fern		<i>Davallia pyxidata</i>						1	10																										
		<i>Doodia aspera</i>				6-20																													
		<i>Platycerium bifurcatum</i>																																	
		<i>Platycerium superbum</i>																																	
		<i>Pteridium esculentum</i>																																	
		<i>Pyrosia rupestris</i>					2	5																											
		<i>Acacia disparima</i>					1	1																											
		<i>Alchornea ilicifolia</i>																																	
		<i>Alphitonia excelsa</i>			1																														
		<i>Cinnamomum camphora</i>	*		1	1	2	1	1																										
Seedling		<i>Cupaniopsis anacardioides</i>			1	1	1																												
		<i>Elaeocarpus obovatus</i>			1																														
		<i>Ficus coronata</i>																																	
		<i>Ficus obliqua</i>																																	
		<i>Flindersia australis</i>																																	
		<i>Glochidion sumatranum</i>																																	
		<i>Guioa semiglaucula</i>																																	
		<i>Hovea acutifolia</i>		1	1																														
		<i>Jagera pseudorhus</i>			1																														
		<i>Lantana camara</i>	*																																
Ground		<i>Phyllanthus gunnii</i>			<5																														
		<i>Psidium guajava</i>	*										1	2																					
		<i>Psychotria loniceroides</i>			<5																														
		<i>Rubus hillii</i>	-																																
		<i>Senna pendula</i> var. <i>glabrata</i>	*																																
		<i>Solanum stelligerum</i>		1																															
		<i>Syagrus romanzoffiana</i>	*												1	1																			
		<i>Toechima dasyrrhache</i>		1																															
		<i>Wilkiea huegeliana</i>																																	
		<i>Ageratina adenophora</i>	*																																
Forb		<i>Ageratum houstonianum</i>	*																																
		<i>Ageratina riparia</i>	*		1																														
		<i>Alpinia caerulea</i>			1																														
		<i>Bidens pilosa</i>	*																																
		<i>Centella asiatica</i>	*																																
		<i>Commelina salicifolia</i>	*																																
		<i>Crassocephalum crepidioides</i>	*																																
		<i>Cuphea carthagenensis</i>	*																																
		<i>Cymbidium madidum</i>																																	
		<i>Dianella caerulea</i>																																	
	<i>Dioscorea transversa</i>																																		

Table 38: Plot and transect data

Site attribute	Zone 1					Zone 2				Zone 3		Zone 4			Zone 5			Zone 6		Exotic Grassland, No zone
	Plot 14	Plot 15	Plot 23	Plot 29	Plot 13	Plot 24	Plot 26	Plot 28	Plot 27	Plot 30	Plot 3	Plot 30	Plot 3	Plot 3	Plot 3	Plot 4	Plot 5	Plot 25	Plot 31	
Number of native plant species	37	49	29	12	41	25	30	12	9	16		16			25	25	31	18		0
Native over-storey cover (%)	35	35	35.5	48.5	38.5	56.5	51	32	30	40		40			33	31.5	39.5	9.5		0
Native mid-storey cover (%)	58.5	34	32.5	8	28	44	63	1	0	38.5		38.5			34.5	35	32	41.5		0
Exotic over-storey cover (%)	0	0	0	0	0	1	0	10	5	0		0			29.5	2.5	13.5	0		0
Exotic mid-storey cover (%)	7	6.5	2	0	13	0	0	2	50	1		1			10.5	1.5	1.5	3.5		0
Native ground cover (hits/50 points) – Grasses	10	4	0	6	20	0	2	0	5	0		0			14	64	20	0		0
Native ground cover (hits/50 points) – shrubs	0	2	6	2	4	2	6	0	0	0		0			0	0	4	0		0
Native ground cover (hits/50 points) – other	18	54	30	6	24	27	40	0	0	0		0			24	22	14	34		0
Exotic ground cover (%)	1	4.5	4	7.1	6	1	0.5	96	30	34		34			24.5	5	4.5	49		90
Number of trees with hollows	1	2	1	2	1	0	1	0	0	1		1			0	0	0	0		0
Over-storey regeneration	None	None	Lophostem on only (20%)	None	None	None	None	None	None	None		None			Camphor only with 5 percent ground cover	Camphor only 5 percent of ground layer	Camphor with 5 percent ground cover	All overstorey spp (100%)		None
Total length fallen logs > 10cm width (m)	13	48	15	0	51	11	33	33	0	43		43			83	88	82	0		0
Easting (meters, GDA1994)	550794	551039	551296	550978	550657	551026	550617	550789	550535	550780		550780			551532	551531	550974	550750		550956
Northing (meters, GDA1994)	6850940	6850890	6850780	6850530	6850960	6850760	6850870	6850720	6850780	6850410		6850410			6850340	6850820	6850390	6850380		6849220
Zone	56	56	56	56	56	56	56	56	56	56		56			56	56	56	56		56

Appendix I - EEC and TEC Descriptions

Information sheets from OEH and DoE

Coastal Cypress Pine Forest in the NSW North Coast Bioregion

Introduction

These guidelines provide background information to assist landholders to identify remnants of Coastal Cypress Pine Forest in the NSW North Coast Bioregion. For more detailed information refer to the NSW Scientific Committee's Determination for Coastal Cypress Pine in the NSW North Coast Bioregion.



Martin Kendall

Coastal Cypress Pine fruit

What is an Endangered Ecological Community?

An ecological community is a group of plants and animals that occur together in a particular area and includes trees and understorey plants. An Endangered Ecological Community (EEC) is a particular group of plants and animals listed under the *Threatened Species Conservation Act 1995* as being at risk of extinction unless threats affecting these areas are managed and reduced.

What is Coastal Cypress Pine Forest?

Coastal Cypress Pine Forest characteristically has a closed to open canopy of Coastal Cypress Pine (*Callitris columellaris*), which may be mixed with eucalypts, wattles, banksias and/or rainforest trees, and an open to sparse understorey of shrubs, sedges and herbs.

Where is Coastal Cypress Pine Forest found?

Coastal Cypress Pine Forest is typically found on coastal sand plains, north from the Angourie area on the far north coast of NSW. It occurs on the inland side of the coastal sandplain on low backbarrier dunes (Morand 1996). The soils are generally deep, freely draining sandy podsols, loam or clay soils associated with basalt or, less commonly, fine-grained sedimentary rocks and similar substrates. Currently known occurrences of the community are generally within 35 km of the coast and below 100 m elevation. In NSW, Coastal Cypress Pine Forest is currently known from the local government areas of Tweed, Byron, Ballina and Richmond Valley, but may occur elsewhere within the bioregion.



Why is it important?

A number of threatened species have been recorded in Coastal Cypress Pine Forest. These include Scented Acronychia (*Acronychia littoralis*), White Lace Flower (*Archidendron hendersonii*), Pink Nodding Orchid (*Geodorum densiflorum*), Stinking Cryptocarya (*Cryptocarya foetida*), Durobby (*Syzygium moorei*) and Basket Fern (*Drynaria rigidula*).

Only small areas of the original distribution of Coastal Cypress Pine Forest remain. Sand mining, agriculture and coastal development continue to threaten at least half of the remaining community that occurs outside of conservation reserves. Other threats that affect the community include weed invasion, human interference such as trampling, easement maintenance and illegal rubbish dumping. The community is fire sensitive and fire regimes that are either too frequent or not frequent enough threaten Coastal Cypress Pine Forest.



Coastal Cypress Pine foliage

Martin Kendall

How can I tell if I have Coastal Cypress Pine Forest on my property?

The following is a list of key characteristics for use in determining whether Coastal Cypress Pine Forest occurs on your property.

- Is the site north of Angourie within 35 kms of the NSW coast and below 100 m elevation?
- Is the site on the coastal sandplain?
- Does the canopy contain Coastal Cypress Pine?
- Is the vegetation open to closed forest with a sparse understorey?

If you answer yes to the above questions, your site is likely to consist of Coastal Cypress Pine Forest.



Disturbed Coastal Cypress Pine forest

Martin Kendall

Description of the community

The tree layer

Coastal Cypress Pine Forest is dominated by a dense to open canopy of Coastal Cypress Pine (*Callitris columellaris*), sometimes with Pink Bloodwood (*Corymbia intermedia*), Blackbutt (*Eucalyptus pilularis*), Scribbly Gum (*Eucalyptus signata*), Salwood (*Acacia disparrima* subsp. *disparrima*), Black She-oak (*Allocasuarina littoralis*), Coast Banksia (*Banksia integrifolia* subsp. *integrifolia*) or Old-man Banksia (*Banksia serrata*).

The shrub layer

The typically sparse layer of shrubs may include Prickly Moses (*Acacia ulicifolia*), Pink Beard-heath (*Leucopogon ericoides*), *Leucopogon leptospermoides*, Tree broom-heath (*Monotoca elliptica*) and juveniles of the canopy species.

The ground layer

The typically sparse groundcover comprises scattered graminoids (grasses and similar), including Three-awn Speargrass (*Aristida vagans*), Brown's Lovegrass (*Eragrostis brownii*), Blady Grass (*Imperata cylindrica* var. *major*), *Paspalidium distans*, Plume Rush (*Baloskion tetraphyllum* subsp. *meiostachyum*) and Spiny-headed Mat-rush (*Lomandra longifolia*), and herbs including Blue Flax Lily (*Dianella caerulea*) and *Pomax umbellata*.

Characteristic species

A list of canopy trees and understorey plants that characterise Coastal Cypress Pine Forest is provided below. Not all the species listed need to occur at any one site for it to be considered Coastal Cypress Pine Forest, and additional species not included in the list may occur.

Species List

Coastal Cypress Pine Forest is characterised by the species listed below. The species present at any site will be influenced by the size of the site, recent rainfall or drought conditions and by its disturbance history. Note that not ALL the species listed below need to be present at any one site for it to constitute Coastal Cypress Pine Forest.

Scientific Name	Common Name	Scientific Name	Common Name
Trees		<i>Notelaea longifolia</i>	Large Mock-olive
<i>Araucaria cunninghamii</i>	Hoop Pine	<i>Oxylobium robustum</i>	Tree Shaggy Pea
<i>Callitris columellaris</i>	Coastal Cypress Pine	<i>Persoonia stradbokensis</i>	Geebung
<i>Corymbia intermedia</i>	Pink Bloodwood	<i>Zieria smithii</i>	Sandfly Zieria
<i>Eucalyptus pilularis</i>	Blackbutt	Graminoids (grasses and similar)	
<i>Eucalyptus resinifera</i> subsp. <i>resinifera</i>	Red Mahogany	<i>Abildgaardia vaginata</i>	
<i>Eucalyptus signata</i>	Scribbly Gum	<i>Aristida</i> spp.	Wiregrass
<i>Euroschinus falcatus</i> var. <i>falcatus</i>	Ribbonwood	<i>Baloskion tetraphyllum</i> subsp. <i>meiostachyum</i>	Plume Rush
<i>Halfordia kendack</i>	Saffron Heart	<i>Bulbostylis barbata</i>	
Shrubs & Small Trees		<i>Cymbopogon refractus</i>	Barbed Wire Grass
<i>Acacia disparrima</i> subsp. <i>disparrima</i>	Salwood	<i>Cyperus stradbokensis</i>	
<i>Acacia ulicifolia</i>	Prickly Moses	<i>Dianella caerulea</i>	Blue Flax-lily
<i>Acronychia imperforata</i>	Logan Apple	<i>Eragrostis brownii</i>	Brown's Lovegrass
<i>Acrotriche aggregata</i>	Red Cluster Heath	<i>Imperata cylindrica</i> var. <i>major</i>	Blady Grass
<i>Allocasuarina littoralis</i>	Black She-oak	<i>Lomandra longifolia</i>	Spiny-headed Mat-rush
<i>Alyxia ruscifolia</i>	Prickly Alyxia	<i>Paspalidium distans</i>	
<i>Astroloma humifusum</i>	Native Cranberry	Herbs & Ferns	
<i>Austromyrtus dulcis</i>	Midgen Berry	<i>Acianthus caudatus</i>	Mayfly Orchid
<i>Banksia integrifolia</i> subsp. <i>integrifolia</i>	Coast Banksia	<i>Acianthus exsertus</i>	Mosquito Orchid
<i>Banksia serrata</i>	Old-man Banksia	<i>Chiloglottis</i> spp.	Orchid
<i>Cyclophyllum longipetalum</i>	Coast Canthium	<i>Commelina cyanea</i>	Native Wandering Jew
<i>Leptospermum polygalifolium</i> subsp. <i>polygalifolium</i>	Tantoon	<i>Platycerium bifurcatum</i>	Elkhorn
<i>Leucopogon ericoides</i>	Pink Beard-heath	<i>Pomax umbellata</i>	
<i>Leucopogon leptospermoides</i>		<i>Pteridium esculentum</i>	Common Bracken
<i>Leucopogon margarodes</i>		<i>Pterostylis nutans</i>	Nodding Greenhood
<i>Monotoca elliptica</i>	Tree Broom-heath	<i>Pterostylis pedunculata</i>	Maroonhood
		<i>Hoya australis</i>	Natve Hoya

Variation in the community

The community may have a distinctive litter layer with patches of compressed Coastal Cypress Pine branchlets. Undisturbed stands of the community may have a woodland or forest structure, with Coastal Cypress Pine dominating the canopy, although larger trees, such as eucalypts may be emergent. Stands of the community that have been partially cleared in the past may be reduced to scattered trees. Fires may also influence the structure of the community, as the dominant tree species, Coastal Cypress Pine, is generally killed when burnt. Post-fire regeneration of the community may therefore create a shrubland or heathland.



Disturbed forest with Asparagus Fern ground layer

Martin Kendall

What does this mean for my property?

As a listed EEC under the *Threatened Species Conservation Act 1995*, Coastal Cypress Pine Forest has significant conservation value and some activities will require consent or approval. In addition, the community can contain threatened species. Please contact the Department of Environment and Climate Change for further information.

Determining the conservation value of remnants

The degree of disturbance (i.e. condition) of many remnants can vary, from almost pristine to highly modified. It is important to note that even small patches that have been disturbed in the past by clearing, or fire are still considered to be important remnants of Coastal Cypress Pine Forest and meet the criteria of being an EEC. Where difficulties arise when faced with decisions on whether particular sites are Coastal Cypress Pine Forest, expert advice may be needed.

Retaining mature native vegetation or EECs for conservation purposes may attract incentive funding. Funding is allocated to landholders by the local Catchment Management Authority (CMA) according to the priorities set out in their Catchment Action Plan and strategies. For more information contact your local CMA or email: info@nativevegetation.nsw.gov.au

For further assistance

This and other EEC guidelines are available on the DECC website at www.environment.nsw.gov.au

The references listed below also provide further information on EECs.

- Botanic Gardens Trust plant identification assistance: http://www.rbgsyd.nsw.gov.au/plant_info/identifying_plants/plant_identification_service
- Department of Environment and Climate Change (NSW) Threatened Species profiles: <http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/index.aspx>
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- Moreland, DT 1996, *Soil Landscapes of the Murwillumbah – Tweed Heads 1:100,000 sheet*, Department of Land and Water Conservation Sydney.
- NSW Scientific Committee Determinations: <http://www.environment.nsw.gov.au/committee/finaldeterminations.htm>
- Thackway, R & Cresswell, ID (Eds) 1995, *An Interim Biogeographic Regionalisation for Australia: a framework for establishing the national system of reserves, Version 4.0*, Australian Nature Conservation Agency, Canberra.



Regrowth Coastal Cypress Pine forest



Mature Coastal Cypress Pine forest

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Sub-tropical Coastal Floodplain Forest

Introduction

These guidelines provide background information to assist landholders to identify remnants of Sub-tropical Coastal Floodplain Forest. For more detailed information, refer to the NSW Scientific Committee's Determination Advice at <http://www.nationalparks.nsw.gov.au/npws.nsf/Content/Final+determinations>

What is an Endangered Ecological Community?

An ecological community is a group of trees, shrubs and understorey plants that occur together in a particular area. An Endangered Ecological Community is an ecological community listed under the *Threatened Species Conservation Act 1995* as being at risk of extinction unless threats affecting these areas are managed and reduced.

What is Sub-tropical Coastal Floodplain Forest?

Sub-tropical Coastal Floodplain Forest is a tall mixed forest occurring on coastal floodplains on the north coast of NSW. The most widespread and abundant dominant trees include Forest Red Gum (*Eucalyptus tereticornis*), Grey Ironbark

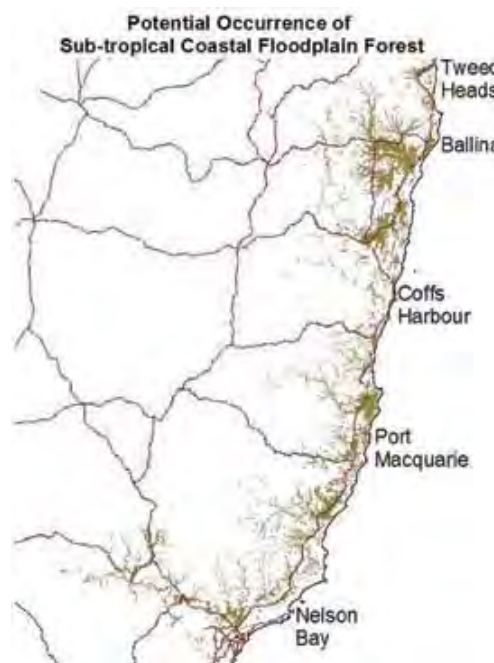
(*E. siderophloia*), Pink Bloodwood (*Corymbia intermedia*) and, north of the Macleay floodplain, Swamp Turpentine (*Lophostemon suaveolens*). A layer of small trees may be present, including Forest Oak (*Allocasuarina torulosa*) and a range of rainforest species such as Red Ash (*Alphitonia excelsa*) and Cheese Tree (*Glochidion ferdinandii*). Scattered shrubs and occasional vines may also be present. The groundcover is composed of abundant herbs, scramblers and grasses.

Where is Sub-tropical Coastal Floodplain Forest found?

Sub-tropical Coastal Floodplain Forest occurs north from Port Stephens. It has been recorded from all coastal and near-coastal local government areas.

Why is it important?

Only a small area (less than 30%) of the original distribution of Sub-tropical Coastal Floodplain Forest remains, and these areas are often highly fragmented and threatened by clearing for cropping and pasture, timber harvesting, drainage works, pollution from urban runoff and weed invasion.



What is the Coastal Floodplain?

Floodplains are level landform patterns on which there may be active erosion and deposition by flooding where the average interval is 100 years or less.

Coastal floodplains include coastal river valleys, alluvial flats and drainage lines below the escarpment of the Great Dividing Range. While most floodplains are below 20m in elevation, some may occur on localised river flats up to 250m elevation. Compared with the surrounding landscape, floodplains are generally quite flat. However, there may be local variation associated with river channels, local depressions, natural levees and river terraces. The latter are areas that rarely flood anymore due to deepening or widening of streams.



Description of the community

The tree layer

The tree layer of Sub-tropical Coastal Floodplain Forest varies considerably, however, the most widespread and abundant dominant trees include Forest Red Gum, Grey Ironbark, Pink Bloodwood and, north of the Macleay floodplain, Swamp Turpentine.

Other less common trees may also be present, particularly where soil type is influenced from rocks upslope. These include Grey Box (*Eucalyptus moluccana*), Grey Gum (*E. propinqua*), Narrow-leaved Red Gum (*E. seeana*), Broad-leaved Apple (*Angophora subvelutina*), Swamp Mahogany (*E. robusta*), Red Mahogany (*E. resinifera* subsp. *hemilampra*), White mahogany (*E. acmenoides*), *Angophora woodsiana*, *A. paludosa* and rainforest trees such as Figs (*Ficus* spp.) and Tuckeroos (*Cupaniopsis* spp.). A number of other Eucalypt species may also occasionally occur.

The shrub layer

A layer of small trees may be present, including Forest Oak, Red Ash, Cheese Tree, Bottlebrushes (*Callistemon* spp.), Paperbarks (*Melaleuca* spp.) and Swamp Oak (*Casuarina glauca*).

Scattered shrubs include Coffee Bush (*Breynia*

oblongifolia), Curracabah (*Acacia concurrens*), (*Commersonia* spp.), and Native Hibiscus (*Hibiscus* spp.). Vines such as Wombat Berry (*Eustrephus latifolius*), Scrambling Lily (*Geitonoplesium cymosum*) and Common Silkpod (*Parsonsia straminea*) may occur occasionally.

The ground layer

The ground layer is made up of herbs, scramblers and grasses. These include Blady Grass (*Imperata cylindrica*), Kangaroo Grass (*Themeda australis*), Blue Flax Lily (*Dianella caerulea*), Whiteroot (*Pratia purpurascens*), Forest Fern (*Cheilanthes sieberi* subsp. *sieberi*), and Kidney Weed (*Dichondra repens*). The composition and structure of the ground layer is influenced by disturbances such as grazing and fire history, and may have a substantial component of weed species.



Forest Red Gum



Pink Bloodwood



Swamp Turpentine

John Turbill

Characteristic species

A list of canopy trees and understorey plants that characterise a patch of Sub-tropical Coastal Floodplain Forest is provided in the Table below. Not all the species listed need to occur at any one site for it to be considered Sub-tropical Coastal Floodplain Forest. Conversely, other species not listed may also form part of this community.

Variation in the community

At heavily disturbed sites only some of the species which characterise the community may be present. In addition, above ground plants of some species may not be present, but may be represented below ground in the soil seed banks or as bulbs, corms, rhizomes or rootstocks.

What does this mean for my property?

As a listed Endangered Ecological Community under the *Threatened Species Conservation Act 1995*, Sub-tropical Coastal Floodplain Forest has significant conservation value and some activities may require consent or approval. Please contact the Department of Environment and Conservation for further information.

How can I identify an area of Sub-tropical Coastal Floodplain Forest?

The following is a list of key characteristics to help identify an area of Sub-tropical Coastal Floodplain Forest:

- Is the site north of Port Stephens?
- Is the site on the coastal floodplain (see "What is the Coastal Floodplain" on previous page)?
- Is the tree layer made up of mixed eucalypts?
- Does the tree layer contain any of the following: Forest Red Gum, Grey Ironbark, Pink Bloodwood or, north of the Macleay floodplain, Swamp Turpentine?
- Are rainforest trees or shrubs scattered throughout?
- Are there relatively low numbers of *Casuarina* species, *Melaleuca* species and Swamp Mahogany?

If you answered yes to the above questions, the area is likely to be Sub-tropical Coastal Floodplain Forest.

Species List

Sub-tropical Coastal Floodplain Forest is characterised by the species listed in the table below. The species present at any site will be influenced by the size of the site, recent rainfall or drought conditions and by its disturbance (including fire and logging) history. Note that **NOT ALL** the species listed below need to be present at any one site for it to constitute Sub-tropical Coastal Floodplain Forest.

Scientific Name	Common Name	Scientific Name	Common Name
Trees		Grasses	
<i>Angophora paludosa</i>		<i>Aristida vagans</i>	Threeawn Speargrass
<i>Angophora subvelutina</i>	Broad-leaved Apple	<i>Cymbopogon refractus</i>	Barbed Wire Grass
<i>Angophora woodsiana</i>		<i>Dichelachne micrantha</i>	Shorthair Plumegrass
<i>Allocasuarina torulosa</i>	Forest Oak	<i>Digitaria parviflora</i>	Small-flowered Finger Grass
<i>Alphitonia excelsa</i>	Red Ash	<i>Echinopogon caespitosus</i>	Hedgehog Grass
<i>Brachychiton populneus</i>	Kurrajong	<i>Entolasia marginata</i>	Bordered Panic
<i>Callitris columellaris</i>	A native Cypress Pine	<i>Entolasia stricta</i>	Wiry Panic
<i>Casuarina cunninghamiana</i>	River Oak	<i>Eragrostis leptostachya</i>	Paddock Lovegrass
<i>Casuarina glauca</i>	Swamp Oak	<i>Imperata cylindrica</i> var. <i>major</i>	Blady Grass
<i>Corymbia intermedia</i>	Pink Bloodwood	<i>Microlaena stipoides</i>	-
<i>Drypetes australasica</i>	Yellow Tulipwood	<i>Panicum simile</i>	Two Colour Panic
<i>Glochidion ferdinandii</i>	Cheese Tree	<i>Themeda australis</i>	Kangaroo Grass
<i>Elaeocarpus reticulatus</i>	Blueberry Ash	Herbs and Ferns	
<i>Eucalyptus acmenoides</i>	White Mahogany	<i>Brunoniella australis</i>	Blue Trumpet
<i>Eucalyptus amplifolia</i>	Cabbage Gum	<i>Centella asiatica</i>	Pennywort
<i>Eucalyptus moluccana</i>	Grey Box	<i>Cheilanthes sieberi</i>	Forest Fern
<i>Eucalyptus propinqua</i>	Grey Gum	<i>Cymbidium suave</i>	Snake Orchid
<i>Eucalyptus resinifera</i>	Red Mahogany	<i>Commelina cyanea</i>	Native Wandering Jew
<i>Eucalyptus robusta</i>	Swamp Mahogany	<i>Cyperus enervis</i>	
<i>Eucalyptus seeana</i>	Narrow-leaved Red Gum	<i>Dianella caerulea</i>	Blue Flax Lily
<i>Eucalyptus siderophloia</i>	Small-fruited Grey Gum	<i>Dianella longifolia</i>	A flax lily
<i>Eucalyptus tereticornis</i>	Forest Red Gum	<i>Dichondra repens</i>	Kidney Weed
<i>Ficus macrophylla</i>	Moreton Bay Fig	<i>Gahnia aspera</i>	
<i>Ficus obliqua</i>	Small-leaved Fig	<i>Gahnia clarkei</i>	
<i>Ficus superba</i> var. <i>henneana</i>	Deciduous Fig	<i>Lomandra filiformis</i>	A mat rush
<i>Lophostemon suaveolens</i>	Swamp Box	<i>Lomandra longifolia</i>	Spiny-headed Mat Rush
<i>Mallotus philippensis</i>	Red Kamala	<i>Lomandra multiflora</i>	A mat rush
<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark	<i>Oplismenus aemulus</i>	
Small trees/shrubs		<i>Oplismenus imbecillis</i>	
<i>Acacia concurrens</i>	Currahbah	<i>Pratia purpurascens</i>	Whiteroot
<i>Acacia disparrima</i>		<i>Pteridium esculentum</i>	Bracken Fern
<i>Breynia oblongifolia</i>	Coffee Bush	<i>Vernonia cinerea</i>	
<i>Callistemon salignus</i>	White Bottlebrush	<i>Viola hederacea</i>	Native Violet
<i>Callistemon viminalis</i>	Weeping Bottlebrush	<i>Lagenifera stipitata</i>	
<i>Commersonia bartramia</i>	Brown Kurrajong	<i>Laxmannia gracilis</i>	
<i>Commersonia fraseri</i>	Brush Kurrajong	<i>Phyllanthus virgatus</i>	
<i>Cordyline congesta</i>	Tooth-leaved Palm Lily	<i>Sigesbeckia orientalis</i>	
<i>Cupaniopsis anacardioides</i>	Tuckeroo	<i>Tricoryne elatior</i>	
<i>Cupaniopsis parviflora</i>	Small-leaved Tuckeroo	Vines	
<i>Hibiscus diversifolius</i>	Swamp Hibiscus	<i>Cissus hypoglauca</i>	Water Vine
<i>Hibiscus tiliaceus</i>	Cottonwood Hibiscus	<i>Desmodium rhytidophyllum</i>	
<i>Hovea acutifolia</i>	A native pea	<i>Desmodium varians</i>	Slender Tick-trefoil
<i>Melaleuca alternifolia</i>	A tea tree	<i>Eustrephus latifolius</i>	Wombat Berry
<i>Melaleuca decora</i>	A tea tree	<i>Geitonoplesium cymosum</i>	Scrambling Lily
<i>Melaleuca nodosa</i>	A tea tree	<i>Glycine clandestina</i>	
<i>Melaleuca styphelioides</i>	Prickly-leaved Tea Tree	<i>Hardenbergia violacea</i>	False Sarsparilla
<i>Notelaea longifolia</i>	Native Olive	<i>Hibbertia scandens</i>	Climbing Guinea Flower
<i>Persoonia stradbrokeensis</i>	A Geebung	<i>Kennedia rubicunda</i>	Red Kennedy Pea
<i>Pimelea linifolia</i>	Rice Flower	<i>Machura cochinchinensis</i>	Cockspur Thorn
<i>Pittosporum revolutum</i>	Hairy Pittosporum	<i>Morinda jasminoides</i>	Morinda Vine
<i>Wikstroemia indica</i>		<i>Parsonsia straminea</i>	Common Silkpod
		<i>Smilax australis</i>	Native Sarsparilla
		<i>Smilax glyciphylla</i>	Sweet Sarsparilla
		<i>Stephania japonica</i>	Snake Vine

Determining the conservation value of remnants

The degree of disturbance (i.e. condition) of many remnants can vary, from almost pristine to highly modified. It is important to note that even small patches or areas that have been disturbed in the past by activities such as selective logging, fire or grazing may still be important remnants of Sub-tropical Coastal Floodplain Forest and be considered the EEC. Where difficulties arise when faced with decisions on whether particular sites are Sub-tropical Coastal Floodplain Forest, expert advice may be needed.

Retaining mature native vegetation or EECs for conservation purposes may attract incentive funding. Funding is allocated to landholders by the local Catchment Management Authority (CMA) according to the priorities set out in their Catchment Action Plan and strategies. For more information contact your local CMA or email: info@nativevegetation.nsw.gov.au

For further assistance

This and other EEC guidelines are available on the DECC website: at www.environment.nsw.gov.au

The references listed below also provide further information on EECs.

- NSW Scientific Committee Determinations: <http://www.nationalparks.nsw.gov.au/npws.nsf/Content/Final+determinations>
- Department of Environment and Climate Change (NSW) Threatened Species profiles: <http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/index.aspx>
- Botanic Gardens Trust plant identification assistance: http://www.rbgsyd.nsw.gov.au/information_about_plants/botanical_info/plant_identification
- Brooker, M. and Kleinig, D. (1990) Field Guide to Eucalypts of South-eastern Australia, Vol 2. Inkata, Melbourne.
- Harden, G. (ed) Flora of NSW Vols 1 – 4 (1990-2002). NSW University Press.
- Harden, G., McDonald, W. and Williams, J. (2006) Rainforest Trees and Shrubs – A Field Guide to their identification. Gwen Harden Publishing, Nambucca Heads.



John Turbill

Examples of Sub-tropical Coastal Floodplain Forest Endangered Ecological Community at Urunga Lagoon

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Swamp Sclerophyll Forest on Coastal Floodplains

Introduction

These guidelines provide background information to assist land managers and approval authorities to identify remnants of Swamp Sclerophyll Forest on Coastal Floodplains (hereafter referred to as Swamp Sclerophyll Forest), an Endangered Ecological Community (EEC). For more detailed information refer to the Swamp Sclerophyll Forest Profile and the NSW Scientific Committee Final Determination at:

threatenedspecies.environment.nsw.gov.au

What is an Endangered Ecological Community?

An ecological community is an assemblage of species which can include flora, fauna and other living organisms that occur together in a particular area. They are generally recognised by the trees, shrubs and groundcover plants that live there. An Endangered Ecological Community is an ecological community listed as facing a very high risk of extinction in NSW under the *Threatened Species Conservation Act 1995*.

What is Swamp Sclerophyll Forest?

Swamp Sclerophyll Forest is a community that generally has several layers of vegetation, including trees, shrubs, groundcovers and wetland plants such as reeds and sedges. It is a community of plants that are generally found close to standing water on soils that are either waterlogged or subject to periodic flooding or inundation. It is usually an open to closed forest with a shrubby or reedy/ferny understorey, although in some areas the tree layer is low and



Lucas McKinnon

Paperbark Forest on the NSW North Coast, a component of Swamp Sclerophyll Forest

dense and the community takes on the structure of scrub. A particular site may only include some of these vegetation structures such as the reedland or a paperbark forest but should still be considered as the community. See 'Identifying Swamp Sclerophyll Forest' below for further assistance.

The Scientific Committee's final determination of the Swamp Sclerophyll Forest does not delineate between higher and lower quality remnants of this community. It specifically notes that partial clearing and disturbance, in some instances, may have reduced this community's canopy to scattered trees and this disturbed type is still considered part of the EEC. Relatively few examples of this community would be unaffected by weedy taxa, including noxious species, such as those listed in a variety of key threatening processes (e.g. Lantana, introduced perennial grasses and exotic vines / creepers).



Clearing on the edge of Swamp Sclerophyll Forest. This introduces the community to edge effects such as weed invasion.



Lucas McKinnon

An area of Swamp Sclerophyll Forest cleared for grazing with scattered paddock trees.



Natural Heritage Trust

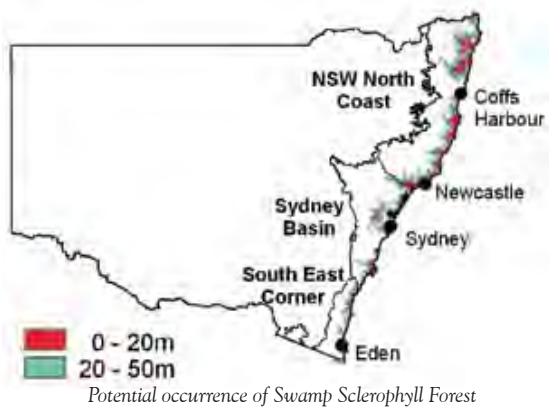
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Department of Environment & Climate Change NSW



Where is Swamp Sclerophyll Forest found?

Swamp Sclerophyll Forest is associated with humic clay and sandy loam soils on waterlogged or periodically flooded areas. These soils are generally deposited during flood events and occur on the flats, drainage lines and river terraces of the Coastal Floodplain. The community is usually found below 20m in elevation although sometimes up to 50 m elevation on small floodplains or where the larger floodplains adjoin lithic (rocky) substrates or coastal sand plains. It is found in the NSW North Coast, Sydney Basin and South East Corner bioregions (see map).



Description of the community

Characteristic species

A list of trees, shrubs and ground cover species that characterise Swamp Sclerophyll Forest have been identified by the NSW Scientific Committee (see table).

The tree layer

The most common trees in Swamp Sclerophyll Forest include Swamp Mahogany (*Eucalyptus robusta*), Broad-leaved paperbark (*Melaleuca quinquenervia*) and, south from Sydney, Bangalay (*Eucalyptus botryoides*) and Woollybutt (*Eucalyptus longifolia*). Other trees occur less frequently or may be locally common at some sites, including Sweet Willow Bottlebrush (*Callistemon salignus*), Swamp Oak (*Casuarina glauca*), Red

Mahogany (*Eucalyptus resinifera* subsp. *hemilampra*), Cabbage Tree Palm (*Livistona australis*) and Swamp Turpentine (*Lophostemon suaveolens*). The density of tree species (i.e. the number of any particular species at any one site), is not a critical factor in determining the presence or absence of this community as this will vary depending on site history.

Shrubs and Groundlayer plants

The understorey of this community is characterised by a layer of shrubs including tea-trees, paperbarks and wattles, and the groundcover may consist of ferns, grass, sedges and reeds. Most commonly a site will have a combination of these plant types. See table for typical species of the understorey.

How can I identify areas of Swamp Sclerophyll Forest?

The following are 'Key Indicators' to look for when identifying Swamp Sclerophyll Forest:

1. Is the site on the coastal floodplain of the NSW North Coast, Sydney Basin or South East Corner bioregion (see map)?
2. Is the site associated with humic clay or sandy loams soils (refer to soil maps)?
3. Is the site subject to waterlogging and/or below the highest flood level (check with Local Government or Catchment Management Authority to determine highest flood mark)?
4. Are any of the tree species present at the site listed as characteristic of Swamp Sclerophyll Forest in the table (check with local botanist, consult reference books or see plantnet.rbgsyd.nsw.gov.au)?
5. Are any of the shrub and/or groundlayer species listed as characteristic in the table present?

If you answered yes to the above questions your site is likely to be Swamp Sclerophyll Forest.

EECs that may adjoin or intergrade with Swamp Sclerophyll Forest

This community occurs with, would have previously occurred with or closely resembles other coastal floodplain vegetation types which are also listed as EECs. Collectively, these EECs cover all remaining native vegetation on the coastal floodplains of NSW. These EECs are:

1. Swamp Oak Floodplain Forest where there is increasing estuarine influence;
2. River-Flat Eucalypt Forest and Sub-tropical Coastal Floodplain Forest (north of Port Stephens) where soils become less waterlogged;
3. Freshwater Wetlands on Coastal Floodplains where they adjoin more permanent standing water;
4. Coastal Saltmarsh; and
5. Bangalay Sand Forest closer to coastal sand dunes.

What is the Coastal Floodplain?

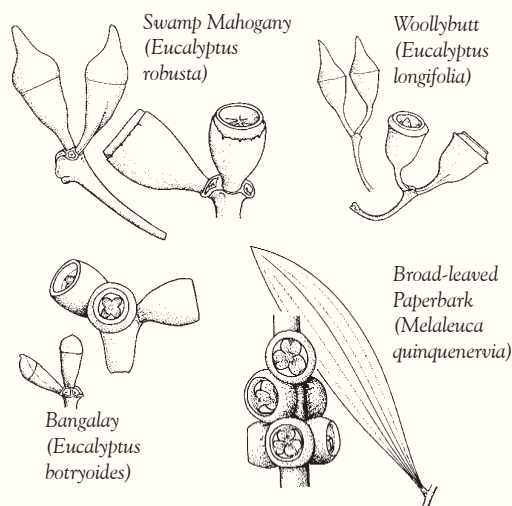
Floodplains are level landform patterns on which there may be active erosion and deposition of sediment by flooding where the average interval is 100 years or less. Coastal floodplains include coastal river valleys, alluvial flats and drainage lines below the escarpment of the Great Dividing Range. While most floodplains are below 20m in elevation, some may occur on localised river flats up to 250m elevation. However, there may be local variation associated with river channels, local depressions, natural levees and river terraces. The latter are areas that rarely flood anymore due to the deepening or widening of streams.

Characteristic Species List

Swamp Sclerophyll Forest is characterised by the species listed below. The species present at any site will be influenced by the size of the site, recent rainfall or drought conditions and by its disturbance (including fire and logging) history. Note that NOT ALL the species listed below need to be present at any one site for it to constitute Swamp Sclerophyll Forest.

+ = Key indicator species; N = North of;
S = South of; B-Bay = Batemans Bay;
Gos = Gosford; Illa = Illawarra; J-Bay = Jervis
Bay; Sho = Shoalhaven; Syd = Sydney;
Ulla = Ulladulla

For further help with identification see:
plantnet.rbg Syd.nsw.gov.au/search/simple.htm



Illustrations © Botanic Gardens Trust 2007



Blue Flax-lily
(*Dianella caerulea*)



Saw sedge (*Gahnia* spp.)



Glochidion ferdinandi; a species
common to Swamp Sclerophyll Forest
and Swamp Oak Floodplain Forest

Scientific Name	Common Name (Range)
Tree Canopy Species (>6m)	
<i>Allocasuarina littoralis</i>	Black She-Oak
<i>Casuarina glauca</i>	Swamp Oak +
<i>Eucalyptus botryoides</i>	Bangalay + (S-Gos)
<i>Eucalyptus longifolia</i>	Woollybutt (S-Syd)
<i>Eucalyptus resinifera</i> subsp. <i>hemilampra</i>	Red Mahogany (N-J-Bay)
<i>Eucalyptus robusta</i>	Swamp Mahogany + (N-Ulla)
<i>Ficus coronata</i>	Sandpaper Fig
<i>Livistona australis</i>	Cabbage Tree Palm +
<i>Lophostemon suaveolens</i>	Swamp Turpentine
<i>Melaleuca ericifolia</i>	Swamp Paperbark
<i>Melaleuca linariifolia</i>	Flax-leaved Paperbark +
<i>Melaleuca quinquenervia</i>	Broad-leaved Paperbark +
<i>Melaleuca styphelioides</i>	Prickly-leaved Tea Tree (N-Now)
Shrub Species (~1.5-6m)	
<i>Acacia irrorata</i>	Green Wattle
<i>Acacia longifolia</i>	Coastal Wattle +
<i>Acmena smithii</i>	Lilly Pilly
<i>Banksia oblongifolia</i>	Fern leaved Banksia (N-Ulla)
<i>Banksia spinulosa</i>	Hairpin Banksia
<i>Breynia oblongifolia</i>	Coffee Bush
<i>Callistemon salignus</i>	Crimson Bottlebrush
<i>Dodonaea triquetra</i>	Large leaf Hop-bush
<i>Elaeocarpus reticulatus</i>	Blueberry Ash
<i>Glochidion ferdinandi</i>	Cheese Tree +
<i>Homalanthus populifolius</i>	Bleeding Heart
<i>Leptospermum polygalifolium</i> subsp. <i>polygalifolium</i>	Tantoon +
<i>Melaleuca sieberi</i>	Sieber's Paperbark (N-Gos)
<i>Morinda jasminoides</i>	Sweet Morinda
<i>Poscias sambucifolia</i>	Elderberry Ash
Groundcover Species (~0-1.5m) & Vines/Scramblers	
<i>Adiantum aethiopicum</i>	Maiden Hair Fern
<i>Baumea articulata</i>	Jointed Twig Rush
<i>Baumea juncea</i>	Bare Twig Rush
<i>Blechnum camfieldii</i>	Lance Water-fern (N-B-Bay)
<i>Blechnum indicum</i>	Swamp Water-fern (N-J-Bay)
<i>Calochlaena dubia</i>	False Bracken
<i>Carex appressa</i>	Tall Sedge
<i>Centella asiatica</i>	Indian Pennywort + (N-Illa)
<i>Dianella caerulea</i>	Blue Flax Lily +
<i>Entolasia marginata</i>	Bordered Panic
<i>Entolasia stricta</i>	Wiry Panic
<i>Gahnia clarkei</i>	Tall Saw-sedge +
<i>Gahnia sieberiana</i>	Red-fruit Saw-sedge +
<i>Glycine clandestina</i>	Twining Glycine
<i>Gonocarpus tetragynus</i>	A Raspwort
<i>Hydrocotyle peduncularis</i>	A Pennywort
<i>Hypolepis muelleri</i>	Harsh Ground Fern
<i>Imperata cylindrica</i> var. <i>major</i>	Blady Grass +
<i>Isachne globosa</i>	Swamp Millet
<i>Lomandra longifolia</i>	Ribbon Grass
<i>Oplismenus aemulus</i>	Basket Grass
<i>Oplismenus imbecillis</i>	Basket Grass
<i>Pteridium esculentum</i>	Bracken +
<i>Parsonsia straminea</i>	Common Silkpod (N-Sho)
<i>Phragmites australis</i>	Common Reed +
<i>Pratia purpurascens</i>	Whiteroot
<i>Stephania japonica</i> var. <i>discolor</i>	Snake Vine
<i>Themeda australis</i>	Kangaroo Grass
<i>Villarsia exaltata</i>	Yellow Marsh Flower
<i>Viola banksii</i>	A Violet
<i>Viola hederacea</i>	Ivy-leaved Violet +

Where fire has been excluded for long periods in Swamp Sclerophyll Forest, it may contain many species typical of the EEC, *Littoral Rainforest*, and on the NSW North Coast where substrates are volcanically derived it may adjoin with the EEC, *Lowland Rainforest on Floodplains*.

Determining the conservation value of remnants

The degree of disturbance (i.e. the site condition) of any remnant of Swamp Sclerophyll Forest may vary dependant on past land use, management practices and/or natural disturbance and this should be considered at the time of assessment. Whilst not exhaustive, the following are a number of variations of Swamp Sclerophyll Forest you may encounter:

1. Tree canopy intact with limited native vegetation in the understorey due to underscrubbing, stock grazing pressure or too frequent fire;
2. Tree canopy intact (+/- reduced cover) with limited native vegetation in the understorey due to lack of fire or weed infestation (e.g. dense Lantana incursion or Carpet Grass (*Axonopus* spp.) invasion in areas partially cleared for agriculture);
3. Tree canopy absent due to prior clearing or fire, occurrence of regrowth of native understorey species along with herbaceous and/or woody weeds; or
4. Some characteristic tree canopy species not present due to past selective clearing.

Even where a remnant is considered to be heavily degraded and in poor condition, it may still have conservation value for a number of reasons including:

1. As part of a wildlife corridor that has connective importance at local and/or regional scales;
2. Providing important winter feed trees for arboreal mammals and birds;
3. Providing a 'stepping stone' for fauna in an otherwise cleared / fragmented landscape;
4. Providing significant habitat components such as hollow bearing trees important to the life cycle of migratory, non-migratory and/or nomadic species;
5. It may contain threatened species of flora in its own right; and/or
6. Maintaining a healthy native seed bank, very important in highly cleared landscapes.



Swamp Sclerophyll Forest in Wollongong LGA, showing the transition between 3 components of the community, reedland, shrubland and sclerophyll forest.

Lucas McKinnon

It is important to take these factors into account when determining the conservation significance of remnants.

For further assistance

This and other EEC guidelines are available on DECC Threatened Species website:

threatenedspecies.environment.nsw.gov.au

The references listed below also provide further information to aid in identifying EECs.

- Botanic Gardens Trust plant identification assistance: rbgsyd.nsw.gov.au/plant_info/botanical_info/plant_identification
- Botanic Gardens Trust PlantNET: plantNET.rbgsyd.nsw.gov.au/search/simple.htm
- Brooker, M. and Kleinig, D. (1990) *Field Guide to Eucalypts of South-eastern Australia*, Vol 2. Inkata, Melbourne.
- Harden, G. (ed) *Flora of NSW Vols 1 – 4* (1990-2002). NSW University Press.
- NSW Scientific Committee Determinations: nationalparks.nsw.gov.au/npws.nsf/Content/Final+determinations
- River-flat Eucalypt Forest on Coastal Floodplains species profile: threatenedspecies.environment.nsw.gov.au/tsprofile/profile.aspx?id=10786
- Robinson, L (2003) *Field guide to native plants of Sydney revised 3rd edition*. Kangaroo Press.
- Thackway, R, and Cresswell, I. (1995) (eds) 'An interim biogeographic regionalisation of Australia: a framework for establishing the national system of reserves.' (Australian Nature Conservation Agency: Canberra)

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**Approved Conservation Advice for the
Lowland Rainforest of Subtropical Australia**

(s266B of the *Environment Protection and Biodiversity Conservation Act 1999*)

This Conservation Advice has been developed based on the best available information at the time this Conservation Advice was approved; this includes existing plans, records or management prescriptions for this ecological community.

Description

Location

The **Lowland Rainforest of Subtropical Australia** ecological community primarily occurs from Maryborough in Queensland to the Clarence River (near Grafton) in New South Wales (NSW). The ecological community also includes isolated areas between the Clarence River and Hunter River such as the Bellinger and Hastings Valleys.

Physical environment

The ecological community occurs on basalt and alluvial soils, including sand and old/elevated alluvial soils as well as floodplain alluvia. It also occurs occasionally on historically enriched rhyolitic soils and basaltically enriched metasediments. Lowland Rainforest mostly occurs in areas <300 m above sea level. Aspect can result in the community being found at >300 m altitude on north-facing slopes, but typically 300 m defines the extent of the lowlands. In addition, Lowland Rainforest typically occurs in areas with high annual rainfall (>1300 mm).

The ecological community is differentiated from the Littoral Rainforest and Coastal Vine Thickets of Eastern Australia ecological community (hereafter referred to as Littoral Rainforest) by the level of coastal or estuarine influence (such as windshear). Lowland Rainforest of Subtropical Australia typically occurs more than 2 km from the coast, however, it can (and does) intergrade with Littoral Rainforest in some coastal areas.

Vegetation structure

The ecological community is generally a moderately tall (≥ 20 m) to tall (≥ 30 m) closed forest (canopy cover $\geq 70\%$). Tree species with compound leaves are common and leaves are relatively large (notophyll to mesophyll). Typically there is a relatively low abundance of species from the genera *Eucalyptus*, *Melaleuca* and *Casuarina*. Buttresses are common as is an abundance and diversity of vines.

The ecological community has the most diverse tree flora of any vegetation type in NSW (Floyd, 1990) and the species composition of the canopy varies between local stands and between regions (Keith, 2004). The canopy comprises a range of tree species but in some areas a particular species may dominate e.g. palm forest, usually dominated by *Archontophoenix cunninghamiana* (bangalow palm) or *Livistona australis* (cabbage palm); and riparian areas dominated by *Syzygium floribundum* (syn. *Waterhousea floribunda*) (weeping satinash/weeping lilly pilly).

The canopy is often multilayered consisting of an upper, discontinuous layer of emergents, over the main canopy and subcanopy. Below the canopy is an understorey of sparse shrubs and seedlings.

The upper, discontinuous layer includes **canopy emergents** that may be 40–50 m tall and have large spreading crowns. This layer is composed of species such as *Araucaria cunninghamii* (hoop pine), *Ficus* spp. (figs), *Lophostemon confertus* (brushbox), and in some sites, *Eucalyptus* spp.. Typically non-rainforest species such as eucalypts and brushbox comprise <30% of canopy emergents.

The **canopy/subcanopy layer** contains a diverse range of species. Representative species include: hoop pine, figs, *Argyrodendron trifoliolatum*/ *Heritiera trifoliolata* (white booyong), *Castanospermum australe* (black bean), *Cryptocarya obovata* (white walnut, pepperberry tree), *Dendrocnide excelsa* (giant stinging tree), *Diploglottis australis* (native tamarind), *Dysoxylum fraserianum* (rosewood), *Dysoxylum mollissimum* (red bean), *Endiandra pubens* (hairy walnut), *Elattostachys nervosa* (green tamarind), *Flindersia schottiana* (bumpy ash, cudgerie, silver ash), *Gmelina leichhardtii* (white beech), *Neolitsea dealbata* (white bolly gum), *Neolitsea australiensis* (bolly gum), *Sloanea australis* (maiden's blush), *Sloanea woollsii* (yellow carabeen), *Toona ciliata* (red cedar), and epiphytes such as *Platyserium* spp. and *Asplenium australasicum* (bird's nest fern).

In areas where the canopy is lower (<25 m) due to coastal or estuarine influences the Littoral Rainforest ecological community typically replaces the Lowland Rainforest ecological community.

The **understorey** contains a sparse layer of species such as *Cordyline stricta* (narrow-leaved palm lily), *Linospadix monostachya* (walking stick palm), *Neolitsea dealbata* (white bolly gum), *Notelaea johnsonii* (veinless mock olive), *Pittosporum multiflorum* (orange thorn), *Triunia youngiana* (native honey-suckle bush), *Wilkiea austroqueenslandica* (smooth wilkiea) and *Wilkiea huegeliana* (veiny wilkiea) as well as seedlings of a variety of canopy species. A variety of vines may be present such as *Calamus muelleri* (Southern lawyer vine), *Cissus antarctica* (native grape vine, water vine), *Cissus hypoglauca* (giant water vine), *Dioscorea transversa* (native yam), *Flagellaria indica* (whip vine), *Morinda jasminoides* (sweet morinda), *Pandorea floribunda* (wonga wonga vine) and *Smilax australis* (sarsaparilla). Ferns such as *Adiantum hispidulum* (rough maidenhair fern), *Doodia aspera* (rasp fern), *Lastreopsis decomposita* (trim shield fern) and *Lastreopsis marginans* (bordered shield fern, glossy shield fern) may also be present.

Fauna

Lowland Rainforest is characterised by a high proportion of frugivorous birds, epiphyte and litter foraging vertebrates, micro- and mega-chiropteran bats, and a broad range of invertebrate groups associated with the decomposition cycle (such as insects and snails).

A more comprehensive description of the ecological community is contained in the Listing Advice which is available on the Internet at:

<http://www.environment.gov.au/cgi-bin/sprat/public/publiclookupcommunities.pl>

Conservation Status

The Lowland Rainforest of Subtropical Australia ecological community is listed as **critically endangered**. This ecological community is eligible for listing as critically endangered under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) as, the Minister has considered the Threatened Species Scientific Committee's (TSSC) advice (TSSC, 2011) and amended the list under section 184 to include the Lowland Rainforest of Subtropical Australia ecological community. The TSSC determined that this ecological community met criteria 1, 2, 3 and 4 of the eligibility criteria for listing as threatened under the EPBC Act because its decline in geographic distribution is severe; its very restricted geographic distribution makes it likely that the action of a threatening process could cause it to be lost in the immediate future; it has undergone a severe decline in functionally important species; and because the reduction in integrity across most its range is severe, as indicated by degradation of the ecological community.

Distribution and Habitat

The ecological community primarily occurs from Maryborough in Queensland to the Clarence River (near Grafton) in NSW. The ecological community also includes isolated areas between the Clarence River and Hunter River such as the Bellinger Valley. Patches of Lowland Rainforest are generally small in size (<10 ha). The ecological community occurs in the following Interim Biogeographic Regionalisation for Australia Version 6.1 (IBRA) Bioregions: South Eastern Queensland Bioregion and NSW North Coast Bioregion.

The ecological community is known to occur in the following Natural Resource Management (NRM) and Catchment Management Authority (CMA) regions: SE Queensland Catchments, Burnett Mary Regional Group, Hunter-Central Rivers and Northern Rivers.

Lowland rainforest mostly occupies areas on highly fertile basaltic and alluvial soils. These areas have been heavily cleared as they are the most suitable for agricultural use.

Most of the remaining patches of this ecological community are small and scattered.

The ecological community provides habitat for a large number of animals including a high proportion of frugivorous birds and large number of threatened species.

Threats

The main ongoing threats to the ecological community include: vegetation clearance, impacts associated with fragmentation of remnants and weeds.

The **Lowland Rainforest of Subtropical Australia** ecological community has been extensively cleared for agricultural purposes because it primarily occurs on flat and relatively fertile soils. Clearing has dramatically decreased its extent and the resulting fragmentation has made the ecological community more vulnerable to threats such as weed invasion.

Weeds compete with native species for space, light, water and nutrients. They also suppress and out-compete mid-storey and canopy trees.

Ongoing incremental clearing of vegetation for agricultural activities (in particular macadamias and fruit crops), horticultural industry (and the subsequent introduction of new potential weeds), hobby farming, peri-urban and rural residential development (including vegetation removal for bush fire protection) and also private native forestry are further adding to isolation and fragmentation of Lowland Rainforest remnants.

Urbanisation results in impacts such as the invasion of bushland by domestic dogs and cats, rubbish dumping, trampling, garden escapes, firewood collection, impacts from vehicles, the creation of informal trails, and arson. Urbanisation also increases pressure to reduce bushfire fuel loads that may be detrimental to the ecological community.

More detail about these threats is contained in the Listing Advice which is available on the Internet at:

<http://www.environment.gov.au/cgi-bin/sprat/public/publiclookupcommunities.pl>

The following EPBC Act listed Key Threatening Processes are considered relevant to Lowland Rainforest of Subtropical Australia:

- Land clearance;
- Predation by European red fox;
- Loss and degradation of native plant and animal habitat by invasion of escaped garden plants, including aquatic plants and;
- The biological effects, including lethal toxic ingestion, caused by Cane Toads (*Rhinella marina*).

Research Priorities

Research priorities that would inform future regional and local priority actions include:

- Undertake surveys to locate and map remnants and other occurrences of the ecological community, as well as threatened species that occur in the ecological community.
- Design and implement a monitoring program or, if appropriate, support and enhance existing programs for the ecological community and associated threatened species.
- Further develop sustainable management guidelines and technical material to assist landowners, including measures to address inappropriate fertiliser application, stock management, ecological fire management and spray drift.
- Develop effective control methods for the most damaging weed species that infest the ecological community e.g. madeira vine (*Anredera cordifolia*), cats claw creeper (*Macfadyena unguis-cati*), morning glory (*Ipomoea* spp.), wandering jew (*Tradescantia fluminensis*), climbing asparagus (*Asparagus plumosus*), ochna (*Ochna serrulata*) and small-leaved privet (*Ligustrum sinense*).
- Investigate the importance of landscape scale gene flow and its implications for management of remnants, associated fauna, plant and animal interactions and longer term ecological function. This includes research into optimal distances between remnants and remnant sizes that are crucial for a range of flora and fauna movements.
- Undertake research, monitoring and evaluation to determine the relative biodiversity, conservation benefits of remnants, areas of regeneration and supplementary planting.
- Assess the vulnerability of the ecological community to climate change.
- Investigate the likely impacts of nearby eucalypt plantations on groundwater and fire potential of the ecological community.
- Undertake analysis of cost effectiveness of landscape connectivity and the importance of small isolates.

Priority Actions

The following priority recovery and threat abatement actions should be done to support the recovery of the **Lowland Rainforest of Subtropical Australia** ecological community.

Habitat Loss, Disturbance and Modification

- Protect and conserve remaining areas of the ecological community. Further clearance and fragmentation of this critically endangered ecological community should be avoided.
- Maintain and reconnect wildlife corridors or linkages and ensure that areas of particularly high quality, connectivity or importance in a landscape context, are protected.
- Investigate formal conservation arrangements, management agreements and covenants on private land and, for crown and private land, investigate inclusion in reserve tenure. This is particularly important for areas that link patches and create wildlife corridors.
- Monitor the progress of recovery, through improved mapping, estimates of extent and condition assessments of the ecological community, and effective adaptive management actions.
- Implement appropriate management regimes to maintain the biodiversity, including the threatened species, of the ecological community.
- Manage any adverse effects on groundwater and altered fire potential due to nearby eucalypt plantations e.g. ensure appropriate fuel load and fire break management is undertaken to minimise the risk of fire in the ecological community.
- Develop and implement best practice standards for management of the ecological community on private and public lands.
- Liaise with local councils and state authorities to ensure new developments, road widening, maintenance activities, or other activities involving substrate or vegetation disturbance in areas where the ecological community occurs, do not adversely impact the ecological community.
- Liaise with planning authorities to ensure that planning takes the protection of the ecological community into account, with due regard to principles for long-term conservation.
- Include buffer zones between the ecological community and development zones and areas undergoing pasture development or cultivation.
- Involve landowners in, and promote community programs that assist with, the conservation of the ecological community.

Impacts from residential and peri-urban development

- Fence significant remnants in or adjacent to residential areas and limit access for vehicles and pets.
- Exclude fire.
- Develop education programs, information products and signage to help the public recognise the presence and importance of the ecological community, and their responsibilities under state and local regulations and the EPBC Act.
- Encourage local patch management through local conservation groups (e.g. Bushcare/Landcare).

Invasive Species

- Target control of key existing weeds which threaten the ecological community, using appropriate methods. Manage sites to prevent the introduction of new, or further spread of existing, invasive weeds.
- Implement staged removal of camphor laurel (*Cinnamomum camphora*) to provide site stability and on-going functionality to facilitate regeneration.
- Discourage the clearing of camphor laurel using heavy machinery. This style of weed control does not help the recovery of the ecological community unless it incorporates ecological restoration as an integrated component of the action.
- Ensure chemicals, or other mechanisms used to manage weeds, do not have significant adverse, non-target impacts on the ecological community.
- Control introduced pest animals to allow natural regeneration and to manage threats, especially to threatened species, at known sites through coordinated landscape-scale control programs.

Trampling, Browsing or Grazing

- Ensure that livestock are excluded from patches of the ecological community, through exclusion fencing or other barriers.

Fire

- Discourage the use of fire as a means to control lantana or other weeds in or near to rainforest remnants.
- Ensure that managed fires and, where possible, wildfires do not enter buffer zones around remnants.
- Negotiate appropriate standing procedures with local fire brigades, in relation to establishing fire control lines in native vegetation areas, to avoid unnecessary destruction of the ecological community.

Conservation Information

- Develop sustainable management guidelines and technical material to assist landowners, including measures to address inappropriate fertiliser application, stock management, weed management and spray drift.
- Raise awareness of the ecological community within State Government authorities (including Natural Resources Management/ Catchment Management Authorities) and the local community (e.g. through active Conservation Management Networks, Landcare groups and other groups), as well as local councils.
- Raise awareness about the importance of large trees, and coarse woody debris (dead trees, logs) as faunal habitat.
- Maintain liaison with private landholders and land managers of land on which the ecological community occurs.

Enable Recovery of Additional Sites

- Patches of the Lowland Rainforest ecological community should be considered a priority for conservation funding (priority repair sites are identified in the Border Ranges Rainforest Biodiversity Management Plan (DECCW, 2010)).
- Plant local indigenous rainforest species to facilitate landscape processes and regeneration.
- Investigate options to maintain and improve connectivity, including the protection of paddock trees and the replanting of key canopy tree species.
- Develop seed harvesting and propagation techniques (having acquired the necessary permits required) for Lowland Rainforest species not already available from rainforest nurseries to facilitate the species diversity in revegetation sites.
- Ensure that any revegetation is undertaken in an appropriate manner.

This list does not necessarily encompass all actions that may be of benefit to the **Lowland Rainforest of Subtropical Australia** ecological community, but highlights those that are currently considered to be a priority.

Existing Plans/Management Prescriptions that are Relevant to the Ecological Community

- Big Scrub Rainforest Landcare Group (2005). Subtropical Rainforest Restoration: A practical manual and data source for landcare groups, land managers and rainforest regenerators. Big Scrub Rainforest Landcare Group, Bangalow NSW.
- Big Scrub Rainforest Landcare Group (2008). Common weeds of subtropical rainforests of eastern Australia. Big Scrub Rainforest Landcare Group, Bangalow NSW.
- DECCW (2010). Border Ranges Rainforest Biodiversity Management Plan - NSW and Queensland. Department of Environment, Climate Change and Water NSW, Sydney.
<http://www.environment.gov.au/biodiversity/threatened/publications/recovery/border-ranges/pubs/brrb-management-plan.pdf>
- DECCW (2010). Northern Rivers Regional Biodiversity Management Plan, National Recovery Plan for the Northern Rivers Region. Department of Environment, Climate Change and Water NSW, Sydney.
<http://www.environment.gov.au/biodiversity/threatened/publications/recovery/pubs/northern-rivers.pdf>

These prescriptions were current at the time of publishing; please refer to the relevant agency's website for any updated versions.

Other Information Sources:

- Qld Department of Environment and Resource Management (2011). Regional Ecosystem details for 12.3.1, 12.5.13, 12.8.3, 12.8.4, 12.11.1, 12.11.10, 12.12.1 and 12.12.16. Available on the Internet at:
http://www.derm.qld.gov.au/wildlife-ecosystems/biodiversity/regional_ecosystems
- NSW Scientific Committee (1999). Lowland Rainforest on Floodplain in the NSW North Coast Bioregion – endangered ecological community listing. Viewed 26 January 2011. Available on the Internet at:
<http://www.environment.nsw.gov.au/determinations/LowlandRainforestNorthCoastEndComListing.htm>
- NSW Scientific Committee (2006). Lowland Rainforest in NSW North Coast and Sydney basin Bioregion – endangered ecological community listing. Viewed 26 January 2011. Available on the Internet at:
<http://www.environment.nsw.gov.au/determinations/LowlandRainforestEndCom.htm>
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Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions - profile

Scientific name: Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions

Conservation status in NSW : **Endangered Ecological Community**

Commonwealth status: **Critically Endangered**

Gazetted date: 22 Dec 2006

Profile last updated: 06 Jun 2017

Description

Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions is an ecological community of subtropical rainforest and some related, structurally complex forms of dry rainforest. Lowland Rainforest, in a relatively undisturbed state, has a closed canopy, characterised by a high diversity of trees whose leaves may be mesophyllous and encompass a wide variety of shapes and sizes. Typically, the trees form three major strata: emergents, canopy and sub-canopy which, combined with variations in crown shapes and sizes results in an irregular canopy appearance. The trees are taxonomically diverse at the genus and family levels, and some may have buttressed roots. A range of plant growth forms are present in Lowland Rainforest, including palms, vines and vascular epiphytes. In disturbed stands of this community the canopy cover may be broken, or the canopy may be smothered by exotic vines.

Distribution

The Hawkesbury River notionally marks the southern limit of Lowland Rainforest in the NSW North Coast and Sydney Basin bioregions. South of the Sydney metropolitan area, Lowland Rainforest is replaced by Illawarra Subtropical Rainforest of the Sydney Basin Bioregion, which is listed as an endangered ecological community. Milton Ulladulla Subtropical Rainforest is also a related rainforest endangered ecological community that occurs still further south in the South East Corner Bioregion.

Regional distribution and habitat

Click on a region below to view detailed distribution, habitat and vegetation information.

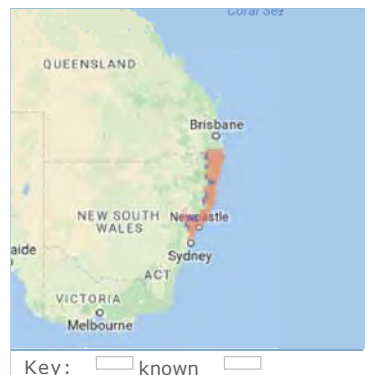
- [Hawkesbury-Nepean](#)
- [Hunter-Central Rivers](#)
- [Northern Rivers](#)

Threats

- Extensive clearing of Lowland Rainforest has resulted in fragmentation and loss of ecological connectivity. The integrity and survival of small, isolated stands is impaired by the small population size of many species, enhanced risks from environmental stochasticity, disruption to pollination and dispersal of fruits or seeds, and likely reductions in the genetic diversity of isolated populations.
- Weed invasion also poses a major threat to Lowland Rainforest, with introduced vines and scramblers having particularly serious impacts. Exotic species form dense thickets capable of smothering indigenous plants, reducing both reproduction and survival.
- Inappropriate fire regimes associated with burning off and hazard reduction pose a threat to the margins of rainforest stands and the entirety of small stands in fragmented landscapes.
- Grazing by livestock, potential impacts of anthropogenic climate change and impacts associated with human interaction; including soil compaction, possible spread of pathogens, clearing of understorey and inappropriate collection of plant species.

Recovery strategies

Indicative distribution



The areas shown in pink and purple are the sub-regions where the species or community is known or predicted to occur. They may not occur throughout the sub-region but may be restricted to certain areas. ([click here](#) to see geographic restrictions). The information presented in this map is only indicative and may contain errors and omissions.

A targeted strategy for managing this species has been developed under the Saving Our Species program; click [here](#) for details. For more information on the Saving Our Species program click [here](#)

Activities to assist this species

- Ensure remnants remain connected or linked to each other; in cases where remnants have lost connective links, re-establish them by revegetating sites to act as stepping stones for fauna, and flora (pollen and seed dispersal).
- Manage weed populations.
- Protect against inappropriate fire regimes associated with burning off and hazard reduction burns.
- Reduce grazing by livestock and minimise environmental impacts associated with human interaction.

Related information

Lowland Rainforest in NSW North Coast and Sydney Basin Bioregion - endangered ecological community listing. Final determination DEC (NSW), Sydney.

[SPRAT Profile: Lowland Rainforest of Subtropical Australia](#)

GET INVOLVED

REPORT A SIGHTING

Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions - endangered ecological listing

NSW Scientific Committee - final determination

The Scientific Committee, established by the Threatened Species Conservation Act, has made a Final Determination to list Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions, as an ENDANGERED ECOLOGICAL COMMUNITY in Part 3 of Schedule 1 of the Act, and as a consequence to omit reference to Sydney Coastal Estuary Swamp Forest in the Sydney Basin bioregion from Part 3 of Schedule 1 of the Act. Listing of endangered ecological communities is provided for by Part 2 of the Act.

The Scientific Committee has found that:

1. Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions is the name given to the ecological community associated with humic clay loams and sandy loams, on waterlogged or periodically inundated alluvial flats and drainage lines associated with coastal floodplains. Floodplains are level landform patterns on which there may be active erosion and aggradation by channelled and overbank stream flow with an average recurrence interval of 100 years or less (adapted from Speight 1990). Swamp Sclerophyll Forest on Coastal Floodplains generally occurs below 20 m (though sometimes up to 50 m) elevation, often on small floodplains or where the larger floodplains adjoin lithic substrates or coastal sand plains in the NSW North Coast, Sydney Basin and South East Corner bioregions. The structure of the community is typically open forest, although partial clearing may have reduced the canopy to scattered trees. In some areas the tree stratum is low and dense, so that the community takes on the structure of scrub. The community also includes some areas of fernland and tall reedland or sedgeland, where trees are very sparse or absent. Typically these forests, scrubs, fernlands, reedlands and sedgelands form mosaics with other floodplain forest communities and treeless wetlands, and often they fringe treeless floodplain lagoons or wetlands with semi-permanent standing water (e.g. Pressey 1989a).

The composition of Swamp Sclerophyll Forest on Coastal Floodplains is primarily determined by the frequency and duration of waterlogging and the texture, salinity nutrient and moisture content of the soil. Composition also varies with latitude. The community is characterised by the following assemblage of species:

Acacia irrorata	Acacia longifolia
Acmena smithii	Adiantum aethiopicum
Allocasuarina littoralis	Banksia oblongifolia
Banksia spinulosa	Baumea articulata
Baumea juncea	Blechnum camfieldii
Blechnum indicum	Breynia oblongifolia
Callistemon salignus	Calochlaena dubia
Carex appressa	Casuarina glauca
Centella asiatica	Dianella caerulea
Dodonaea triquetra	Elaeocarpus reticulatus
Entolasia marginata	Entolasia stricta
Eucalyptus botryoides	Eucalyptus longifolia
Eucalyptus resinifera subsp. hemilampra	Eucalyptus robusta
Ficus coronata	Gahnia clarkei
Gahnia sieberiana	Glochidion ferdinandi

<i>Glycine clandestina</i>	<i>Gonocarpus tetragynus</i>
<i>Hydrocotyle peduncularis</i>	<i>Hypolepis muelleri</i>
<i>Imperata cylindrica</i> var. <i>major</i>	<i>Isachne globosa</i>
<i>Leptospermum polygalifolium</i> subsp. <i>polygalifolium</i>	<i>Livistona australis</i>
<i>Lomandra longifolia</i>	<i>Lophostemon suaveolens</i>
<i>Melaleuca ericifolia</i>	<i>Melaleuca linariifolia</i>
<i>Melaleuca quinquenervia</i>	<i>Melaleuca sieberi</i>
<i>Melaleuca styphelioides</i>	<i>Morinda jasminoides</i>
<i>Omalanthus populifolius</i>	<i>Oplismenus aemulus</i>
<i>Oplismenus imbecillis</i>	<i>Parsonsia straminea</i>
<i>Phragmites australis</i>	<i>Polyscias sambucifolia</i>
<i>Pratia purpurascens</i>	<i>Pteridium esculentum</i>
<i>Stephania japonica</i> var. <i>discolor</i>	<i>Themeda australis</i>
<i>Villarsia exaltata</i>	<i>Viola banksii</i>
<i>Viola hederacea</i>	□

2. The total species list of the community is considerably larger than that given above, with many species present at only one or two sites or in low abundance. The species composition of a site will be influenced by the size of the site, recent rainfall or drought conditions and by its disturbance (including fire, grazing, flooding and land clearing) history. The number and relative abundance of species will change with time since fire, flooding or significant rainfall, and may also change in response to changes in grazing regimes. At any one time, above-ground individuals of some species may be absent, but the species may be represented below ground in the soil seed banks or as dormant structures such as bulbs, corms, rhizomes, rootstocks or lignotubers. The list of species given above is of vascular plant species, the community also includes micro-organisms, fungi, cryptogamic plants and a diverse fauna, both vertebrate and invertebrate. These components of the community are poorly documented.

3. Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions is known from parts of the Local Government Areas of Tweed, Byron, Lismore, Ballina, Richmond Valley, Clarence Valley, Coffs Harbour, Bellingen, Nambucca, Kempsey, Hastings, Greater Taree, Great Lakes and Port Stephens, Lake Macquarie, Wyong, Gosford, Hornsby, Pittwater, Warringah, Manly, Liverpool, Rockdale, Botany Bay, Randwick, Sutherland, Wollongong, Shellharbour, Kiama and Shoalhaven but may occur elsewhere in these bioregions. Bioregions are defined in Thackway and Creswell (1995). Major examples once occurred on the floodplains of the Tweed, Richmond, Clarence, Macleay, Hastings and Manning Rivers, although smaller floodplains would have also supported considerable areas of this community.

4. Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions has an open to dense tree layer of eucalypts and paperbarks, which may exceed 25 m in height, but can be considerably shorter in regrowth stands or under conditions of lower site quality. For example, stands dominated by *Melaleuca ericifolia* typically do not exceed 8 m in height. The most widespread and abundant dominant trees include *Eucalyptus robusta* (swamp mahogany), *Melaleuca quinquenervia* (paperbark) and, south from Sydney, *Eucalyptus botryoides* (bangalay) and *Eucalyptus longifolia* (woollybut). Other trees may be scattered throughout at low abundance or may be locally common at few sites, including *Callistemon salignus* (sweet willow bottlebrush), *Casuarina glauca* (swamp oak) and *Eucalyptus resinifera* subsp. *hemilampra* (red mahogany), *Livistona australis* (cabbage palm) and *Lophostemon suaveolens* (swamp turpentine). A layer of small trees may be present, including *Acacia irrorata* (green wattle), *Acmena smithii* (lilly pilly), *Elaeocarpus reticulatus* (blueberry ash), *Glochidion ferdinandi* (cheese tree), *Melaleuca linariifolia* and *M. styphelioides* (paperbarks). Shrubs include *Acacia longifolia* (Sydney golden wattle), *Dodonaea triquetra* (a hopbush), *Ficus coronata* (sandpaper fig), *Leptospermum polygalifolium* subsp. *polygalifolium* (lemon-scented tea tree) and *Melaleuca* spp. (paperbarks). Occasional vines include *Parsonsia straminea* (common silkpod), *Morinda jasminoides* and *Stephania japonica* var. *discolor* (snake vine). The groundcover is composed of abundant sedges, ferns, forbs, and grasses including *Gahnia clarkei*, *Pteridium esculentum* (bracken), *Hypolepis muelleri* (batswing fern), *Calochlaena dubia* (false bracken), *Dianella caerulea* (blue flax lily), *Viola hederacea*, *Lomandra longifolia* (spiny-headed mat-rush) and *Entolasia marginata* (bordered panic) and *Imperata cylindrica* var. *major* (blady grass). The endangered swamp orchids *Phaius australis* and *P. tankervillei* are found in this community. On sites downslope of lithic

substrates or with soils of clay-loam texture, species such as *Allocasuarina littoralis* (black she-oak), *Banksia oblongifolia*, *B. spinulosa* (var. *collina* or var. *spinulosa*) (hairpin banksia), *Ptilothrix deusta* and *Themeda australis* (kangaroo grass), may also be present in the understorey. The composition and structure of the understorey is influenced by grazing and fire history, changes to hydrology and soil salinity and other disturbance, and may have a substantial component of exotic grasses, vines and forbs.

5. Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions provides habitat for a broad range of animals, including many that are dependent on trees for food, nesting or roosting (Law et al. 2000). The blossoms of *Eucalyptus robusta* and *Melaleuca quinquenervia* are also an important food source for the Grey-headed Flying Fox (*Pteropus poliocephalus*) and Common Blossom Bat (*Sycoptes australis*) (Law 1994), as well as the Yellow-bellied Glider (*Petaurus australis*), Sugar Glider (*Petaurus breviceps*), Regent Honeyeater (*Xanthomyza phrygia*) and Swift Parrot (*Lathamus discolor*). Other animals found in this community include the Osprey (*Pandion haliaetus*), Australasian Bittern (*Botaurus poiciloptilus*), Large-footed myotis (*Myotis adversus*), *Litoria longburnensis* and Wallum Froglet (*Crinia tinnula*).

6. Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions forms part of a complex of forested and treeless wetland communities found throughout the coastal floodplains of NSW. A recent analysis of available quadrat data from these habitats identified a distinct grouping of vegetation samples attributable to this community (Keith and Scott 2005). The combination of features that distinguish Swamp Sclerophyll Forest on Coastal Floodplains from other endangered ecological communities on the coastal floodplains include: its relatively dense tree canopy dominated by *Eucalyptus robusta*, *Melaleuca quinquenervia* or *E. botryoides*, the relatively infrequent occurrence of other eucalypts, *Casuarina glauca* or *Lophostemon suaveolens*; the occasional presence of rainforest elements as scattered trees or understorey plants; and the prominence of large sedges and ferns in the groundcover. It generally occupies small alluvial flats and peripheral parts of floodplains where they adjoin lithic substrates or coastal sandplains. The soils are usually waterlogged, stained black or dark grey with humus, and show little influence of saline ground water.

7. Swamp Sclerophyll Forest on Coastal Floodplains includes and replaces Sydney Coastal Estuary Swamp Forest in the Sydney Basin bioregion. It may adjoin or intergrade with several other endangered ecological communities, which collectively cover all remaining native vegetation on the coastal floodplains of New South Wales. These include Lowland Rainforest on Floodplain in the NSW North Coast bioregion, River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions (including the formerly listed Sydney Coastal River-Flat Forest in the Sydney Basin bioregion), Subtropical Floodplain Forest, Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions and Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions. For example, as soils become less waterlogged, Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions may adjoin or intergrade with River-Flat Eucalypt Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions. As soil salinity increases Swamp Sclerophyll Forest on Coastal Floodplains may intergrade with, and be replaced by, Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions. The boundaries between these communities are dynamic and may shift in response to changes in hydrological regimes, fire regimes or land management practices (e.g. Johnston et al. 2003, Stevenson 2003). The Determinations for these communities collectively encompass the full range of intermediate assemblages in transitional habitats.

8. A number of vegetation surveys and mapping studies have been conducted across the range of Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions. This community includes the *Eucalyptus robusta* (Swamp Mahogany) community identified on coastal alluvium by Douglas and Anderson (2002) and the Coastal Alluvium Swamp Forest complex defined by Anderson and Asquith (2002). In the Comprehensive Regional Assessment of the north-eastern NSW (NPWS 1999), those areas on floodplains mapped as 'Forest Ecosystem 112, Paperbark', and those areas on floodplains mapped as 'Forest Ecosystem 142, Swamp Mahogany' are included within this community. On the Tweed lowlands, this community includes '*Eucalyptus robusta* mid-high to very tall closed forest' (F7), '*Archontophoenix cunninghamiana*-*Melaleuca quinquenervia* very tall feather palm swamp forest' (F9), those parts of *Melaleuca quinquenervia* tall to very tall open to closed forest' (F8) on alluvial soils and parts of 'Floodplain Wetland Complex' (FL) dominated by *Eucalyptus robusta* or *Melaleuca quinquenervia* (Pressey and Griffith 1992). In the lower Hunter district, this community includes 'Swamp Mahogany-Paperbark Swamp Forest' (map unit 37), Riparian *Melaleuca* Swamp Woodland (map unit 42) and *Melaleuca* Scrub (map unit 42a) of NPWS (2000). In the Sydney-Gosford region, this community includes those parts of 'Freshwater Swamp complex' (map unit 27a) dominated by *Eucalyptus robusta* or *E. botryoides* (Benson 1986, Benson and Howell 1994) and parts of the 'Freshwater wetlands - on the floodplains' of Benson and Howell (1990) and Benson et al. (1996). In the Illawarra, this community includes 'Alluvial swamp mahogany forest' (map unit 35) of NPWS (2002). On the south coast, this community includes 'Northern Coastal Lowlands Swamp Forest' (forest ecosystem 175) of Thomas et al. (2000) and 'Coastal Sand Swamp Forest' (map unit 45) of Tindall et al. (2004). Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions is included within the 'Coastal Floodplain Wetlands' and 'Coastal Swamp Forest' vegetation classes of Keith (2002, 2004). There may be additional or unmapped occurrences of Swamp Sclerophyll Forest on Coastal Floodplains within and beyond these surveyed areas.

9. The extent of the Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions prior to European settlement has not been mapped across its entire range. However, one estimate based on a compilation of regional vegetation maps suggests that Coastal Floodplain Wetlands, which include Swamp Sclerophyll Forest on Floodplains, currently cover 800-1400 km², representing less than 30% of the original extent of this broadly defined vegetation class (Keith 2004). Compared to this combined estimate, the remaining area of Swamp Sclerophyll Forest on Coastal Floodplains is likely to be considerably smaller and is likely to represent much less than 30% of its original range. For example, there were less than 350 ha of native vegetation attributable to this community on the Tweed lowlands in 1985 (Pressey and Griffith 1992), less than 2500 ha on the Clarence floodplain in 1982 (Pressey 1989a), less than 700 ha on the Macleay floodplain in 1983 (Pressey 1989b), up to 7000 ha in the lower Hunter - central coast district during the 1990s (NPWS 2000), and less than 1000 ha in the Sydney - South Coast region in the mid 1990s (Tindall et al. 2004), including less than 40 ha on the Illawarra plain in 2001 (NPWS 2002) and about 450 ha on the South Coast in the 1990s (Thomas et al. 2000).

10. Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions has been extensively cleared and modified. Large areas that formerly supported this community are occupied by exotic pastures grazed by cattle, market gardens, other cropping enterprises (e.g. sorghum, corn, poplars, etc.) and, on the far north coast, canefields. On the Tweed lowlands, Pressey and Griffith (1992) estimated that less than 3% of the original Floodplain Wetlands and Floodplain Forest remained in 1985. Similar estimates are likely to apply to Swamp Sclerophyll Forest on Coastal Floodplains in other parts of the NSW North Coast bioregion (Goodrick 1970, Pressey 1989a, 1989b). In the lower Hunter - central coast district, about 30 % of the original area of Swamp mahogany - paperbark forest was estimated to remain in the 1990s (NPWS 2000).

11. Land clearing continues to threaten Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions. A small minority of the remaining area occurs on public land (e.g. Pressey and Griffith 1992, NPWS 2000), with most occurring on productive agricultural land or in close proximity to rural centres. The remaining stands are severely fragmented by past clearing and further threatened by continuing fragmentation and degradation, flood mitigation and drainage works, landfilling and earthworks associated with urban and industrial development, pollution from urban and agricultural runoff, weed invasion, overgrazing, trampling and other soil disturbance by domestic livestock and feral animals including pigs, activation of 'acid sulfate soils', removal of dead wood and rubbish dumping (e.g. Pressey 1989a, b; Pressey and Griffith 1992, Boulton and Brock 1999, Johnston *et al.* 2003). Anthropogenic climate change may also threaten Swamp Sclerophyll Forest on Coastal Floodplains if future flooding regimes are affected (IPCC 2001, Hughes 2003). Localised areas, particularly those within urbanised regions, may also be exposed to frequent burning which reduces the diversity of woody plant species. Clearing of native vegetation; Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands; Invasion of native plant communities by exotic perennial grasses; Predation, habitat destruction, competition and disease transmission by feral pigs; Anthropogenic climate change; High frequency fire and Removal of dead wood and dead trees are listed as Key Threatening Processes under the Threatened Species Act (1995).

12. Large areas of habitat formerly occupied by Swamp Sclerophyll Forest on Coastal Floodplains have been directly drained by construction of artificial channels (e.g. Pressey 1989a, Boulton and Brock 1999). While much of the early drainage works were associated with agricultural development, more recently they are associated with urban expansion. Additional areas that have not been directly drained may have been altered hydrologically by changed patterns of flooding and drainage following flood mitigation works, particularly the construction of drains, levees and floodgates (Pressey and Griffith 1992). On the north coast of NSW, expansion of *Melaleuca quinquenervia* into open floodplain swamps has been attributed to artificial drainage and shortening of the hydroperiod (Johnston *et al.* 2003, Stevenson 2003). These changes appear to be closely associated with enhanced acidity, altered ionic ratios, increased dissolved organic carbon and sulfide oxidation in the soil profile (Johnston *et al.* 2003).

13. Relatively few examples of Swamp Sclerophyll Forest on Coastal Floodplains remain unaffected by weeds. The causes of weed invasion include physical disturbance to the vegetation structure of the community, dumping of landfill rubbish and garden refuse, polluted runoff from urban and agricultural areas, construction of roads and other utilities, and grazing by domestic livestock. The principal weed species affecting Swamp Sclerophyll Forest on Coastal Floodplains include *Andropogon virginicus* (whiskey grass), *Anredera cordifolia* (Madeira vine), *Ageratina adenophora* (crofton weed), *Baccharis halimifolia* (groundsel bush), *Cinnamomum camphora* (camphor laurel), *Lantana camara* (lantana), *Ligustrum sinense* (small-leaved privet), *Lonicera japonica* (Japanese honeysuckle) and *Ludwigia peruviana* (Keith and Scott 2005).

14. Small areas of Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions are contained within existing conservation reserves, including Bungawalbin, Tuckean and Moonee Beach Nature Reserves, and Hat Head, Crowdy Bay, Wallingat, Myall Lakes and Garigal National Parks. These occurrences are unevenly distributed throughout the range and unlikely to represent the full diversity of the community. In addition, wetlands within protected areas are exposed to hydrological changes that were, and continue to be initiated outside their boundaries. Some areas of Swamp Oak Floodplain Forest are protected by State Environmental Planning Policy 14, although this has not always precluded impacts on wetlands from the development of major infrastructure.

15. Given the dynamic hydrological relationship between Swamp Sclerophyll Forest on Coastal Floodplains, Coastal Saltmarsh and other endangered ecological communities on coastal floodplains, future management of water and tidal flows may result in the expansion of some communities at the expense of others. Proposals for the restoration of natural hydrological regimes and for the rehabilitation of acid sulfate soils may also result in changes to the distribution and composition of floodplain communities. Co-ordinated planning and management approaches across whole catchments will be required to address and resolve priorities between different management objectives.

16. In view of the above the Scientific Committee is of the opinion that Swamp Sclerophyll Forest on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions is likely to become extinct in nature in New South Wales unless the circumstances and factors threatening its survival or evolutionary development cease to operate.

Associate Professor Paul Adam

Chairperson

Scientific Committee

Proposed Gazettal date: 17/12/04

Exhibition period: 17/12/04 - 28/01/05

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About the NSW Scientific Committee

Appendix J - Likelihood Assessment for Fauna Species

Species name	TSC / BC Act	EPBC Act	Distribution	Habitat	Likelihood of occurrence in the development site	Habitat on site directly or indirectly impacted
Amphibians						
<i>Assa darlingtoni</i> Pouched Frog	V		North-east NSW and far south-east Qld. There are three isolated populations in NSW: Dorrigo Plateau and Gibraltar Range, Border Ranges.	Cool, moist rainforest (including Antarctic Beech), or moist eucalypt forest in mountainous areas, mostly above 800 m.	Unlikely. Species not recorded in surveys on the site in 2007, 2009 and 2014	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Crinia tinnula</i> Wallum Froglet	V		Along the coastal margin from Litabella National Park in south-east Qld to Kurnell in Sydney.	Acidic swamps on coastal sand plains (typically in sedgelands and wet heathlands), drainage lines, and swamp sclerophyll forests.	Unlikely. Species not recorded in BNR or in surveys on the site in 2007, 2009 and 2014. Detected during bird counts on freehold land to northeast of the site.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Litoria brevipalmata</i> Green-thighed Frog	V		Isolated localities along the coast and ranges from just north of Wollongong to south-east Qld.	Rainforest and moist eucalypt forest to dry eucalypt forest and heath, typically in areas where surface water gathers after rain.	Unlikely. Species not recorded in Byron LGA, or in BNR or in systematic fauna surveys on the site in 2007, 2009 and 2014	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Litoria longiburrensis</i> Olongburra Frog	V	V	Distributed from Fraser Island in southern Qld to Yuraygir National Park in northern NSW.	Confined to coastal sandplain wallum swamps. Breeding habitat is characterised by the presence of emergent sedges.	Species not recorded in surveys on the site in 2007, 2009 and 2014	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Mixophyes fleayi</i> Fleay's Barred Frog	E1	E	Eastern side of the ranges in south-east Qld (south from Conondale ranges) and northeast NSW	Rainforest and wet eucalypt forest of the escarpment and foothills, usually close to gravely streams.	Unlikely. Escarpment and foothill riparian species. Systematic fauna surveys in 2007, 2009, 2014, not detected	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Mixophyes iteratus</i> Giant Barred Frog	E1	E	Coast and ranges from Eumundi in south-east Qld to Warrimoo in the Blue Mountains.	Freshwater permanent/semi-permanent streams, generally at lower elevation. Riparian rainforest or wet sclerophyll forest is favoured.	Unlikely. Riparian species not recorded in BNR or in systematic fauna surveys on the site in 2007, 2009 and 2014	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Birds						
<i>Anaauromis moluccana</i> Pale-vented Bush-hen	V		In NSW, occurs from the Qld border south to the Clarence River, though the species appears to be expanding its range southwards with recent records as far south as the Nambucca River.	Tall dense vegetation on the margins of freshwater streams and natural or artificial wetlands, usually within or bordering rainforest, rainforest remnants or forests. Also rank grass or reeds, thickets of weeds and farmland.	Unlikely. Targeted in call playback surveys in 2007 & 2014, not detected.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.

<i>Anthochaera Phrygia</i> Regent Honeyeater	E4A	CE	Inland slopes of south-east Australia, and less frequently in coastal areas. In NSW, most records are from the North-West Slopes, North-West and South-West Slopes, Northern Tablelands, Central Tablelands and Southern Tablelands regions; also recorded in the Central Coast and Hunter Valley regions.	Eucalypt woodland and open forest, wooded farmland and urban areas with mature eucalypts, and riparian forests of <i>Casuarina cunninghamiana</i> (River Oak).	Unlikely. Species not recorded in BNR or in surveys on the site in 2007, 2009 and 2014	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Botaurus poeciloptilus</i> Australasian Bittern	E1	E	Found over most of NSW except for the far north-west.	Permanent freshwater wetlands with tall, dense vegetation, particularly <i>Typha</i> spp. (bullrushes) and <i>Eleocharis</i> spp. (spikerushes).	Unlikely. Targeted in call playback surveys in 2007, 2009, 2014, not detected	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Calyptrornis bairdii banksia</i> Red-tailed Black-Cockatoo (coastal subspecies)	E4A		Confined to northern and eastern coastal Qld and, possibly, far north-eastern NSW. Only four records for NSW between 1980 and July 2009, all in the Tweed and Richmond Valleys: at Bungawalbin Nature Reserve, Round Mountain (Bogangar), Wilsons Creek (north of Alstonville), and at Cabarita.	In NSW, reported from dry open forest and mixed rainforest-eucalypt forest.	Unlikely. Species not recorded in Byron LGA or in surveys on the site in 2007, 2009 and 2014.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Cartierornis leucotis</i> White-eared Monarch	V		In NSW, generally found from the Qld border south to Iluka at the mouth of the Clarence River, and inland to the Richmond Range. Occasional records further south near Woolgoolga and around Port Macquarie.	In NSW, it occurs in rainforest, especially drier types, such as littoral rainforest, as well as wet and dry sclerophyll forests, swamp forest and regrowth forest.	Known. Low probability of birds foraging within the development footprint.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Cyclopsitta diophthalma coxeni</i> Coxen's Fig-Parrot	E4A	E	Limited to about five populations scattered between Bundaberg in Qld and the Hastings River in NSW.	Drier rainforests and adjacent wetter eucalypt forest, and wetter lowland rainforests.	Potential. Systematic fauna surveys in 2007, 2009, 2014, not detected. However, potential habitat present adjacent to development site	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Ephippiorhynchus asiaticus</i> Black-necked Stork	E1		Coastal and subcoastal northern and eastern Australia, south to central-eastern NSW and with vagrants recorded further south and inland.	In NSW, floodplain wetlands of the major coastal rivers are key habitat. Also minor floodplains, coastal sandplain wetlands and estuaries.	Unlikely. Not detected in 45 surveys from 2005-2017 of the only suitable habitat in the development area. Annual Performance Reports	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.

<i>Erythrorhynchus radiates</i> Red Goshawk	E4A	V	In NSW, extends to ~30°S. Recent records confined to the Northern Rivers region north of the Clarence River.	Open woodland and forest, often along or near watercourses or wetlands. In NSW, preferred habitats include mixed subtropical rainforest, <i>Mealeuca</i> swamp forest and coastal riparian <i>Eucalyptus</i> forest.	Unlikely. Species not recorded in surveys on the site in 2007, 2009 and 2014	This species is rare in NSW and has a very low probability of occurrence in the development footprint, but is unlikely to experience any direct adverse effect.
<i>Glossopsitta pusilla</i> Little Lorikeet	V		In NSW, found from the coast westward as far as Dubbo and Albury.	Dry, open eucalypt forests and woodlands, including remnant woodland patches and roadside vegetation.	Known. Recorded in surveys	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Ixobrychus flavicollis</i> Black Bittern	V		In NSW, records are scattered along the east coast, with individuals rarely being recorded south of Sydney or inland.	Terrestrial and estuarine wetlands. Also flooded grassland, forest, woodland, rainforest and mangroves where permanent water is present.	Unlikely. Targeted in call playback surveys in 2007, 2009, 2014, not detected	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Lathamus discolor</i> Swift Parrot	E1	CE	Migrates from Tasmania to mainland in Autumn-Winter. In NSW, the species mostly occurs on the coast and south west slopes.	Box-ironbark forests and woodlands.	Potential. Not detected in previous surveys however potential to occur intermittently.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Menura alberti</i> Albert's Lyrebird	V		Restricted to a small area of far south-eastern Qld and north-eastern NSW. In NSW, it is mainly found in the McPherson and Tweed Ranges, but occurs west to the Acacia Plateau in the Border Ranges and south to the Koonum and Nightcap Ranges, and with an isolated population at the species' eastern and southern limit in the Blackwall Range, between Alstonville and Bagotville.	Rainforests or wet sclerophyll forests with a wet understorey, often of rainforest plants.	Unlikely. NSW OEH Bionet Atlas mapping for this species. Not detected in systematic fauna surveys in 2007, 2009, 2014.	No, physical impacts of the development are essentially confined to the development footprint. Nearest records of the species are >8kms west & separated by the Pacific Highway, and fauna fencing
<i>Pandion cristatus</i> Eastern Osprey	V		Common around the northern NSW coast, and uncommon to rare from coast further south. Some records from inland areas.	Rocky shorelines, islands, reefs, mouths of large rivers, lagoons and lakes.	Potential. Systematic fauna surveys in 2007, 2009, 2014, not detected. However, potential habitat present in the site and has the potential to occur intermittently.	Once found near the large dam in the development footprint. Single record was during an event, however event related disturbance may alienate a small area of forage habitat for this species, during events.
<i>Podargus ocellatus</i> Marbled Frogmouth	V		Southern subspecies restricted to south-eastern Qld and north-eastern NSW, between Gladstone and Lismore, and inland to Burnett Range in Qld and west of the Richmond Range.	Subtropical rainforest, or occasionally cool rainforest, higher elevation temperate rainforests or wet Eucalypt forest. In NSW, most often found in moist, lowland, mesophyll vine forest.	Unlikely. Species not recorded in surveys on the site in 2007, 2009 and 2014	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.

<i>Ptilinopus magnificus</i> Wompoo Fruit-Dove	V		In NSW, occurs south along coast and coastal ranges to the Hunter River.	Rainforest, low-elevation moist eucalypt forest and brush box forests.	Known – recorded in 2014	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Ptilinopus regina</i> Rose-crowned Fruit-Dove	V		In NSW, found on coast and ranges north from Newcastle. Vagrants are occasionally found further south to Victoria.	Sub-tropical and dry rainforest, moist eucalypt forest and swamp forest, where fruit is plentiful.	Known – recorded in surveys	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Todiramphus chloris</i> Collared Kingfisher	V		In NSW, occurs along north coast south to the estuary of the Tweed River, with rare scattered records south to the Clarence River.	Mainly restricted to mangrove associations of estuaries, inlets, sheltered bays and islands, and the tidal flats and littoral zone bordering mangroves.	Unlikely. Estuarine & Mangrove species. Not detected in systematic fauna surveys.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Tyto longimembris</i> Eastern Grass Owl	V		Recorded occasionally in all mainland states. In NSW they are more likely to be resident in the north-east	Areas of tall grass, including grass tussocks, swampy areas, grassy plains, swampy heath, and in cane grass or sedges on flood plains.	Targeted surveys were undertaken in July each year for four years (2013 – 2016) and in September 2014 as part of the biennial fauna survey. This species was not present in the main event area (north of Jones Rd) in any year. A pair of Eastern Grass Owls responded to call play back in July 2016 in the exotic grassland in the south of the Parklands. This was the first observation of these species within the site since 2007.	A small area of potential habitat (exotic grassland) will be removed for the construction of the southern carpark.
Invertebrates						
<i>Thersites mitchelliae</i> Mitchell's Rainforest Snail	E1	CE	Found on the coastal plain between the Richmond River and Tweed River on the NSW north coast. It has also been recorded from some adjacent mid-elevation areas including Wilsons River and Mount Jerusalem.	Remnant areas of lowland subtropical rainforest and swamp forest on alluvial soils. Particularly favours wetland edges with palms and fig trees.	Known. Annual Performance Reports 2015, 2016	The species has been found in BNR during bird surveys, but no direct impact from the development is likely. Only indirect potential threat is the possible increase in the risk of wildfire.
<i>Petalura litorea</i> Coastal Petaltail	E1		In NSW it is known from a very small number of locations, including Brooms Head, Tucabia, Diggers Camp and Bonville.	Permanent to semi-permanent coastal freshwater wetlands.	Unlikely. Not recorded in BNR, Bionet Atlas records for Byron LGA are from >20km to south. Not detected in systematic fauna surveys.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Mammals						
<i>Aepyprymnus rufescens</i> Rufous Bettong	V		Distribution extends south to Mt Royal National Park in north-eastern NSW. There are also sporadic, unconfirmed records inland from the Pilliga and Torrington districts.	From tall wet sclerophyll forests on the coast to the dry forests and open woodlands west of the Great Dividing Range.	Unlikely. Species not recorded in surveys on the site in 2007, 2009 and 2014	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.

<i>Cercartetus nanus</i> Eastern Pygmy-possum	V	In NSW it extends from the coast inland as far as the Pilliga, Dubbo, Parkes and Wagga Wagga on the western slopes.	Rainforest, sclerophyll forest (including Box-Ironbark), woodland and heath.	Unlikely. Systematic fauna surveys in 2007, 2009, 2014, not detected	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Petaurus norfolcensis</i> Squirrel Glider	V	Widely though sparsely distributed on both sides of the Great Dividing Range in eastern Australia, from northern Qld to western Victoria.	Mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas.	Unlikely. Species not recorded in surveys on the site in 2007, 2009 and 2014	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Phascogale tapoatafa</i> Brush-tailed Phascogale	V	In NSW it is mainly found east of the Great Dividing Range although there are occasional records west of the divide.	Dry sclerophyll open forest, heath, swamps, rainforest and wet sclerophyll forest.	Unlikely. Systematic fauna surveys in 2007, 2009, 2014, not detected	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Phascolarctos cinereus</i> Koala	V	In NSW it mainly occurs on the central and north coasts with some populations in the west of the Great Dividing Range. There are sparse and possibly disjunct populations in the Bega District, and at several sites on the southern tablelands.	Eucalypt woodlands and forests.	Potential. Species not recorded in systematic fauna surveys on the site in 2007, 2009 and 2014. Biolink surveys found koalas outside the development area in 2007, 2008, & 2016.	Scats found in the far north west of the development footprint in 2016, but the species has not been observed on the site. Numerous koala preferred feed trees included in plantings. Only indirect potential threat is the possible increase in the risk of wildfire. Species may exhibit avoidance behaviour during events.
<i>Planigale maculata</i> Common Planigale	V	Occurs in coastal north-eastern NSW, and reported from as far south as the central NSW coast west of Sydney.	Rainforest, eucalypt forest, heathland, marshland, grassland and rocky areas.	Potential. However, not detected in systematic fauna surveys.	No, physical impacts of the development are essentially confined to the development footprint. Possible direct impact; loss of habitat if the species is present in southern grassland to be cleared for parking.
<i>Potorous tridactylus</i> Long-nosed Potoroo, Cobaki Lakes and Tweed Heads West population	E2,V	The Endangered Population is found in a small area between the northern shore of Cobaki Broadwater and the NSW-Qld border, within the localities of Cobaki Lakes and Tweed Heads West.	Occupies a patch of heath and healthy woodland. At Cobaki, potoroos have been recorded mainly in Scribbly Gum Heathland, but also in Scribbly Gum/Swamp Mahogany Forest, Tree Broom Heath, Scribbly Gum Forest, Black She-oak Heath and Swamp Mahogany Forest.	Unlikely. Species not recorded in surveys on the site in 2007, 2009 and 2014	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Potorous tridactylus</i> Long-nosed Potoroo	V	In NSW it is generally restricted to coastal heaths and forests east of the Great Dividing Range, with an annual rainfall exceeding 760 mm.	Coastal heaths and dry and wet sclerophyll forests.	Unlikely. Species not recorded in surveys on the site in 2007, 2009 and 2014	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.

<i>Pseudomys gracilicaudatus</i> Eastern Chestnut Mouse	V		In NSW, it mainly occurs north from the Hawkesbury River area along the coast and eastern edge of the Great Dividing Range. There are however isolated records in the Jervis bay area.	In NSW mostly found in dense, wet heathland and swamps.	Unlikely. Not recorded in BNR, sole Bionet Atlas record for Byron LGA is from >20km to south.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
Bats						
<i>Chalinolobus dwyeri</i> Large-eared Pied Bat	V	V	Recorded from Rockhampton in Qld south to Ulladulla in NSW. Largest concentrations of populations occur in the sandstone escarpments of the Sydney basin and the NSW north-west slopes.	Wet and dry sclerophyll forests, Cypress Pine dominated forest, woodland, sub-alpine woodland, edges of rainforests and sandstone outcrop country.	Known. Anabat call results, Annual Performance reports	No. Known from the site, recorded from bat calls at the large dam both during and outside events.
<i>Falstrelus tasmaniensis</i> Eastern False Pipistrelle	V		South-east coast and ranges of Australia, from southern Qld to Victoria and Tasmania. In NSW, records extend to the western slopes of the Great Dividing Range.	Tall (greater than 20m) moist habitats.	Known. Anabat call results, Annual Performance reports	No direct impact of any potential habitat for this species and event related disturbance may alienate a small area of forage habitat for this species, during events.
<i>Kerivoula papuensis</i> Golden-tipped Bat	V		Scattered locations on east coast of Australia to south of Eden in southern NSW.	Rainforest and adjacent wet and dry sclerophyll forest up to 1000m. Also recorded in tall open forest, <i>Casuarina</i> -dominated riparian forest and coastal <i>Melaleuca</i> forests.	Known. Anabat call results, Annual Performance reports	No direct impact of any potential habitat for this species and event related disturbance may alienate a small area of forage habitat for this species, during events.
<i>Miniopterus australis</i> Little Bentwing-bat	V		East coast and ranges south to Wollongong in NSW.	Moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, <i>Melaleuca</i> swamps, dense coastal forests and banksia scrub.	Known. Anabat call results, Annual Performance reports	No direct impact of any potential habitat for this species and event related disturbance may alienate a small area of forage habitat for this species, during events.
<i>Miniopterus schreibersii oceanensis</i> Eastern Bentwing-bat	V		In NSW it occurs on both sides of the Great Dividing Range, from the coast inland to Moree, Dubbo and Wagga Wagga.	Rainforest, wet and dry sclerophyll forest, monsoon forest, open woodland, paperbark forests and open grassland.	Known. Anabat call results, Annual Performance reports	No direct impact of any potential habitat for this species and event related disturbance may alienate a small area of forage habitat for this species, during events.
<i>Mormopterus norfolkensis</i> Eastern Freetail-bat	V		Found along the east coast from south Qld to southern NSW.	Dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range.	Known. Anabat call results, Annual Performance reports	No direct impact of any potential habitat for this species and event related disturbance may alienate a small area of forage habitat for this species, during events.
<i>Myotis macropus</i> Southern Myotis	V		In NSW, found in the coastal band. It is rarely found more than 100 km inland, except along major rivers.	Foraging habitat is waterbodies (including streams, or lakes or reservoirs) and fringing areas of vegetation up to 20m.	Known. Anabat call results, Annual Performance reports	No direct impact of any potential habitat for this species and event related disturbance may alienate a small area of forage habitat for this species, during events.

<i>Nyctimene robinsoni</i> Eastern Tube-nosed Bat	V		Few records from far north-east NSW, including the Nightcap, Tweed and Burringbar Ranges and in the vicinity of Mt Warning.	Streamside habitats in coastal subtropical rainforest and moist eucalypt forests with a well-developed rainforest understorey.	Unlikely. Systematic fauna surveys in 2007, 2009, 2014, not detected	Low probability of this species foraging within the development footprint. No direct impact of any potential habitat for this species and event related disturbance may alienate a small area of forage habitat for this species, during events.
<i>Nyctophilus bifax</i> Eastern Long-eared Bat	V		In NSW, appears to be confined to the coastal plain and nearby coastal ranges, extending south to the Clarence River area, with a few records further south around Coffs Harbour.	Lowland subtropical rainforest, wet and swamp eucalypt forest, moist eucalypt forest, coastal scrub.	Known. Detected only during harp trapping (2007 and 2014).	No direct impact of any potential habitat for this species and event related disturbance may alienate a small area of forage habitat for this species, during events.
<i>Pteropus poliocephalus</i> Grey-headed Flying-fox	V	V	Along the eastern coast of Australia, from Bundaberg in Qld to Melbourne in Victoria.	Subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops.	Known. Numerous Grey-headed Flying-fox and Black Flying Foxes observed in 2007, with only single number of individuals observed subsequently. This decline is attributed to the abandonment of the maternity camp in Brunswick Heads Nature Reserve, as well as a lack of foraging resources (blossom) on site during survey periods.	No direct impact of any potential habitat for this species and event related disturbance may alienate a small area of forage habitat for this species, during events.
<i>Saccolaimus flaviventris</i> Yellow-bellied Sheath-tail-bat	V		There are scattered records of this species across the New England Tablelands and North West Slopes. Rare visitor in late summer and autumn to south-western NSW.	Almost all habitats, including wet and dry sclerophyll forest, open woodland, open country, mallee, rainforests, heathland and waterbodies.	Known. Anabat call results, Annual Performance reports	No direct impact of any potential habitat for this species and event related disturbance may alienate a small area of forage habitat for this species, during events.
<i>Syconycteris australis</i> Common Blossom-bat	V		Found north from Hawks Nest in NSW in coastal areas of eastern Australia.	Often roost in littoral rainforest and feed in adjacent heathland and paperbark swamps. Also recorded in subtropical rainforest, wet sclerophyll forest and other coastal forests.	Known. Detected only during harp trapping (2007 and 2014)	No direct impact of any potential habitat for this species and event related disturbance may alienate a small area of forage habitat for this species, during events.
Reptiles						
<i>Cacophis hamlettae</i> White-crowned Snake	V		Coastal and near-coastal areas south to the Coffs Harbour area in north-east NSW. The western limit is the Legume area near the NSW-Qld border.	Low to mid-elevation dry eucalypt forest and woodland, moist eucalypt forest and coastal heathland.	Species not recorded in BNR or Byron LGA or in surveys on the site in 2007, 2009 and 2014.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Coeranoscincus reticulatus</i> Three-toed Snake-tooth Skink	V	V	Coast and ranges from the Macleay valley in NSW to south-eastern Qld.	Rainforest and occasionally moist eucalypt forest, on loamy or sandy soils.	Unlikely. Species not recorded in Byron LGA or in surveys on the site in 2007, 2009 and 2014	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.

<i>Hoplocephalus bitorquatus</i> Pale-headed Snake	V		In NSW, it occurs from the coast to the western side of the Great Divide as far south as Tuggerah. Historically recorded west to Mungindi and Quamby on the Darling Riverine Plains, across the North West Slopes, and the New England Tablelands.	Dry eucalypt forests and cypress forest, rainforest and moist eucalypt forest.	Unlikely. Not recorded from the Byron LGA. Species not recorded in surveys on the site in 2007, 2009 and 2014	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Hoplocephalus stephensi</i> Stephens' Banded Snake	V		Coast and ranges from Southern Qld to Gosford in NSW.	Rainforest and eucalypt forests and rocky areas up to 950 m in altitude.	Unlikely. Species not recorded in surveys on the site in 2007, 2009 and 2014	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.

Appendix K – Likelihood Assessment for Migratory Fauna Species

Scientific Name	Common Name	EPBC Act Status	TSC / BC Act Status	Distribution and Habitat	Likelihood	Justification
Birds						
<i>Anthochaera phrygia</i>	Regent Honeyeater	CE 2012: E, Mi	E4A, P	The Regent Honeyeater mostly inhabits the inland slopes of the Great Dividing Range and can be found in dry eucalypt woodland and open forests on wetter, more fertile areas around forest edges, wooded farmland and urban areas.	Unlikely	Outside species primary range and habitat largely unsuitable. One record approximately 2km south of site. Species not recorded in BNR or in surveys on the site in 2007, 2009 and 2014. Nor during event monitoring.
<i>Apus pacificus</i>	Fork-tailed Swift	Mi		The Fork-tailed Swift is predominantly aerial, more commonly inland however occasionally above foothills in coastal areas with dry and open habitat.	Possible	Marginal habitat, may be seen flying overhead
<i>Calidris ferruginea</i>	Curlew Sandpiper	CE, Mi 2012: Mi		Curlew Sandpiper commonly occur on the coastline, foraging and roosting in intertidal mudflats in sheltered estuaries, bays, inlets and lagoons.	Unlikely	No suitable habitat
<i>Cuculus optatus</i>	Oriental Cuckoo	Mi		Oriental Cuckoo inhabits forested woodlands. Large range, visiting the east coast of Australia from late Spring and Summer.	Likely	Recorded once in four years' of site surveys within 1 km of project area
<i>Gallinago hardwickii</i>	Latham's Snipe	Mi		Latham's Snipe occurs in permanent and ephemeral wetlands, inhabiting low dense vegetation.	Possible	Marginal habitat on site, existing records in surrounding areas Species not detected during targeted surveys on the site in 2007, 2009 and 2014. Nor during event monitoring.
<i>Gallinago megala</i>	Swinhoe's Snipe	Mi		Swinhoe's Snipe occurs along the coast, preferring the edges of wetlands, such as wet paddy fields, swamps and freshwater streams.	Unlikely	Marginal habitat, few definite records exist within Australia
<i>Gallinago stenura</i>	Pin-tailed Snipe	Mi		The distribution of the Pin-tailed Snipe in Australia is not well understood. The species can be found most often in or at the edges of shallow freshwater swamps, ponds and lakes with emergent, sparse to dense cover of grass/sedge or other vegetation.	Unlikely	Marginal habitat, few definite records exist within Australia
<i>Hirundapus caudacutus</i>	White-throated Needletail	Mi		White-throated Needletail is recorded in all regions of Australia and is almost exclusively aerial, however has been observed roosting in a variety of wooded habitats.	Known	Recorded during 2009 surveys.
<i>Limosa lapponica</i>	Bar-tailed Godwit	V, Mi 2012: Mi		Bar-tailed Godwit is found in all coastal areas of Australia, inhabiting large intertidal sandflats, mudflats, banks and estuaries	Unlikely	No suitable habitat
<i>Monarcha melanopsis</i>	Black-faced Monarch	Mi		Black-faced Monarch occurs in rainforest ecosystems, including semi-deciduous vine-thickets, complex notophyll vine-forest, tropical and sub-tropical rainforests	Known	Recorded in Parklands during targeted bird surveys
<i>Monarcha trivirgatus</i>	Spectacled Monarch	Mi		The Spectacled Monarch prefers thick understorey in rainforests, wet gullies and waterside vegetation, as well as mangroves.	Known	Recorded regularly in Parklands during targeted bird surveys

Scientific Name	Common Name	EPBC Act Status	TSC / BC Act Status	Distribution and Habitat	Likelihood	Justification
<i>Motacilla flava</i>	Yellow Wagtail	Mi		Summer migrant to north-east Queensland and increasing records in the Hunter region of NSW (DoE 2017). No known records in the Byron LGA. Habitats include open areas with low vegetation such as grasslands, airstrips, pastures, sports fields; damp open areas such as muddy or grassy edges of wetlands, rivers, irrigated farmland	Unlikely	Suitable habitat, no records in Byron LGA
<i>Myiagra cyanoleuca</i>	Satin Flycatcher	Mi		The Satin Flycatcher is widespread across Australia, often found in eucalypt forests near wetlands or watercourses.	Known	Recorded in Parklands during targeted bird surveys
<i>Numenius madagascariensis</i>	Eastern Curlew	CE, Mi 2012; Mi		The Eastern Curlew can be found along the Australian coast, found in estuaries, bays, harbours, inlets and coastal lagoons with large intertidal mudflats or sandflats	Unlikely	No suitable habitat
<i>Numenius minutus</i>	Little Curlew	Mi		The Little Curlew can be found along the NSW coast, often found in short, dry grassland and sedgeland, including dry floodplains with scattered shallow freshwater pools or seasonally inundated areas.	Unlikely	Marginal habitat, no known records in area
<i>Numenius phaeopus</i>	Whimbrel	Mi		The Whimbrel can be found along the coast of Australia, typical habitat includes intertidal mudflats or sheltered coasts, as well as harbours, lagoons, estuaries and rivers.	Unlikely	No suitable habitat
<i>Pandion cristatus</i>	Eastern Osprey	Mi		Osprey habitat includes terrestrial wetlands, mostly in coastal areas, however can travel inland along major rivers. They frequent a variety of wetland habitats including inshore waters, reefs, bays, coastal cliffs, beaches, estuaries, mangrove swamps, broad rivers, reservoirs and large lakes and waterholes (DoE 2017)	Known	Recorded in Parklands during targeted bird surveys (2015)
<i>Pluvialis fulva</i>	Pacific Golden Plover	Mi		The Pacific Golden Plover is a widespread coastal species, usually inhabiting beaches, mudflats and sandflats, occasionally around inland wetlands.	Unlikely	Marginal habitat, no known records in area
<i>Rhipidura rufifrons</i>	Rufous Fantail	Mi		The Rufous Fantail occurs in coastal and near coastal areas of northern and eastern Australia. Usually inhabits wet sclerophyll forests usually with a dense shrubby understorey.	Known	Recorded in Parklands during targeted bird surveys
<i>Rostratula australis</i>	Australian Painted Snipe	E 2012; V, Mi		Australian Painted Snipe occurs in all states of Australia, more common in eastern Australia. Wetland dependent species, found in shallow terrestrial freshwater (occasionally brackish) wetlands, temporary or permanent lakes, swamps and clay pans.	Unlikely	Marginal habitat, no records in area
<i>Sterna albigrons</i>	Little Tern	Mi		In NSW, the Little Tern occurs mostly north of Sydney, with small numbers in Victoria. Species is almost exclusively coastal, preferring sheltered environments, occasionally observed in inlets and rivers.	Unlikely	No suitable habitat
<i>Tringa brevipes</i>	Grey-tailed Tattler	Mi		Grey-tailed Tattler is found in most coastal regions in Australia, found in sheltered coasts with reefs and rock platforms or intertidal mudflats.	Unlikely	No suitable habitat
<i>Tringa nebularia</i>	Common Greenshank	Mi		The Common Greenshank can be found along the coast and coastal inland areas of Australia. Occurs in all types of wetland habitats and coastal habitats of varying salinity, both permanent and ephemeral.	Unlikely	No suitable habitat

Scientific Name	Common Name	EPBC Act Status	TSC / BC Act Status	Distribution and Habitat	Likelihood	Justification
<i>Turnix melanogaster</i>	Black-breasted Button-quail	V		Black-breasted Button-quail has a scattered distribution in New South Wales. Often found in semi-evergreen vine thickets, coastal dune scrub and dry rainforests	Unlikely	Suitable habitat onsite, no known records in area

Appendix L - Likelihood Assessment for Flora Species

Species name	Common name	TSC / BC Act	EPBC Act	Distribution	Habitat	Likelihood of occurrence in the development site	Habitat on site directly or indirectly impacted
<i>Acacia bakeri</i>	Marblewood	V		Restricted to coastal south-east Qld and north-east NSW, where it occurs north from Mullumbimby.	Lowland subtropical rainforest, adjacent eucalypt forest and in regrowth of both.	Unlikely. Targeted threatened flora surveys 2009.	No, physical impacts of the development are confined to the development footprint which does not contain any potential habitat for this species.
<i>Acalypha eremorum</i>	Acalypha	E1		In NSW it occurs in only a few localities, including the Chaelundi, Lismore and Burringbar areas.	Subtropical rainforest, dry rainforest and vine thickets.	Unlikely. Surveys within the property targeting Threatened flora species.	No, physical impacts of the development are confined to the development footprint which does not contain any potential habitat for this species.
<i>Acronychia littoralis</i>	Scented Acronychia	E1	E	Between Fraser Island in Qld and Port Macquarie on the north coast of NSW.	Littoral rainforest on sand.	Unlikely. No suitable habitat (unsuitable soils within site)	No, physical impacts of the development are confined to the development footprint which does not contain any potential habitat for this species.
<i>Allocasuarina defungens</i>	Dwarf Heath Casuarina	E1	E	Only in NSW, from the Napiac area, north-west of Forster, to Byron Bay on the NSW north coast.	Tall heath on sand, also nearby-coastal hills or headlands adjacent to sandplains.	Unlikely. Surveys within the property targeting Threatened flora species.	No, physical impacts of the development are confined to the development footprint which does not contain any potential habitat for this species.
<i>Angiopteris evecta</i>	Giant Fern	E1		Only one plant known in the wild in NSW, in the Burringbar Range near Murwillumbah.	Lowland rainforest or wet eucalypt forest where water is abundant.	Unlikely. Surveys within the property targeting Threatened flora species.	No, physical impacts of the development essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Archidendron hendersonii</i>	White Lace Flower	V		Found south to the Richmond River in north-east NSW.	Riverine and lowland subtropical rainforest and littoral rainforest.	Unlikely. Targeted threatened flora surveys 2009. Basalt soils, not present on the site.	No, physical impacts of the development essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Arthraxon hispidus</i>	Hairy Joint Grass	V	V	In NSW, found on the northern tablelands and north coast.	Edges of rainforest and in wet eucalypt forest, often near creeks or swamps.	Unlikely. Target survey in June 2017 did not detect the species and habitat suitability was considered poor.	No, physical impacts of the development essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Belvisia mucronata</i>	Needle-leaf Fern	E1		In NSW, it is known from only five locations on the far north coast, north from Evans Head.	On trees or rocks in dry rainforest or along creeks in moist open forest.	Unlikely. Targeted threatened flora surveys 2009.	No, physical impacts of the development essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Bosistoia transversa</i>	Yellow Satinheart	V	V	In north-east NSW, it is found south to the Nightcap Range north of Lismore.	Lowland subtropical rainforest up to 300 m in altitude.	Unlikely. Targeted threatened flora surveys 2009.	No, physical impacts of the development essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Caesalpinia bonduc</i>	Knicker Nut	E1		In NSW found on the northern part of Lord Howe Island, and on the far north coast.	Coastal scrub on sandy, coral-derived soil close to the shoreline.	Unlikely. Targeted threatened flora surveys 2009	No, physical impacts of the development essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Cassia brewsteri</i> <i>var. markiana</i>	Brush Cassia	E1		North from Brunswick Heads, around Murwillumbah.	Littoral and riverine rainforest, regrowth vegetation on farmland and along roadsides.	Unlikely. Surveys within the property targeting Threatened flora species.	No, physical impacts of the development essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Centranthera cochinchinensis</i>	Swamp Foxglove	E1		North from Woolli.	Swampy areas and other moist sites.	Unlikely. Targeted threatened flora surveys 2009.	No, physical impacts of the development essentially confined to the development footprint which does not contain any potential habitat for this species.

Species name	Common name	TSC / BC Act	EPBC Act	Distribution	Habitat	Likelihood of occurrence in the development site	Habitat on site directly or indirectly impacted
<i>Choricarpia subargentea</i>	Giant Ironwood	E1		Known in NSW only from Mount Chincogan near Mullumbimby and one recent record at Jiggi north-west of Lismore.	Has been recorded in NSW in rainforest regrowth on basalt-derived soil.	Unlikely. Surveys within the property targeting Threatened flora species.	No, physical impacts of the development essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Coatesia paniculata</i>	Axe-Breaker	E1		Moderately common in restricted habitat in Queensland between the Brisbane River and the central Queensland coast, but very rare in north-east NSW, where it is known from the Tweed, Lismore and Wardell areas.	Axe-Breaker is found in dry subtropical rainforest and vine scrub, often along rivers.	Unlikely. Surveys within the property targeting Threatened flora species.	No, physical impacts of the development essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Corokia whiteana</i>	Corokia	V	V	Only in north-east NSW: one population in the Nightcap Range, one in the Tweed Valley, and the other near Brunswick Heads.	Boundaries between wet eucalypt forest and warm temperate rainforest, at altitudes up to 800 m.	Potential. Marginal habitat on site, records within BNR 1.5 km from site. Species not observed during targeted flora survey 2009 or subsequent site inspections	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Cryptocarya foetida</i>	Sinking Cryptocarya	V	V	Coastal south-east Qld and north-east NSW south to Iluka.	Littoral rainforest, on sandy or basaltic soils.	Known. Recorded during targeted threatened flora surveys 2009.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Cupaniopsis serrata</i>	Smooth Tuckeroo	E1		In NSW, it is confined to the Tweed Valley.	Subtropical and dry rainforest.	Unlikely. Targeted threatened flora surveys 2009.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Cyperus aquatilis</i>	Water Nutgrass	E1		In NSW, known only from a few sites north from Grafton.	Ephemeral wet sites, such as roadside ditches and seepage areas from small cliffs, in sandstone areas.	Unlikely. Targeted threatened flora surveys 2009.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Davidsonia jerseyana</i>	Davidson's Plum	E1	E	Restricted to north-east NSW to as far south as Wardell.	Lowland subtropical rainforest and wet eucalypt forest below 300m.	Potential. Suitable habitat on site, records to the west of the development footprint.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Davidsonia johnsonii</i>	Smooth Davidson's Plum	E1	E	South-east Qld and north-east NSW south to Tintenbar.	Lowland subtropical rainforest and wet eucalypt forest below 300m.	Known. Targeted threatened flora surveys 2009. Recorded immediately adjacent to development site	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Dendrobium melaleucaphilum</i>	Spider orchid	E1		Coastal districts and nearby ranges, extending from Qld to the lower Blue Mountains.	Grows on <i>Melaleuca styphelioides</i> , on rainforest trees or on rocks in coastal districts.	Unlikely. Targeted threatened flora surveys 2009.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.

Species name	Common name	TSC / BC Act	EPBC Act	Distribution	Habitat	Likelihood of occurrence in the development site	Habitat on site directly or indirectly impacted
<i>Dendrocnide moroides</i>	Gympie Stinger	E1		South from Qld to the Clarence River in north-east NSW.	Lowland rainforest, especially in gaps or other disturbed sites.	Unlikely. Targeted threatened flora surveys 2009.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Desmodium acanthocladium</i>	Thorny Pea	V	V	Occurs only in north-east NSW, in the Lismore area, near Grafton, Coraki, Casino and the Mount Warning area.	Dry rainforest and fringes of riverine subtropical rainforest, on basalt-derived soils at low elevations.	Unlikely. Targeted threatened flora surveys 2009. Basalt soils, not present on the site.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Diospyros mabacea</i>	Red-fruited Ebony	E1	E	Only in north-east NSW. Found in a few stands on the Tweed and Oxley Rivers, upstream from Murwillumbah, on Stott's Island in the lower Tweed River and west of Mullumbimby on the Brunswick River.	Lowland subtropical rainforest, often close to rivers.	Unlikely. Targeted threatened flora surveys 2009.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Diospyros yandina</i>	Shiny-leaved Ebony	E1		In NSW this species is found only in Hogans Scrub at North Tumbulgum and on Mount Cougal, in the Tweed Valley. It also occurs in south-east Queensland.	It grows in the understorey of riverine or lowland subtropical rainforest.	Unlikely. Targeted threatened flora surveys 2009.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Diploglottis campbellii</i>	Small-leaved Tamarind	E1	E	Coastal lowlands between Richmond River on the Far North Coast of NSW and Mudgeeraba Creek on the Gold Coast hinterland, Qld.	Confined to the warm subtropical rainforests of the NSW-Qld border lowlands and adjacent low ranges, ranging from lowland subtropical rainforest to drier subtropical rainforest with a Brush Box open overstorey.	Unlikely. Targeted threatened flora surveys 2009.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Doryanthes palmeri</i>	Giant Spear Lily	V		In NSW, occurs on the coastal ranges that are part of the Mt Warning Caldera. Its southern distributional limit is Mount Billen.	Exposed rocky outcrops, cliff-tops and on steep cliff-faces in montane heath next to subtropical rainforest, warm temperate rainforest or wet eucalypt forest.	Potential. Surveys within the property targeting Threatened flora species.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Drynaria rigidula</i>	Basket Fern	E1		In NSW it is only found north of the Clarence River, in a few locations at Maclean, Bogangar, Byron Bay, Mullumbimby, in the Tweed Valley and at Woodenbong.	Rainforest, moist eucalypt or Swamp Oak forest, growing on plants, rocks or on the ground.	Potential. Surveys within the property targeting Threatened flora species.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Elathea hardeniana</i>	Nightcap Oak	E1	CE	Only in the Nightcap Range north of Lismore.	Upland warm temperate rainforest, usually near creeks.	Unlikely. Targeted threatened flora surveys 2009.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.

Species name	Common name	TSC / BC Act	EPBC Act	Distribution	Habitat	Likelihood of occurrence in the development site	Habitat on site directly or indirectly impacted
<i>Eleocharis williamsianus</i>	Hairy Quandong	E1	E	Restricted to a very few sites between Goonengerry and Burringbar in north-east NSW.	Subtropical to warm temperate rainforest, including regrowth areas, on soils derived from metasediments.	Potential. Targeted threatened flora surveys 2009	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Elionurus citreus</i>	Lemon-scented Grass	E1		North of Grafton, NSW specifically Casino, Cudgen Lake and Yuraygir National Park. Also occurs in QLD, NT, WA and New Guinea.	Grows on sandy soils near rivers or along the coast in wallum areas or sand dunes. In NSW, the species has been found growing in infertile white sands.	Unlikely. All NSW locations the species has been found growing in infertile white sands: OEH species profile. Targeted threatened flora surveys 2009.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Endlandra floydii</i>	Crystal Creek Walnut	E1	E	In NSW, confined to the Tweed and Brunswick Valleys and Byron Bay area.	Warm temperate or subtropical rainforest with Brush Box overstorey, and in regrowth rainforest and Camphor Laurel forest.	Recorded immediately adjacent to development site	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Endlandra hayesii</i>	Rusty Rose Walnut	V	V	From Burleigh Heads in Qld to the Richmond River in north-east NSW.	Sheltered moist gullies in lowland subtropical and warm temperate rainforest on alluvium or basaltic soils.	Suitable habitat, several records adjacent to site (<500 m), one within BNR Species not observed during targeted flora surveys 2009 or subsequent site inspections	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Endlandra muelleri</i> subsp. <i>bracteata</i>	Green-leaved Rose Walnut	E1		From southern Qld to north-east NSW south to Maclean.	Subtropical rainforest or wet eucalypt forest, chiefly at lower altitudes.	Known. Plants are present within development site and adjacent areas. Targeted threatened flora surveys 2009.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Floydia praealta</i>	Ball Nut	V	V	Scattered populations from Gympie in Qld to the Clarence River in north-east NSW.	Riverine and subtropical rainforest, usually on soils derived from basalt.	Potential. Surveys within the property targeting Threatened flora species.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Fontainea australis</i>	Southern Fontainea	V	V	Restricted to the Tweed Valley and a few locations in the upper reaches of the Richmond Valley.	Lowland subtropical rainforest, usually on basaltic alluvial flats, and cooler subtropical rainforest in the Nightcap Range.	Unlikely. Targeted threatened flora surveys 2009.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Geodorum densiflorum</i>	Pink Nodding Orchid	E1		In NSW, occurs north of Bundjalung National Park, including the Tweed Shire.	Dry eucalypt forest and coastal swamp forest at lower altitudes, often on sand.	Known from outside the development site. No, physical impacts of the development are essentially confined to the development footprint.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Gossia fragrantissima</i>	Sweet Myrtle	E1	E	South-east Qld and in north-east NSW south to the Richmond River.	Dry subtropical and riverine rainforest, mainly on basalt-derived soils.	Unlikely. Targeted threatened flora surveys 2009.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.

Species name	Common name	TSC / BC Act	EPBC Act	Distribution	Habitat	Likelihood of occurrence in the development site	Habitat on site directly or indirectly impacted
<i>Grevillea hilliana</i>	White Yiel Yiel	E1		In NSW, known only near Brunswick Heads, on the slopes of Mt Chincogan near Byron Shire, and in patches of remnant habitat in the Tweed Shire, particularly around Terranora.	Subtropical rainforest, often on basalt-derived soils.	Unlikely. Targeted threatened flora surveys 2009.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Hamleria hygrophiloides</i>		E1		In NSW, recorded only at Hortons Creek and two other places south of Nymboida, and at Brunswick Heads.	Littoral rainforest, dry rainforest and wet eucalypt forest, usually in well-drained areas.	Potential. Targeted threatened flora surveys 2009	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Hicksbeachia pinnatifolia</i>	Red Boppel Nut	V	V	Coastal areas of north-east NSW from the Nambucca Valley north to south-east Qld.	Subtropical rainforest, moist eucalypt forest and Brush Box forest.	Potential. Targeted threatened flora surveys 2009.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Isoglossa eranthemoides</i>	Isoglossa	E1	E	Very restricted distribution in north-east NSW from the Tweed to the Lismore area.	Lowland subtropical rainforest, in moist situations on floodplains and slopes.	Unlikely. Targeted threatened flora surveys 2009. All Byron LGA records in the Bionet Atlas are located in the far south-west of the Shire.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Lepiderema pulchella</i>	Fine-leaved Tuckeroo	V		NSW north coast, north of Brunswick Heads, into Qld. Most records in NSW are from the Tweed Valley.	Subtropical rainforest, mainly on infertile metasediments, fertile basalts and back swamp alluvium.	Potential. Surveys within the property targeting Threatened flora species.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Lindsaea brachypoda</i>	Short-footed Screw Fern	E1		In NSW mainly found in a few locations north from Minyon Falls in Nightcap National Park. Records exist for Tumbulgum, Mullumbimby and Mooball.	Very moist habitats in subtropical or warm-temperate rainforest or palm forest.	No suitable habitat (unsuitable soils within site)	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Lindsaea fraseri</i>	Fraser's Screw Fern	E1		In NSW it is known from near Hastings Point on the Tweed coast and in the Pillar Valley east of Grafton.	Poorly drained, infertile soils in swamp forest or open eucalypt forest.	Potential. Surveys within the property targeting Threatened flora species.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Macadamia tetraphylla</i>	Rough-shelled Bush Nut	V	V	Confined chiefly to the north of the Richmond River in north-east NSW, extending just across the border into Qld.	Subtropical rainforest, usually near the coast.	Known. Targeted threatened flora surveys 2009.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Marsdenia longiloba</i>	Slender Marsdenia	E1	V	In NSW, occurs at scattered locations on the north coast north from Barrington Tops.	Subtropical and warm temperate rainforest, lowland moist eucalypt forest adjoining rainforest, areas with rock outcrops.	Known Targeted threatened flora surveys 2009.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.

Species name	Common name	TSC / BC Act	EPBC Act	Distribution	Habitat	Likelihood of occurrence in the development site	Habitat on site directly or indirectly impacted
<i>Myrsine richmondensis</i>	Ripple-leaf Muttonwood	E1	E	Coraki, Boatharbour near Lismore, and the Cherry Tree area west of Casino.	Subtropical and dry rainforest and swamp forest on creek flats and slopes on basalt derived soil.	Potential. Targeted threatened flora surveys 2009.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Niemeyera whitei</i>	Rusty Plum, Plum Boxwood	V		Coast and adjacent ranges of northern NSW from the Macleay River into southern Qld.	Rainforest and adjacent moist eucalypt forest.	Potential. Targeted threatened flora surveys 2009.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Oberonia complanata</i>	Yellow-flowered King of the Fairies	E1		Within NSW, several historical collections from Byron Bay, Lismore, and Coffs Harbour. More recently recorded from Lismore and Wollumbin.	Littoral rainforest, subtropical rainforest, wet or dry eucalypt forests, stream-side areas, swampy forests and mangroves. Grows on trees and rocks.	Potential. Targeted threatened flora surveys 2009.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Ochrosia moorei</i>	Southern Ochrosia	E1	E	North-east NSW north from the Richmond River into south-east Qld.	Riverine and lowland subtropical rainforest.	Potential. Targeted threatened flora surveys 2009.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Oldenlandia galloides</i>		E1		In NSW, known from Whioirie State Forest south of Casino, one location in the Tweed district, and also occurs on the north-west plains.	Margins of seasonally inundated wetlands in paperbark swamps and <i>Eucalyptus tereticornis</i> (Forest Red Gum) woodlands.	Potential. Targeted threatened flora surveys 2009.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Owenia cepiadora</i>	Onion Cedar	V	V	North from the Richmond River in north-east NSW extending just across the Qld border.	Subtropical and dry rainforest on or near soils derived from basalt.	Potential. Targeted threatened flora surveys 2009.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Ozothamnus vagans</i>	Wollumbin Dogwood	E1	V	Restricted to Mt Warning and the Tweed and McPherson Ranges of north east NSW and south east Qld.	Subtropical rainforest and cool temperate rainforest. Prefers open areas of disturbance.	Potential. Targeted threatened flora surveys 2009.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Phaius australis</i>	Southern Swamp Orchid	E1	E	Qld and north-east NSW as far south as Coffs Harbour.	Swampy grassland or swampy forest including rainforest, eucalypt or paperbark forest, mostly in coastal areas.	Potential. Targeted threatened flora surveys 2009.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Phaius tancarvilleae</i>	Lady Tankerville's Swamp Orchid	E1	E	May now be extinct in former range of north-east NSW. Also Qld.	Swampy grassland or swampy forest, including rainforest, eucalypt and paperbark forest.	Potential. Targeted threatened flora surveys 2009.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.

Species name	Common name	TSC / BC Act	EPBC Act	Distribution	Habitat	Likelihood of occurrence in the development site	Habitat on site directly or indirectly impacted
<i>Phyllanthus microcladus</i>	Brush Sauropus	E1		In NSW confined to a few locations in the Tweed, Brunswick, Richmond and Wilson River Valleys with an outlying population near Grafton.	Riparian rainforest.	Unlikely. Surveys within the property targeting Threatened flora species.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Pomaderris notata</i>	McPherson Range Pomaderis	V		In NSW it is known from five sites in the McPherson and Tweed Range areas, including Mount Warning National Park, Meebin National Park and Limpinwood Nature Reserve.	Rocky/basalt ranges in montane heathlands and scrubs or in scrubby rainforest.	Unlikely. Targeted threatened flora surveys 2009.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Randia moorei</i>	Spiny Gardenia	E1	E	From Lismore in north-east NSW north to the Logan River in south-east Qld.	Subtropical, riverine, littoral and dry rainforest.	Potential. Targeted threatened flora surveys 2009.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Rhynchosia acuminatissima</i>	Pointed Trefoil	V		Nine locations north of Lismore, in NSW and Qld.	In or near dry rainforest dominated by Hoop Pine.	Potential. Targeted threatened flora surveys 2009.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Senna acclinis</i>	Rainforest Cassia	E1		Coastal districts and adjacent tablelands of NSW from the Illawarra in NSW to Qld.	Subtropical and dry rainforest.	Potential. Targeted threatened flora surveys 2009.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Sophora fraseri</i>	Brush Sophora	V	V	North from the Casino district in north-east NSW, into south-east Qld.	Moist situations, often near rainforest.	Potential. Surveys within the property targeting Threatened flora species.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Syzygium hodgkinsoniae</i>	Red Lilly Lilly	V	V	From the Richmond River in north-east NSW to Gympie in Qld.	Riverine and subtropical rainforest on rich alluvial or basaltic soils.	Potential. Targeted threatened flora surveys 2009.	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.
<i>Syzygium moorei</i>	Durobby / Coolamon Rose Apple	V	V	Richmond, Tweed and Brunswick River valleys in north-east NSW and into south-east Qld.	Subtropical and riverine rainforest at low altitude. Often occurs as isolated remnant paddock trees.	Recorded on site	No, physical impacts of the development are essentially confined to the development footprint which does not contain any potential habitat for this species.

Appendix M - EP&A Act Assessment of Significance (7-Part Test)

The TSC Act (now repealed and replaced by the BC Act) aimed to protect and encourage the recovery of threatened species, populations and communities listed under the Act. The Act was integrated with the EP&A Act and required consideration of whether a development was likely to significantly affect threatened species, populations and ecological communities or their habitat. Impacts were assessed through the application of the Assessment of Significance (7-part test). If such impacts were considered significant under the terms of the TSC Act, a Species Impact Statement may have been required.

As the TSC Act has now been repealed, the equivalent assessment process has now been integrated into the BC Act (Part 7, Division 1, Section 7.3). Nonetheless, the below assessment has been undertaken using the TSC Act 7-part test assessment, as it was drafted when the TSC Act was in effect.

Threatened species and communities known or potentially likely to occur have been assessed and are grouped below.

Table 13: Species and EEC groupings subject to 7-part test assessment

Grouping	Species / Community
Forest flora	KNOWN
	Davidson's Plum (<i>Davidsonia jerseyana</i>)
	Rough Shelled Bushnut (<i>Macadamia tetraphylla</i>)
	Durobby / Coolamon Rose Apple (<i>Syzygium moorei</i>)
	Stinking Cryptocarya (<i>Cryptocarya foetida</i>)
	Green-leafed Rose Walnut (<i>Endiandra muelleri</i> ssp. <i>bracteata</i>)
	POTENTIAL
	Rusty Rose Walnut (<i>Endiandra hayesii</i>)
	Clear Milkvine (Slender Marsdenia) (<i>Marsdenia longiloba</i>)
	Southern Fontainea (<i>Fontainea australis</i>)
	Pink Nodding Orchid (<i>Geodorum densiflorum</i>)
	<i>Corokia whiteana</i>
EECs	Swamp sclerophyll forest on coastal floodplains of the NSW north coast bioregion
	Subtropical coastal floodplain forest of the NSW north coast bioregion
	Lowland rainforest of the NSW north coast bioregion
	Coastal Cypress Pine of the NSW north coast bioregion
Microbats	KNOWN
	Common Blossum-bat (<i>Syconycteris australis</i>)
	Eastern Bent-wing Bat (<i>Miniopterus schreibersii oceanensis</i>)
	Eastern False Pipistrelle (<i>Falsistrellus tasmaniensis</i>)
	Eastern Freetail-bat (<i>Mormopterus norfolkensis</i>)
	Eastern Long-eared Bat (<i>Nyctophilus bifax</i>)

	Golden-tipped Bat (<i>Kerivoula papuensis</i>) Large-eared Pied Bat (<i>Chalinolobus dwyeri</i>) – EPBC Act vulnerable species Little Bent-wing Bat (<i>Miniopterus australis</i>) Southern Myotis (<i>Myotis macropus</i>) Yellow-bellied Sheath-tailed Bat (<i>Saccolaimus flaviventris</i>)
Nectar or fruit foraging species (birds and bats)	KNOWN Little Lorikeet (<i>Glossopsitta pusilla</i>) Rose-crowned Fruit Dove (<i>Ptilinopus regina</i>) White-eared Monarch (<i>Carterornis leucotis</i>) Wompoo Fruit Dove (<i>Ptilinopus magnificus</i>) Grey-headed Flying-fox (<i>Pteropus poliocephalus</i>) POTENTIAL Coxen's Fig Parrot (<i>Cyclopsitta diophthalma coxeni</i>) Swift Parrot (<i>Lathamus discolor</i>)

Individually assessed species:

- Eastern Grass Owl (*Tyto longimembris*) – known
- Eastern Osprey (*Pandion cristatus*) – known
- Koala (*Phascolarctos cinereus*) – vulnerable species AND endangered population (Koala *Phascolarctos cinereus* (Goldfuss, 1817) between the Tweed and Brunswick Rivers east of the Pacific Highway) – known
- Mitchell's Rainforest Snail (*Thersites mitchellae*) – potential (known from Billinudgel Nature Reserve)
- Common Planigale (*Planigale maculata*) – potential

12.1 Flora

Five listed flora species have been identified as occurring in the Development site and five have the potential to occur. A 7 part test, conducted in accordance with the EP&A Act, has been conducted for the flora species and is provided in **Table 39**.

12.1.1 Five flora species identified within the Development Site

Davidson's Plum (*Davidsonia jerseyana*)

This species occurs in lowland subtropical rainforest and wet eucalypt forest at low altitudes. Many trees are isolated in paddocks and on roadsides in former rainforest habitats. A small stand of mature Davidson's Plum trees occurs just outside the western boundary of the Parklands site, in association with an area of Lowland Rainforest TEC. The OEH profile for this species list the following threats:

- Clearing and fragmentation of habitat
- Grazing by domestic stock
- Roadworks
- Invasion of habitat by weeds
- Fire
- Collection of fruit for bush food, and seeds for horticulture

Rough-shelled Bush Nut (*Macadamia tetraphylla*)

This species occurs in subtropical rainforest, usually near the coast and was found in the rainforest and Brush Box communities in the development site. Three Rough-shelled Bush Nut trees are located in the northwest corner of the Parklands site. They are located in a paddock in the north-east corner of the site and are associated with an old domestic structure. It is possible that they represent planted specimens. These individuals are have impacted by historical competition from Camphor Laurel and Mango Trees (Fitzgerald 2016a), but this is being addressed by the Parkland's bush regeneration team. The OEH profile for this species list the following threats:

- Clearing and fragmentation of habitat for coastal development, agriculture and roadworks
- Risk of local extinction due to low numbers
- Grazing and trampling by domestic stock
- Fire
- Invasion of habitat by weeds
- Loss of local genetic strains through hybridisation with commercial varieties
- Reduction of genetic diversity as a result of fragmentation

Durobby / Coolamon Rose Apple (*Syzygium moorei*)

This species prefers subtropical and riverine rainforest at low altitude. It often occurs as isolated remnant paddock trees and is readily propagated and widely planted in rural areas. The species has been recorded 75 times in the Byron Bay Local Government Area, with many records consisting of just one individual (TSSC, 2008b). This species was found in rainforest and as isolated individuals in paddocks in the development site. Two mature Coolamon Rose Apple trees are located close to the western boundary of the Parklands site. The OEH profile for this species list the following threats:

- Clearing and fragmentation of habitat for agriculture
- Clearing and fragmentation of habitat for rural and residential development and roadworks
- Weed infestation of rainforest habitats
- Grazing and trampling of seedlings and saplings by domestic stock, particularly around remnant paddock trees
- Illegal collection for horticulture
- Risk of local extinction due to small population sizes

Stinking Cryptocarya (*Cryptocarya foetida*)

This species is found in littoral, warm temperate and subtropical rainforest, wet sclerophyll forest and Camphor laural forest usually on sandy soils, but mature trees are also known on basalt soils. This species occurs as a single tree specimen located in an area of Swamp Sclerophyll Forest habitat on Lot 402 DP755687 near the centre of the Parklands site. The OEH profile for this species list the following threats:

- Risk of local extinction because populations are small
- Clearing and fragmentation of habitat for development
- Clearing and fragmentation of habitat for agriculture
- Infestation of habitat by weeds
- Clearing and disturbance as a result of roadworks and track maintenance
- Inappropriate fire regime including altering habitat and destroying individuals
- Trampling by visitors when accessing beach areas through littoral rainforest
- Trampling by domestic stock
- Risk of local extinction due to small population sizes

Green-leaved Rose Walnut (*Endiandra muelleri* subsp. *bracteata*)

This species occurs in subtropical and warm temperate rainforests and Brush Box forests, including regrowth and highly modified forms of these habitats. This species was found adjacent to the project area in Lowland Rainforest. The OEH profile for this species list the following threats:

- Clearing and fragmentation of habitat for coastal development
- Clearing and fragmentation of habitat for agriculture
- Infestation of habitat by weeds
- Clearing and fragmentation of habitat for road works
- Frequent fire
- Disturbance from recreational users in reserve areas
- Forestry related activities within wet sclerophyll forest habitat
- Damage from domestic stock
- Habitat loss and fragmentation as a result of infrastructure development including powerline construction

12.1.2 Five flora species with the potential to occur within the Development Site.

Rusty Rose Walnut (*Endiandra hayesii*)

This species is found on sheltered moist gullies in lowland subtropical and warm temperate rainforest on alluvium or basaltic soils. The species occurs in regrowth and highly modified forms of these habitats. No individuals of these species have been detected within the development site. However, suitable habitat is present within the stands of native remnant vegetation on site. The OEH profile for this species list the following threats:

- Clearing and fragmentation of habitat for coastal development
- Clearing and fragmentation of habitat for agriculture
- Infestation of habitat by weeds
- Clearing and fragmentation of habitat for road works
- Frequent fire
- Disturbance from recreational users in reserve areas
- Forestry related activities within we sclerophyll forest habitat
- Damage from domestic stock
- Habitat loss and fragmentation as a result of infrastructure development including powerline construction

Slender Marsdenia (*Marsdenia longiloba*)

This species is found in subtropical and warm temperate rainforest, lowland moist or open eucalypt forest adjoining rainforest and, sometimes, in areas with rock outcrops. No individuals of these species have been detected within the development site. However, suitable habitat is present within the stands of native remnant vegetation on site. The OEH profile for this species list the following threats:

The OEH profile for this species list the following threats for this species:

- Loss and fragmentation of habitat through land clearing for agriculture
- Loss and fragmentation of habitat through land clearing for urban development
- Invasion of habitat by introduced weeds
- Grazing and trampling of plants by cattle
- Disturbance of habitat and loss of individuals as a result of forestry activities
- Risk of local extirpation because populations are small
- At risk from the use of herbicides in weed control activities
- Roadside populations are at risk from road works

Southern Fontainea (*Fontainea australis*)

Southern Fontainea is found in lowland subtropical rainforest, usually on basaltic alluvial flats, and also in cooler subtropical rainforest in the Nightcap Range. No individuals of these species have been detected within the development site. However, suitable habitat is present within the stands of native remnant vegetation on site. The OEH profile for this species list the following threats:

- Clearing and fragmentation of habitat for agriculture
- Clearing and fragmentation of habitat for urban development
- Infestation of habitat by weeds

- Risk of local extinction because populations are small
- Low genetic diversity
- Grazing and trampling by domestic stock limiting opportunities for recruitment
- Loss of individuals as a result of fire

Pink Nodding Orchid (*Geodorum densiflorum*)

This species is found on dry eucalypt forest and coastal swamp forest at lower altitudes, often on sand. No individuals of these species have been detected within the development site. However, suitable habitat is present within the stands of native remnant vegetation on site. The OEH profile for this species list the following threats:

- Clearing and fragmentation of habitat for urban development
- Infestation of habitat by introduced weeds such as Bitou Bush
- Trampling by bushwalkers and fishers
- Illegal collection of orchids

Corokia (*Corokia whiteana*)

Inland populations of this species are found at the boundaries between wet eucalypt forest and warm temperate rainforest, at altitudes up to 800 m. No individuals of these species have been detected within the development site. However, suitable habitat is present within the stands of native remnant vegetation on site. The OEH profile for this species list the following threats:

- Loss of habitat clearing for urban expansion
- Risk of extinction because populations are small and distribution is highly restricted
- Timber harvesting activities
- Fire, as hot fires will kill the plants
- Invasion of habitat by weeds

Hairy Joint Grass

Hairy-joint Grass is a slender tufted creeping grass. It occurs in scattered areas in Queensland and on the northern tablelands and north coast of New South Wales. No individuals of these species have been detected within the development site.

This species was recognised as having a greater potential to occur within the development footprint, specifically within the area of unmanaged pasture grass in the south of the development site.

The OEH lists the threatening processes to Hairy-joint Grass as:

- Clearing of habitat for agriculture and development
- Inappropriate fire regimes
- Over-grazing by domestic stock
- Competition from introduced grasses such as *Paspalum dilatatum* (Paspalum) and *Pennisetum clandestinum* (Kikuyu)
- Slashing or mowing of habitat

Table 39: Flora grouping 7-part test assessment

Criteria	Response to Criteria
a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at the risk of extinction.	No individual plants of these flora species will be removed. On-going benefits will continue to be realised via active habitat creation and preservation, major site bush regeneration, maximising down times between larger events, and utilising best practice with soil and water systems. Indirect impacts: • Potential increased bushfire risk, considered low risk due to stringent bushfire management during events for public safety • Trampling associated with unauthorised access, considered low risk due to fencing and previously low incidence • Increased weed invasion, considered low risk due to few event days and ongoing rehabilitation of the site Ongoing monitoring and remedial action will be undertaken if condition is impaired (e.g. Rough-shelled Bush Nut individuals were experiencing some impact from historical competition from Camphor Laurel and Mango Trees, though this is unrelated to the SITG and FF events and has been addressed by Parklands' bush regeneration team).
b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction	N/A - this is not an endangered population.
c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed: i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or ii. is likely to substantially and adversely modify the composition of the ecological community such that its local	N/A - this is not an EEC or CEEC

occurrence is likely to be placed at risk of extinction.	
d) in relation to the habitat of a threatened species, population or ecological community: i. the extent to which habitat is likely to be removed or modified as a result of the action proposed, and ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long term survival of the species, population or ecological community in the locality	No individual plants of these species will be removed. Overall, the biodiversity characteristics of the site are being permanently improved by the current site managers and utilisation patterns. On-going benefits will continue to be realised via active habitat creation and preservation, major site bush regeneration, maximising down times between larger events, and utilising best practice with soil and water systems.
e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)	The Development site does not constitute a critical habitat for these species.
f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan	No recovery plan or threat abatement plan have yet been developed for the Durobby / Coolamon Rose Apple (<i>Syzygium moorei</i>), Stinking Cryptocarya (<i>Cryptocarya foetida</i>), Slender Marsdenia (<i>Marsdenia longiloba</i>), Southern Fontainea (<i>Fontainea australis</i>), Pink Nodding Orchid (<i>Geodorum densiflorum</i>), Hairy-joint Grass (<i>Arthraxon hispidus</i>) or Corokia (<i>Corokia whiteana</i>). However a National recovery plan has been prepared for the Davidson's Plum by the (former) Department of Environment and Conservation (now OEH) in 2004. The recovery plan identifies the following objectives: • Objective 1: Co-ordinate the recovery of the Davidson's Plum • Objective 2: Determine whether further wild sub-populations exist in NSW, and implement measures as appropriate • Objective 3: Research into the biology, ecology and genetics of the Davidson's Plum • Objective 4: Gain an understanding of the cultural importance of the Davidson's Plum to Local Aboriginal Land Councils, Elders and other groups representing indigenous people. • Objective 5: Manage and protect the Davidson's Plum and associated habitat from threatening processes

	- Objective 6: Develop a contingency strategy to ensure the long-term survival of the Davidson's Plum The proposed works do not conflict with any of the objectives of the recovery plan. A recovery plan for Southern Macadamia Species was produced by Horticulture Australia Limited and the Australian Macadamia Society which includes <i>Macadamia tetraphylla</i>. The recovery plan identifies the following objectives: - Objective 1: Identify and evaluate the extent and quality of southern macadamia species populations and their habitat - Objective 2: Reduce and manage the major threatening processes affecting southern macadamia species habitat - Objective 3: Increase knowledge of southern macadamia species and their ecology to effect their conservation and management - Objective 4: Improve awareness and understanding of southern macadamia species, especially the management requirements of these species and their major threats. - Objective 5: Manage, monitor and evaluate the Southern Macadamia Species Recovery Plan The proposed works do not conflict with any of the objectives of the recovery plan. An approved recovery plan for the Green-leaved rose Walnut (<i>Endiandra muelleri</i> subsp. <i>bracteata</i>) and Rudy Rose Walnut (<i>Endiandra hayesii</i>) has been prepared by the (former) Department of Environment and Conservation (now OEH) in 2004. The recovery plan identifies the following objectives: - Objective 1: Co-ordinate the recovery of the Green-leaved Rose Walnut and the Rusty Rose Walnut - Objective 2: To resolve the taxonomic difficulties in the separation of the Green-leaved Rose Walnut and the Rusty Rose Walnut, and other closely related taxa and conduct field surveys where necessary to fill information gaps - Objective 3: To reassess background information for the newly resolved taxa - Objective 4: To improve the consideration of the Green-leaved Rose Walnut and the Rusty Rose Walnut in environmental impact assessments for developments and activities. - Objective 5: To manage and protect the Green-leaved Rose Walnut and Rusty Rose Walnut and associated habitat from threatening processes - Objective 6: fire planning and management - Objective 7: To improve knowledge of distribution, regeneration and genetics - Objective 8: To integrate the recovery of the Green-leaved Rose Walnut and the Rusty Rose Walnut with the recovery of other biota
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	- Objective 9: To involve the community in the recovery of the Green-leaved Rose Walnut and Rusty Rose Walnut The proposed works do not conflict with any of the objectives of the recovery plan. The Border Ranges Rainforest Biodiversity Management Plan prepared by the (former) Department of Environment, Climate Change and Water (now OEH) in 2010 which covers all of the flora species mentioned in this assessment with the exception of Pink Nodding Orchid (<i>Geodorum densiflorum</i>). The management plans identify the following objectives: - Objective 1: to reduce organisational-related impediments to biodiversity conservation - Objective 2: to minimize the impacts of climate change on biodiversity - Objective 3: to protect rainforest, related vegetation and species from clearing - Objective 4: to protect rainforest and related vegetation from fragmentation, modification and degradation. - Objective 5: To protect rainforest and related vegetation from the impact of weeds - Objective 6: to protect rainforest from fire and to promote the implementation of appropriate fire regimes in related vegetation - Objective 7: to protect rainforest and related vegetation from the impact of pest animals - Objective 8: to minimize the effects of Bell miner associated dieback on rainforest and associated wet sclerophyll forest - Objective 9: to protect rainforest and related vegetation from grazing and trampling by livestock - Objective 10: To minimize the impacts of human interference - Objective 11: to control and minimize impacts of introduced pathogens and diseases - Objective 12: to maintain the viability and evolutionary potential of rainforest and related populations, species and communities - Objective 13: to recognize the cultural value of rainforest and related vegetation to the Indigenous community and engage the Indigenous community in the protection and enhancement of rainforest and associated biodiversity and cultural values - Objective 14: to engage the community and private land-holders in biodiversity conservation - Objective 15: to establish effective monitoring of biodiversity related projects The proposed works do not conflict with any of the objectives of the management plan.
g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.	Clearing is a key threatening process to all of the threatened flora species assessed as part of this 7 part test. However, no individual plants of these species will be removed. The proposed action may result in the following indirect impacts: Potential increased bushfire risk, considered low risk due to stringent bushfire management during events for public safety

	• Trampling associated with unauthorised access, considered low risk due to fencing and previously low incidence • Increased weed invasion, considered low risk due to few event days and ongoing rehabilitation of the site The proposed action is therefore unlikely to result in the establishment or contribute to any of the key threatening processes listed under Schedule 3 of the TSC Act that would pose a threat to these species in and adjacent to the development site.
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12.1.3 Conclusion

The proposal is unlikely to have a significant impact on the listed flora species given that:

- No individuals of these species will be removed
- Only a very small area of vegetation will be removed as part of the project (approximately 300m², or >0.001% of native vegetation within the development site. Pre-clearing survey will ensure that no threatened flora species will be impacted by the proposed clearing.
- Potential indirect impacts are considered low risk
- Large amounts of potential habitat for these species will remain within the site and is present throughout the adjacent Billinudgel Nature Reserve and more broadly in the region
- On-going benefits will continue to be realised through habitat restoration and conservation activities

On the basis of the above considerations, it is considered unlikely that the proposal would result in a significant impact on the survival of these species. Consequently, a Species Impact Statement is not required for the proposal with respect to these listed flora species.

12.2 EEC

Two listed EECs have been identified as occurring in the Development site and two have been located adjacent to the development site. A 7 part test, conducted in accordance with the EP&A Act, has been conducted for the EECs and is provided in Table 40.

Subtropical Coastal Floodplain Forest of the New South Wales North Coast Bioregion

Subtropical Coastal Floodplain Forest is listed as an EEC under the TSC Act. Subtropical Coastal Floodplain Forest is known from parts of the Local Government Areas of Tweed, Byron, Lismore, Ballina, Richmond Valley, Clarence Valley, Coffs Harbour, Bellingen, Nambucca, Kempsey, Hastings, Greater Taree, Great Lakes and Port Stephens, but may occur elsewhere in this bioregion. Major examples once occurred on the floodplains of the Tweed, Richmond, Clarence, Macleay, Hastings and Manning Rivers, although smaller floodplains would have also supported considerable areas of this community.

The extent of the Subtropical Coastal Floodplain Forest prior to European settlement has not been mapped across its entire range. However, the remaining area of Subtropical Coastal Floodplain Forest is likely to be considerably smaller and is likely to represent much less than 30% of its original range. There are less than 350 ha of native floodplain vegetation on the Tweed lowlands.

Small areas of Subtropical Coastal Floodplain Forest are contained within existing conservation reserves, including Stotts Island, Ukerebagh and Limeburners Creek Nature Reserves and Bundjalung and Myall Lakes National Parks. These are unevenly distributed throughout the range and unlikely to represent the full diversity of the community.

This community occurs within the Parklands.

The OEH profile for this EEC list the following threats:

- Further clearing for urban and rural development, and the subsequent impacts from fragmentation
- Flood mitigation and drainage works.
- Management of water and tidal flows
- Landfilling and earthworks associated with urban and industrial development
- Grazing and trampling by stock and feral animals (e.g. pigs)
- Changes in water quality, particularly increased nutrients and sedimentation
- Weed invasion
- Climate change
- Activation of acid sulfate soils
- Removal of dead wood
- Rubbish dumping
- Frequent burning which reduces the diversity of woody plant species

Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions

Swamp Sclerophyll Forest is listed as an EEC under the TSC Act. This community is known from parts of the Local Government Areas of Tweed, Byron, Lismore, Ballina, Richmond Valley, Clarence Valley, Coffs Harbour, Bellingen, Nambucca, Kempsey, Hastings, Greater Taree, Great Lakes and Port Stephens, Lake Macquarie, Wyong, Gosford, Hornsby, Pittwater, Warringah, Manly, Liverpool, Rockdale, Botany Bay, Randwick, Sutherland, Wollongong, Shellharbour, Kiama and Shoalhaven but may occur elsewhere in these bioregions. Major examples once occurred on the floodplains of the Tweed, Richmond, Clarence, Macleay, Hastings and Manning Rivers, although smaller floodplains would have also supported considerable areas of this community.

The exact amount of its original extent is unknown but it is much less than 30%. There are less than 350 ha of native vegetation attributable to this community on the Tweed lowlands, less than 2,500 ha on the Clarence floodplain, less than 700 ha on the Macleay floodplain, up to 7,000 ha in the lower Hunter – central coast district, and less than 1,000 ha in the Sydney – South Coast region.

This community occurs within the Parklands.

The OEH profile for this EEC list the following threats:

- Further clearing for urban and rural development, and the subsequent impacts from fragmentation
- Flood mitigation and drainage works
- Management of water and tidal flows
- Landfilling and earthworks associated with urban and industrial development
- Grazing and trampling by stock and feral animals (particularly pigs)
- Changes in water quality, particularly increased nutrients and sedimentation
- Weed invasion
- Climate change
- Activation of acid sulfate soils
- Removal of dead wood
- Rubbish dumping

- Frequent burning which reduces the diversity of woody plant species

Coastal Cypress Pine Forest in the New South Wales North Coast Bioregion

Coastal Cypress Pine Forest is listed as an EEC under the TSC Act. It is apparently restricted to the NSW North Coast bioregion. The dominant species, *Callitris columellaris*, extends into south-east Queensland as far north as Hervey Bay. Any occurrence of the community in south-east Queensland is likely to be highly restricted. In NSW, Coastal Cypress Pine Forest is currently known from the local government areas of Tweed, Byron, Ballina, Richmond Valley and Clarence Valley, but may occur elsewhere within the bioregion. This community was not recorded within the parklands site but has been recorded nearby.

The OEH profile for this EEC list the following threats:

- Occurrence in small, isolated stands enhances risks from environmental stochasticity, disruption to pollination and dispersal of fruits or seeds, and likely reductions in the genetic diversity.
- Edge encroachment associated with maintenance of service easements and fence construction.
- Trampling and rubbish dumping where the community is close to towns and recreational sites.
- Invasion of weeds, which may form a dense understorey or ground layer, displacing native understorey species and inhibiting recruitment of canopy species. Principal weed species include *Asparagus aethiopicus*, *Bryophyllum delagoense*, *Chloris gayana*, *Lantana camara*, *Ochna serrulata* and *Schefflera actinophylla*. Other weed species recorded in the community include *Panicum maximum*, *Rhaphiolepis indica*, *Solanum nigrum* and *S. seaforthianum*.
- Inappropriate fire regimes. The dominant species, *Callitris columellaris*, may be killed by crown fires or heavy scorching of the lower trunk. High frequency fires are likely to be deleterious while occasional fires may be needed to create gaps for regeneration.

Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions

The Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions (Lowland Rainforest) is listed as an EEC under the TSC Act. The Hawkesbury River notionally marks the southern limit of Lowland Rainforest in the NSW North Coast and Sydney Basin bioregions. South of the Sydney metropolitan area, Lowland Rainforest is replaced by Illawarra Subtropical Rainforest of the Sydney Basin Bioregion, which is listed as an endangered ecological community. Milton Ulladulla Subtropical Rainforest is also a related rainforest endangered ecological community that occurs still further south in the South East Corner Bioregion. This community was not recorded within the parklands site but has been recorded immediately adjacent to the Parklands in an area of remnant vegetation.

The OEH profile for this EEC list the following threats:

- Extensive clearing of Lowland Rainforest has resulted in fragmentation and loss of ecological connectivity. The integrity and survival of small, isolated stands is impaired by the small population size of many species, enhanced risks from environmental stochasticity, disruption to pollination and dispersal of fruits or seeds, and likely reductions in the genetic diversity of isolated populations.
- Weed invasion also poses a major threat to Lowland Rainforest, with introduced vines and scramblers having particularly serious impacts. Exotic species form dense thickets capable of smothering indigenous plants, reducing both reproduction and survival.

- Inappropriate fire regimes associated with burning off and hazard reduction pose a threat to the margins of rainforest stands and the entirety of small stands in fragmented landscapes.
- Grazing by livestock, potential impacts of anthropogenic climate change and impacts associated with human interaction; including soil compaction, possible spread of pathogens, clearing of understorey and inappropriate collection of plant species.

Table 40: EEC grouping 7-part test assessment

Criteria	Response to Criteria
a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at the risk of extinction.	N/A – this is not a threatened species.
b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction	N/A – this is not an endangered population.
c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed: i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or ii. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.	No EEC vegetation is proposed to be removed as part of the proposed action. Indirect impact are expected to be minimal and would consist of: • Potential increased bushfire risk, considered low risk due to stringent bushfire management during events for public safety • Trampling associated with unauthorised access, considered low risk due to fencing and previously low incidence • Increased weed invasion, considered low risk due to few event days and ongoing rehabilitation of the site Overall, the biodiversity characteristics of the site are being permanently improved by the current site managers and utilisation patterns. On-going benefits will continue to be realised via active habitat creation and preservation, major site bush regeneration, maximising down times between larger events, and utilising best practice with soil and water systems.

d) in relation to the habitat of a threatened species, population or ecological community: i. the extent to which habitat is likely to be removed or modified as a result of the action proposed, and ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long term survival of the species, population or ecological community in the locality	No EEC vegetation is proposed to be removed as part of the proposed action. Indirect impact are expected to be minimal and would consist of: • Potential increased bushfire risk, considered low risk due to stringent bushfire management during events for public safety • Trampling associated with unauthorised access, considered low risk due to fencing and previously low incidence • Increased weed invasion, considered low risk due to few event days and ongoing rehabilitation of the site Overall, the biodiversity characteristics of the site are being permanently improved by the current site managers and utilisation patterns. On-going benefits will continue to be realised via active habitat creation and preservation, major site bush regeneration, maximising down times between larger events, and utilising best practice with soil and water systems.
e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)	No areas identified under the TSC Act as 'critical habitat' will be affected by the proposed activity.
f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan	There is currently no Recovery Plan or Threat Abatement Plan for these ecological communities.
g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.	The proposed action may result in the following indirect impacts: • Potential increased bushfire risk, considered low risk due to stringent bushfire management during events for public safety • Trampling associated with unauthorised access, considered low risk due to fencing and previously low incidence • Increased weed invasion, considered low risk due to few event days and ongoing rehabilitation of the site The proposed action is therefore unlikely to result in the establishment or contribute to any of the key threatening processes listed under Schedule 3 of the TSC Act that would pose a threat to these vegetation communities in and adjacent to the development site.

12.2.1 Conclusion

The proposal is unlikely to have a significant impact on the listed EECs given that:

- No EEC vegetation will be removed
- Potential indirect impacts associated with bushfire, weed invasion and trampling are considered low risk
- Potential indirect impacts from erosion and sedimentation will be managed and ameliorated and are therefore considered low risk
- On-going benefits will continue to be realised through habitat restoration and conservation activities
- No local occurrence of these communities will be placed at risk of extinction.

On the basis of the above considerations, it is considered unlikely that the proposal would result in a significant impact on the survival of these EECs. Consequently, a Species Impact Statement is not required for the proposal with respect to these EECs.

12.3 Microbats

Eight listed microbat species have been identified as occurring in the Development site. A 7 part test, conducted in accordance with the EP&A Act, has been conducted for these species and is provided in Table 41.

Common Blossum-bat (*Syconycteris australis*)

This species occurs in coastal areas of eastern Australia from Hawks Nest in NSW to Cape York Peninsula in Queensland. In some areas, the distribution extends inland to coastal foothills. Common Blossum-bats often roost in littoral rainforest and feed on nectar and pollen from flowers in adjacent heathland and paperbark swamps. They have also been recorded in a range of other vegetation communities, such as subtropical rainforest, wet sclerophyll forest and other coastal forests. The OEH profile for this species list the following threats:

- Clearing of coastal habitat for urban development and sandmining
- Weeds, such as Bitou Bush, that suppress the regeneration of key food trees, such as Coastal Banksia
- Predation by foxes and feral cats may occur whilst the bat is feeding on low hanging flowers and fruit
- Inappropriate fire regimes in heathland habitats leading to reduced flowering of Banksia, Callistemon and Melaleuca species

Eastern Bent-wing Bat (*Miniopterus schreibersii oceanensis*)

This species occurs in rainforest, wet and dry sclerophyll forest, monsoon forest, open woodland, paperbark forests and open grassland. It forages above and below the tree canopy on small insects, especially moths. The bats congregate at the same maternity roosts each year to give birth and rear young. In the southern part of the species' range this occurs during spring. Maternity roosts may be located in caves, abandoned mines, concrete bunkers and lava tubes. Over-wintering roosts used outside the breeding period include cooler caves, old mines, and stormwater channels, under bridges and occasionally buildings. This species is capable of flying 30-50 km in a single night of foraging. The OEH profile for this species list the following threats:

- Disturbance by recreational cavers and general public accessing caves and adjacent areas particularly during winter or breeding
- Loss of high productivity foraging habitat
- Introduction of exotic pathogens, particularly white-nose fungus
- Cave entrances being blocked for human health and safety reasons, or vegetation (particularly blackberries) encroaching on and blocking cave entrances
- Hazard reduction and wildfire fires during the breeding season

Eastern False pipistrelle (*Falsistrellus tasmaniensis*)

The Eastern False Pipistrelle is found on the south-east coast and ranges of Australia, from southern Queensland to Victoria and Tasmania. This species prefers moist habitats, with trees taller than 20 m and generally roosts in eucalypt hollows, but has also been found under loose bark on trees or in buildings. The OEH profile for this species list the following threats:

- Disturbance to winter roosting and breeding sites

- Loss of roosting habitat, primarily hollow-bearing eucalypts
- Loss and fragmentation of foraging habitat, particularly extensive areas of continuous forest and areas of high productivity

Eastern Freetail-bat (*Mormopterus norfolkensis*)

The Eastern Freetail-bat is found along the east coast from south Queensland to southern NSW and occurs in dry sclerophyll forest, woodland, swamp forests and mangrove forests east of the Great Dividing Range. Eastern Freetail-bats roost mainly in tree hollows but will also roost under bark or in man-made structures. They are usually solitary but have also been recorded roosting communally. They are thought to be insectivorous. The OEH profile for this species list the following threats:

- Loss of hollow-bearing trees
- Loss of foraging habitat
- Application of pesticides in or adjacent to foraging areas
- Artificial light sources spilling onto foraging and/or roosting habitat
- Large scale wildfire or hazard reduction burns on foraging and/or roosting habitat

Eastern Long-eared Bat (*Nyctophilus bifax*)

The Eastern Long-eared Bat is found from Cape York through eastern Queensland to the far north-east corner of NSW. In NSW they appear to be confined to the coastal plain and nearby coastal ranges, extending south to the Clarence River area, with a few records further south around Coffs Harbour. The species can be locally common within its restricted range.

Suitable habitat includes lowland subtropical rainforest and wet and swamp eucalypt forest, extending into adjacent moist eucalypt forest. Coastal rainforest and patches of coastal scrub are particularly favoured. The species roosts in tree hollows, the hanging foliage of palms, in dense clumps of foliage of rainforest trees, under bark and in shallow depressions on trunks and branches, among epiphytes, in the roots of strangler figs, among dead fronds of tree ferns and less often in buildings.

The OEH profile for this species list the following threats:

- Loss of hollow-bearing trees
- Loss of foraging habitat
- Application of pesticides in or adjacent to foraging areas
- Artificial light sources spilling onto foraging and/or roosting habitat
- Large scale wildfire or hazard reduction burns on foraging and/or roosting habitat

Golden-tipped Bat (*Kerivoula papuensis*)

The Golden-tipped Bat is distributed along the east coast of Australia in scattered locations from Cape York Peninsula in Queensland to south of Eden in southern NSW. It also occurs in New Guinea. It is found in rainforest and adjacent wet and dry sclerophyll forest up to 1000 m and has also been recorded in tall open forest, Casuarina-dominated riparian forest and coastal Melaleuca forests. Bats will fly up to two kilometres from roosts to forage in rainforest and sclerophyll forest on mid and upper-slopes.

The species roost mainly in rainforest gullies on small first- and second-order streams in usually abandoned hanging Yellow-throated Scrubwren and Brown Gerygone nests modified with an access hole

on the underside. Bats may also roost under thick moss on tree trunks, in tree hollows, dense foliage and epiphytes. Bats will use multiple roost and change roosts regularly. They roost individually or in small colonies which can contain up to approximately 20 bats of both males and females or just a single sex. Maternity roosts may occur away from water sources.

The OEH profile for this species list the following threats:

- Loss of riparian rainforest for roosting and foraging habitat
- Loss of understorey habitat on upper-slopes for foraging
- Forestry operations that fragment habitat or result in loss of roosting habitat
- Habitat fragmentation
- Lack of knowledge of the threats to the species
- Burning of rainforest habitat
- Loss of hollow-bearing trees

Large-eared Pied Bat (*Chalinolobus dwyeri*)

The Large-eared Pied Bat is found mainly in areas with extensive cliffs and caves, from Rockhampton in Queensland south to Bungonia in the NSW Southern Highlands. It is generally rare with a very patchy distribution in NSW. There are scattered records from the New England Tablelands and North West Slopes.

Large-eared Pied Bats are found in well-timbered areas containing gullies. It frequents low to mid-elevation dry open forest and woodland close to caves, crevices in cliffs, old mine workings and disused mud nests of Fairy Martin. The relatively short, broad wing combined with the low weight per unit area of wing indicates manoeuvrable flight. This species probably forages for small, flying insects below the forest canopy.

This species roosts in caves (near their entrances), crevices in cliffs, old mine workings and in the disused, bottle-shaped mud nests of the *Hirundo ariel* (Fairy Martin) in south-eastern Queensland. Females have been recorded raising young in maternity roosts (c. 20-40 females) from November through to January in roof domes in sandstone caves. They remain loyal to the same cave over many years.

The OEH profile for this species list the following threats:

- Clearing and isolation of forest and woodland habitats near cliffs, caves and old mine workings for agriculture or development
- Loss of foraging habitat close to cliffs, caves and old mine workings from forestry activities and too-frequent burning, usually associated with grazing
- Damage to roosting and maternity sites from mining operations, and recreational caving activities
- Use of pesticides
- Disturbance to roosting areas by goats

Little Bentwing-bat (*Miniopterus australis*)

This species occurs in moist eucalypt forest, rainforest, vine thicket, wet and dry sclerophyll forest, Melaleuca swamps, dense coastal forests and banksia scrub. It roosts in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings during the day, and at night forages for small insects beneath the canopy of densely vegetated habitats. They often share

roosting sites with the Common Bentwing-bat. Maternity colonies form in spring. Males and juveniles disperse in summer. The species capable of flying up to 55 km from nursery roosts.

The OEH profile for this species list the following threats:

- Disturbance of colonies, especially in nursery or hibernating caves, may be catastrophic
- Destruction of caves that provide seasonal or potential roosting sites
- Changes to habitat, especially surrounding maternity/nursery caves and winter roosts
- Pesticides on insects and in water consumed by bats bio accumulates, resulting in poisoning of individuals
- Predation from foxes, particularly around maternity caves, winter roosts and roosts within culverts, tunnels and under bridges
- Predation from feral cats, particularly around maternity caves, winter roosts and roosts within culverts, tunnels and under bridges
- Introduction of exotic pathogens such as the White-nosed fungus
- Hazard reduction and wildfire fires during the breeding season
- Large scale wildfire or hazard reduction can impact on foraging resources
- Poor knowledge of reproductive success and population dynamics

Southern Myotis (*Myotis macropus*)

The Southern Myotis (also known as the Large-footed Myotis) is found in the coastal band from north-west Australia to western Victoria. The Large-footed Myotis generally roost in groups of 10-15 in caves, mine shafts, hollow-bearing trees, storm water channels and under bridges in areas of dense foliage. They forage across the top of water sources, catching insects and small fish by raking their feet across the surface of the water (OEH 2015). Their foraging range is in the order of 10-15 km from roosts and they will roost in tree hollows as well as culverts.

The OEH profile for this species list the following threats:

- Loss or disturbance of roosting sites
- Clearing adjacent to foraging areas
- Application of pesticides in or adjacent to foraging areas
- Reduction in stream water quality affecting food resources

Yellow-bellied Sheath-tailed Bat (*Saccolaimus flaviventris*)

The Yellow-bellied Sheath-tail Bat roosts singly or in groups of up to six, in tree hollows and buildings. In treeless areas they are known to utilise mammal burrows. They forage in most habitats throughout their very wide range, including areas with and without trees and appear to defend an aerial foraging territory. This species is a high and fast flying bat that forages above the canopy or lower in open areas and along water courses. It is not very manoeuvrable and requires room to move. It will not be found within the cluttered road area, but rather along the edges of such sites.

The OEH profile for this species list the following threats:

- Disturbance to roosting and summer breeding sites
- Foraging habitats are being cleared for residential and agricultural developments, including clearing by residents within rural subdivisions
- Loss of hollow-bearing trees; clearing and fragmentation of forest and woodland habitat

- Pesticides and herbicides may reduce the availability of insects, or result in the accumulation of toxic residues in individuals' fat stores

Table 41: Microbat species 7-part test assessment

Criteria	Response to Criteria
a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at the risk of extinction.	With the exception of the 300m² required to be cleared/pruned for the proposed vehicular track, the proposed action will not result in clearing of native vegetation that represent potential foraging or roosting habitat within the Parklands. The proposed action will result in temporary disturbance to these species in the form of noise and increased lighting in the Parklands during events. The behaviour of numerous microbats (including these threatened species) has been monitored during previous events. Food resources and feeding behaviour are increased for many of these species during events, as light attracts insects, which are a key diet item. Adverse impacts such as avoiding lighting or leaving the Parklands were not observed. A range of light and noise management measures are implemented during each event, which aim to minimise disturbance impacts to these species. On-going benefits to microbat habitat will continue to be realised via active habitat creation and preservation, major site bush regeneration, maximising down times between larger events, and utilising best practice with soil and water systems.
b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction	N/A – these species are not part of an endangered population
c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed: i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or ii. is likely to substantially and adversely modify the	N/A – these species are not an EEC or CEEC

composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.	
d) in relation to the habitat of a threatened species, population or ecological community: i. the extent to which habitat is likely to be removed or modified as a result of the action proposed, and ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long term survival of the species, population or ecological community in the locality	With the exception of the 300m² required to be cleared/pruned for the proposed vehicular track, the proposed action will not result in clearing of native vegetation that represent potential foraging or roosting habitat within the Parklands.. The proposed action will result in temporary disturbance to these species in the form of noise and increased lighting in the Parklands during events. The behaviour of numerous microbats (including these threatened species) has been monitored during previous events. Food resources and feeding behaviour are increased for many of these species during events, as light attracts insects, which are a key diet item. Adverse impacts such as avoiding lighting or leaving the Parklands were not observed. A range of light and noise management measures are implemented during each event, which aim to minimise disturbance impacts to these species. On-going benefits to microbat habitat will continue to be realised via active habitat creation and preservation, major site bush regeneration, maximising down times between larger events, and utilising best practice with soil and water systems. Given that these species are highly mobile, only a very minor area of potential habitat will be removed (300m² or >0.001% of native vegetation within the development site) and that no roosting habitat will be directly impacted, it is considered unlikely that the proposal would impact on this species such that it would place any local populations at risk of extinction.
e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)	No critical habitat has been declared for these species with the Development site.
f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan	No recovery plan or threat abatement plan has been prepared for the Eastern Bentwing-bat, Little bentwing-bat, Eastern False Pipistrelle, Eastern Freetail-bat, Yellow-bellied Sheath-tail Bat, Golden-tipped Bat or Southern Myotis, however a National recovery plan has been prepared for the Large-eared Pied Bat by the State of Queensland, (former) Department of Environment and Resource Management (now DEHP) in 2011. The recovery plan identifies the following objectives: • Objective 1: Identify priority roost and maternity sites for protection • Objective 2: Implement conservation and management strategies for priority sites • Objective 3: Educate the community and industry to understand and participate in the conservation of the Large-eared Pied Bat • Objective 4: Research the Large-eared Pied Bat to augment biological and ecological data to enable conservation management

	Objective 5: Determine the meta-population dynamics throughout the distribution of the Large-eared Pied Bat The proposed works do not conflict with any of the objectives of the recovery plan.
g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.	Only a very minor area of potential habitat will be removed (300m² or >0.001% of native vegetation within the development site). The extent of clearing represents an insignificant increase in a key threatening impact. Furthermore, all other habitat on site will be preserved and protected for the duration of the project whilst significant areas of bushland rehabilitation has occurred, and is planned to occur in the future. The proposed action may result in the following indirect impacts to : - Potential increased bushfire risk, trampling and weed invasion to habitat areas – all considered low risk - Temporary disturbance from light and noise during events – has been shown to be temporary and reversible The proposed action is therefore unlikely to result in the establishment or contribute to any of the key threatening processes listed under Schedule 3 of the TSC Act that would pose a threat to these species in and adjacent to the development site.

12.3.1 Conclusions

The proposal is unlikely to have a significant impact on these species given that:

- Only a very minor area of potential habitat will be removed (300m² or >0.001% of native vegetation within the development site).
- The proposed action will result in a minor disturbance to these species during events, which has been shown via monitoring to be temporary and reversible upon the conclusion of events
- Bat monitoring data has shown ongoing use of the site with numbers (both species and individuals) maintained within the range of natural viability over time
- Large amounts of potential habitat for these species will remain within the site and is present throughout the adjacent Billinudgel Nature Reserve and more broadly in the region
- On-going benefits to habitat will continue to be realised through habitat restoration and conservation activities

On the basis of the above considerations, it is considered unlikely that the proposal would result in a significant impact on the survival of these species. Consequently, a Species Impact Statement is not required for the proposal with respect to the Common Blossum-bat, Eastern Bentwing-bat, Little Bentwing-bat, Eastern False Pipistrelle, Eastern Freetail-bat, Eastern Long-eared Bat, Yellow-bellied Sheathtail Bat, Golden-tipped Bat, Southern Myotis or the Large-eared Pied Bat.

12.4 Nectar or fruit foraging species

Five listed nectar or fruit foraging species have been identified as occurring in the Development site and two have the potential to occur. A 7 part test, conducted in accordance with the EP&A Act, has been conducted for these species and is provided in Table 42.

Little Lorikeet (*Glossopsitta pusilla*)

The Little Lorikeet is distributed widely across the coastal and Great Divide regions of eastern Australia from Cape York to South Australia. NSW provides a large portion of the species' core habitat, with lorikeets found westward as far as Dubbo and Albury. Nomadic movements are common, influenced by season and food availability, although some areas retain residents for much of the year and 'locally nomadic' movements are suspected of breeding pairs. This species forages primarily in the canopy of open Eucalyptus forest and woodland, yet also finds food in Angophora, Melaleuca and other tree species. Riparian habitats are particularly used, due to higher soil fertility and hence greater productivity. This species is known at the Parklands from one recorded during surveys completed in 2015-2016.

The OEH profile for this species list the following threats:

- Given that large old Eucalyptus trees on fertile soils produce more nectar, the extensive clearing of woodlands for agriculture has significantly decreased food for the lorikeet, thus reducing survival and reproduction. Small scale clearing, such as during roadworks and fence construction, continues to destroy habitat and it will be decades before revegetated areas supply adequate forage sites
- The loss of old hollow bearing trees has reduced nest sites, and increased competition with other native and exotic species that need large hollows with small entrances to avoid predation. Felling of hollow trees for firewood collection or other human demands increases this competition
- Competition with the introduced Honeybee for both nectar and hollows exacerbates these resource limitations
- Infestation of habitat by invasive weeds
- Inappropriate fire regimes
- Aggressive exclusion from forest and woodland habitat by over abundant Noisy Miners
- Climate change impacts including reduction in resources due to drought
- Degradation of woodland habitat and vegetation structure due to overgrazing

Rose Crowned Fruit Dove (*Ptilinopus regina*)

This species occurs in sub-tropical and dry rainforest, moist eucalypt forest and swamp forest, where fruit is plentiful. Birds feed entirely on fruit from vines, shrubs, large trees and palms, and are thought to be locally nomadic as they follow the ripening of fruits. Some populations are migratory in response to food availability. Numbers in north-east NSW increase during spring and summer then decline in April or May.

This species is regularly recorded in surveys at the Parklands, both on site and within the adjacent Billinudgel Nature Reserve.

The OEH profile for this species list the following threats:

- Clearing and fragmentation of low to mid-elevation rainforest
- Logging and roading in moist eucalypt forest with well-developed rainforest understorey
- Burning of remnant rainforest habitat
- Invasion of habitat by introduced weed species
- Removal of Camphor Laurel food source without appropriate mitigation measures

Wompoo Fruit Dove (*Ptilinopus magnificus*)

This species occurs in rainforest, low-elevation moist eucalypt forest and brush box forests. It feeds on a diverse range of tree and vine fruits and is locally nomadic following ripening fruit. The nest is a flimsy

platform of sticks on a thin branch or a palm frond, often over water, usually 3 – 10 m above the ground. Birds breed in spring and early summer.

This species has been recorded at the Parklands during monitoring in winter 2014.

The OEH profile for this species list the following threats:

- Clearing and fragmentation of low to mid-elevation rainforest due to coastal development and grazing
- Logging and road creation in moist eucalypt forest with well-developed rainforest understorey
- Burning, which reduces remnant rainforest habitat patches
- Infestation of rainforest habitat by invasive weeds

Grey-headed Flying-fox (*Pteropus poliocephalus*)

The Grey-headed Flying-fox is endemic to the east coast of Australia with a distribution from Bundaberg in the north to Melbourne in the south, from the western slopes of the Great Dividing Range to the coast.

Grey-headed Flying-foxes are a highly mobile species whose migration patterns are determined by the availability of flowering food resources (Eby 1991). The species is a canopy-feeding frugivore, blossom-eater and nectarivore, and occurs in rainforest, woodlands, paperbark swamps and Banksia woodlands (NSW Scientific Committee 2001). This species feeds in particular on the nectar and pollen of native trees, especially *Eucalyptus* spp., *Melaleuca* spp. and *Banksia* spp., and fruits of rainforest trees and vines. During times when native food resources are limited, Grey-Headed Flying-foxes forage on fruit crops and cultivated gardens.

Grey-headed Flying-foxes congregate in large colonies of up to 200,000 individuals in the summer season (Churchill 1998). Camp sites are generally located next to rivers or creeks, and occur in a range of vegetation communities including rainforest, wet sclerophyll forest, Melaleuca woodland, Casuarina forest or mangroves (Eby 2000). These sites have a dense canopy, providing them with the moist, humid microclimate they require. Campsites are critical for mating, birthing, rearing of young and as diurnal refuge from predators (Tidemann *et al.* 1999). Urban gardens, cultivated fruit crops and roadside verges may also provide temporary roosting habitat for this species.

Grey-headed flying foxes have been recorded within the development site on multiple occasions since 2007. The species is known to utilise the site when food resources are present and has been recorded feeding on flowering Forest Red Gum and Swamp Mahogany (*Eucalyptus robusta*) during spot-light surveys of the Development site (Fitzgerald, 2007). The species has also been observed feeding in Blackbutt (*Eucalyptus pilularis*) (Fitzgerald, 2014). Records are primarily from the south-eastern boundary of the project area, adjacent to Billinudgel Nature Reserve. Grey-headed Flying Foxes have been recorded within event areas.

The OEH profile for this species list the following threats:

- Loss of roosting and foraging sites
- Electrocution on powerlines, entanglement in netting and on barbed-wire
- Heat stress
- Conflict with humans
- Incomplete knowledge and abundance and distribution across the species' range

Fauna species with the potential to occur within the development site include:

Coxen's Fig-Parrot (*Cyclopsitta diopthalma coxeni*)

This species is limited to about five populations scattered between Bundaberg in Queensland and the Hastings River in NSW. The total number is thought to be less than 200 birds which makes it one of Australia's most endangered birds. It is usually recorded from drier rainforests and adjacent wetter eucalypt forest but is rarely seen due to its small size and cryptic habits. It is also found in the wetter lowland rainforests that are now largely cleared in NSW.

The Coxen's Fig Parrot has not been recorded at the Parklands during the extensive fauna survey and monitoring that has been undertaken since 2007. However, there are numerous food trees for this species within the patches of remnant vegetation on site. This includes native fig trees e.g. Sandpaper Figs, Moreton Bay Fig, Strangler Figs and Small-leaved Figs. It is therefore possible that this species would occasionally visit the Parklands for foraging. Given the small overall extent and fragmented nature of the remnant vegetation on site and historical disturbance, the Parklands is not considered to be habitat critical to the survival of these species.

The OEH profile for this species list the following threats:

- Clearing of rainforest, wet sclerophyll and ecotone habitat and clearing of fig trees on farms for agricultural purposes
- Clearing of habitat for rural and residential development
- Logging or clearing of eucalypt forest adjacent to rainforest
- Habitat fragmentation, including loss of connectivity between summer and winter feeding areas
- Illegal bird trapping and egg collection
- Dissection of habitat corridors by roads
- Small population sizes make populations susceptible stochastic events and fluctuations in food supply
- Low numbers, preventing a social breeding triggers being activated and reducing available breeding partners
- Weeds, particularly exotic vines and scramblers, impacting on habitat and food trees.
- Burning of rainforest and wet sclerophyll ecotone areas preventing establishment of additional habitat and foraging resources

Swift Parrot (*Lathamus discolor*)

This species breeds in Tasmania during spring and summer, migrating in the autumn and winter months to south-eastern Australia from Victoria and the eastern parts of South Australia to south-east Queensland. In NSW, it mostly occurs on the coast and south west slopes. On the mainland birds occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations.

Favoured feed trees include winter flowering species such as Swamp Mahogany (*Eucalyptus robusta*), Spotted Gum (*Corymbia maculata*), Red Bloodwood (*C. gummifera*), Mugga Ironbark (*E. sideroxylon*), and White Box (*E. albens*). Commonly used lerp infested trees include Inland Grey Box (*E. macrocarpa*), Grey Box (*E. moluccana*) and Blackbutt (*E. pilularis*).

The Swift Parrot has not been recorded at the Parklands during the extensive fauna survey and monitoring that has been undertaken since 2007. However, there are numerous food trees for this species within the patches of remnant vegetation on site. This includes Eucalyptus species e.g. Forest Red Gum and Blackbutt. The Swift Parrot has also been recorded within 5 km of the Parklands. It is therefore possible

this species would occasionally visit the Parklands for foraging (during its winter northward migration). Given the small overall extent and fragmented nature of the remnant vegetation on site and historical disturbance, the Parklands is not considered to be habitat critical to the survival of this species.

The OEH profile for this species list the following threats:

- Habitat loss and fragmentation from forest harvesting, residential/industrial development, agricultural clearing, senescence and dieback
- Changes in spatial and temporal distribution of habitat due to climate change
- Reduced food availability due to drought conditions
- Competition from introduced bees and large, aggressive honeyeaters for food resources
- Collision with human made structures resulting in death or injury
- Psittacine Beak and Feather Disease vulnerability
- Weed invasion impacting on habitat regeneration and health
- High fire frequency impacting on food resource availability
- Aggressive exclusion from forest and woodland habitat by over abundant Noisy Miners
- Predation by cats
- Illegal capture and trade of wild birds for aviculture

Table 42: Nectar or fruit foraging species 7-part test assessment

Criteria	Response to Criteria
a) in the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at the risk of extinction.	With the exception of the 300m² required to be cleared/pruned for the proposed vehicular track, the proposed action will not result in clearing of native vegetation that represent potential foraging or roosting habitat within the Parklands. On-going benefits will continue to be realised via active habitat creation and preservation, major site bush regeneration, maximising down times between larger events, and utilising best practice with soil and water systems. Both the White-eared Monarch and Rose-crowned Fruit Dove have been recorded within regeneration areas ('the plantings'). Indirect impacts to these species are also unlikely. Minor disturbance of individuals may occur if the species is present on site during events (for the Swift Parrot this is relevant only during the winter months). These species are highly mobile and as such this disturbance is likely to be insignificant. Monitoring of events has demonstrated that all bird species that leave the site during events return very soon after. This is not likely to affect the life cycle of this species such that a viable local population would be placed at risk of extinction.
b) in the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction	N/A – not an endangered population

c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed: i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or ii. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.	N/A – not an EEC or CEEC
d) in relation to the habitat of a threatened species, population or ecological community: i. the extent to which habitat is likely to be removed or modified as a result of the action proposed, and ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long term survival of the species, population or ecological community in the locality	Only a very minor area of potential habitat will be removed (300m² or >0.001% of native vegetation within the development site). All other habitat on site will be preserved and protected for the duration of the project. All areas of remnant vegetation will be fenced during events to prevent disturbance and strict fire management procedures are also implemented. These measures have been in place during the trial period. During this time, monitoring has detected no adverse impacts to the native vegetation on site. Ongoing vegetation management and restoration measures will continue across the site with the objective of improving the ecological condition of the vegetation and therefore its value as habitat for these species over time.
e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)	The habitat is not critical habitat and therefore the proposed action will not have an adverse effect (either directly or indirectly).

f) whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan	There is no recovery plan or threat abatement plan for Little Lorikeet, Rose-crowned Lorikeet and Wompoo Fruit-dove. However recovery plans have been prepared for the Grey-headed Flying-fox, Swift Parrot and Coxen's Fig-parrot. A Draft National Recovery Plan for the Grey-headed Flying-fox was created in 2009 (DECCW 2009). Specific recovery actions identified in the recovery plan include: • Action 1: Identify and protect foraging habitat critical to the survival of Grey-headed Flying-foxes across their range • Action 2: Enhance winter and spring foraging habitat for Grey-headed Flying-foxes • Action 3: Identify, protect and enhance roosting habitat critical to the survival of Grey-headed Flying-foxes • Action 4: Significantly reduce levels of deliberate Grey-headed Flying-fox destruction associated with commercial horticulture • Action 5: Provide information and advice to managers, community groups and members of the public that are involved with controversial flying-fox camps • Action 6: Produce and circulate educational resources to improve public attitudes toward Grey-headed Flying-foxes, promote the recovery program to the wider community and encourage participation in recovery actions • Action 7: Monitor population trends for the Grey-headed Flying-fox • Action 8: Assess the impacts on Grey-headed Flying-foxes of electrocution on powerlines and entanglement in netting and barbed wire, and implement strategies to reduce these impacts • Action 9: Oversee a program of research to improve knowledge of the demographics and population structure of the Grey-headed Flying-fox • Action 10: Maintain a National Recovery Team to oversee the implementation of the Grey-headed Flying-fox National Recovery Plan. The current proposal is not in conflict with any recovery actions from the recovery plan. A recovery plan for the Coxen's fig-parrot (<i>Cyclopsitta diophthalma coxeni</i>) 2001-2005 was prepared by the State of Queensland, Environmental Protection Agency, 2001. The overall objective of this recovery plan is to prevent extinction of Coxen's fig-parrot from human-induced causes and ensure the stability of wild populations. Specific objectives during the life of the current recovery plan are to: • Locate one or more remaining populations • Protect remaining populations and their habitat from human-induced threatening processes, thereby maintaining the populations and habitat • Increase understanding of the ecology of Coen's fig-parrot • Secure and breed a captive population of Coxen's fig-parrots
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	• Increase the extent, quality and connectivity of the habitat of Coxen's fig-parrot The current proposal is not in conflict with any recovery actions/objectives from the recovery plan. A recovery plans been prepared for the Swift Parrot (<i>Lathamus dicolor</i>) for NSW. A recovery plan has also been prepared under the EPBC Act. A summary of the objectives and actions outlined in this plan are included below (Swift Parrot Recovery Team 2001): Overall objectives • To change the conservation status of the swift parrot from endangered to vulnerable within 10 years. • To achieve a demonstrable sustained improvement in the quality of swift parrot habitat to increase carrying capacity. Specific objectives • To identify priority habitats and sites across the range of the swift parrot. • To implement management strategies to protect and improve priority habitats and sites resulting in a sustained improvement in carrying capacity. • To reduce the incidence of collisions with man-made structures. • To determine population trends within the breeding range. • To quantify improvements in carrying capacity by monitoring changes in extent and quality of habitat. • To increase public awareness about the recovery program and to involve the community in the recovery Recovery Criteria • Priority habitats and sites have been identified and protected. • Management strategies to protect breeding and foraging habitat have been implemented. • The incidence of collisions is reduced. • The population density or extent and quality of habitat is not reduced and ideally is enhanced. • Community based networks are maintained and a newsletter is produced. Actions Needed • Identify the extent and quality of foraging habitat. • Protect and manage the habitat of swift parrots at a landscape scale. • Reduce the incidence of collisions. • Monitor population trends and habitat use. • Keep the public, volunteers and community networks informed. • Manage the recovery process through a recovery team. The proposal does not conflict with any of the proposed objectives or actions.
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g) whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.	Only a very minor area of potential habitat will be removed (300m² or >0.001% of native vegetation within the development site). The extent of clearing represents an insignificant increase in a key threatening impact. Furthermore, all other habitat on site will be preserved and protected for the duration of the project whilst significant areas of bushland rehabilitation has occurred, and is planned to occur in the future. The proposed action may result in the following indirect impacts to : • Potential increased bushfire risk, trampling and weed invasion to habitat areas – all considered low risk • Temporary disturbance from light and noise during events – has been shown to be temporary and reversible The proposed action is therefore unlikely to result in the establishment or contribute to any of the key threatening processes listed under Schedule 3 of the TSC Act that would pose a threat to these species in and adjacent to the development site.
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12.4.1 Conclusions

The proposal is unlikely to have a significant impact on these species given that:

- Only a very minor area of potential habitat will be removed (300m² or >0.001% of native vegetation within the development site)
- The proposed action will result in a minor disturbance to these species during events, which has been shown via monitoring to be temporary and reversible upon the conclusion of events
- Bird monitoring data has shown ongoing use of the site with numbers (both species and individuals) maintained within the range of natural viability over time
- Large amounts of potential habitat for these species will remain within the site and is present throughout the adjacent Billinudgel Nature Reserve and more broadly in the region
- On-going benefits to habitat will continue to be realised through habitat restoration and conservation activities
- Both Rose-crowned Fruit-Dove and White-eared Monarch have begun to use the plantings (areas of regeneration) showing positive effects of works at the Parklands

On the basis of the above considerations, it is considered unlikely that the proposal would result in a significant impact on the survival of these species. Consequently, a Species Impact Statement is not required for the proposal with respect to these nectar or fruit foraging species.

12.5 Common Planigale (*Planigale maculata*)

The common Planigale occurs in rainforest, eucalypt forest, heathland, marshland, grassland and rocky areas. They are active at night and during the day shelter in saucer-shaped nests built in crevices, hollow logs, beneath bark or under rocks. This species has not been recorded at the Parklands, but some areas of suitable habitat area present on site and in adjacent areas. I.e. forests within the development site. It is less likely to inhabit pasture areas (particularly the unmanaged pasture areas in the south of the site) as this area lacks the microhabitat features such as hollow logs, bark and rocks. Targeted surveys within the parklands over the last 10 years have not detected this species.

The OEH profile for this species list the following threats:

- Predation by foxes
- Predation by cats
- Predation and poisoning by cane toads
- Loss and fragmentation of habitat through clearing for agriculture and development in coastal areas
- Frequent burning that reduces ground cover such as hollow logs and bark
- Over grazing that reduces ground cover
- Disturbance of vegetation surrounding water bodies

- a. In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.**

All areas of remnant vegetation will be fenced during events to prevent disturbance and strict fire management procedures are also implemented. These measures have been in place during the trial period. During this time, monitoring has detected no adverse impacts to the native vegetation on site. Ongoing vegetation management and restoration measures will continue across the site with the objective of improving the ecological condition of the vegetation and therefore its value as Common Planigale habitat over time.

Therefore, the proposed works are not likely to place any viable local population of the species at risk of extinction.

- b. In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.**

Not applicable. The Common Planigale is not an endangered population.

- c. in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:**

- i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**
- ii. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,**

Not applicable. The Common Planigale is not an endangered ecological community.

d. in relation to the habitat of a threatened species, population or ecological community:

i. the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

- ii. Only a very minor area of potential habitat will be removed (300m² or >0.001% of native vegetation within the development site) . Slashing of the unmanaged exotic grassland in the south of the development area is planned to occur. However, this is less likely to constitute habitat for the species.

iii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

No vegetation will be removed which would result in potential habitat for this species becoming fragmented or isolated from other areas of habitat.

iv. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,

Only a very minor area of potential habitat will be removed (300m² or >0.001% of native vegetation within the development site). This will not result in fragmentation and isolation of habitat or impacts to the long term survival of the species.

All areas of remnant vegetation will be fenced during events to prevent disturbance and strict fire management procedures are also implemented. These measures have been in place during the trial period. During this time, monitoring has detected no adverse impacts to the native vegetation on site. Ongoing vegetation management and restoration measures will continue across the site with the objective of improving the ecological condition of the vegetation and therefore its value as Common Planigale habitat over time

Therefore, the proposed action is not considered likely to have an impact on habitats that are important to the long term survival of this species in the locality

e. Whether the action proposed is likely to have an adverse effect on critical habitat.

No critical habitat has been declared by the Director-General of the NPWS for the Common Planigale.

f. Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

No recovery plan or threat abatement plan has been prepared for the Common Planigale.

g. The action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The proposed action may result in the following indirect impacts to:

- Potential increased bushfire risk, trampling and weed invasion to habitat areas – all considered low risk
- Temporary disturbance from light and noise during events – has been shown to be temporary and reversible

The proposed action is therefore unlikely to result in the establishment or contribute to any of the key threatening processes listed under Schedule 3 of the TSC Act that would pose a threat to these species in and adjacent to the development site.

12.5.1 Conclusion

The proposal is unlikely to have a significant impact on the Common Planigale given that:

- Only a very minor area of potential habitat will be removed (300m² or >0.001% of native vegetation within the development site).
- Large amounts of potential habitat for these species will remain within the site and is present throughout the adjacent Billinudgel Nature Reserve and more broadly in the region
- The proposed action will result in a minor disturbance during events, but monitoring data has shown ongoing use of the site by fauna with no evidence of disturbance of remnant vegetation
- On-going benefits to habitat will continue to be realised through habitat restoration and conservation activities

On the basis of the above considerations, it is considered unlikely that the proposal would result in a significant impact on the Common Planigale. Consequently, a Species Impact Statement is not required for the proposal with respect to this species.

12.6 Eastern Grass Owl (*Tyto longimembris*)

Eastern Grass Owls have been recorded occasionally in all mainland states of Australia but are most common in northern and north-eastern Australia. In NSW they are more likely to be resident in the north-east. Eastern Grass Owl numbers can fluctuate greatly, increasing especially during rodent plagues.

Eastern Grass Owls are found in areas of tall grass, including grass tussocks, in swampy areas, grassy plains, swampy heath, and in cane grass or sedges on flood plains. Targeted surveys for the Eastern Grass Owl were undertaken in July each year for four years (2013 – 2016) and in September 2014 as part of the biennial fauna survey. This species was not present in the main event area (north of Jones Rd) in any year. A pair of Eastern Grass Owls responded to call play back in July 2016 in the exotic grassland in the south of the Parklands. This was the first observation of these species within the site since 2007.

The OEH profile for this species list the following threats:

- Predation by foxes
- Loss of suitable habitat due to grazing, agriculture and development
- Habitat disturbance and degradation by stock
- Use of pesticides in agriculture to control rodent populations thereby limiting seasonal food sources for owls, reducing reproductive potential, and potentially poisoning owls
- Frequent burning, which reduces ground cover needed for safe roosting and nesting, and can reduce prey abundance
- Poor understanding of the ecology of inland populations
- Interacting effects of habitat degradation and increasing prevalence of invasive species

- a. **In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.**

The Eastern Grass Owl has been recorded infrequently at the site, despite targeted survey.

Large amounts of habitat will remain in the development site and only a small proportion of potential habitat in the form of exotic grassland will be directly impacted for the construction of the southern carpark.

All areas of remnant forest vegetation will be fenced during events to prevent disturbance and strict fire management procedures are also implemented. These measures have been in place during the trial period. During this time, monitoring has detected no adverse impacts to the native vegetation on site. Ongoing vegetation management and restoration measures will continue across the site with the objective of improving the ecological condition of the vegetation and therefore its potential value as Eastern Grass Owl habitat over time.

Therefore, the proposed works are not likely to place any viable local population of this species at risk of extinction.

- b. In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.**

Not applicable. The Eastern Grass Owl is not an endangered population.

- c. in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:**

- i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**
- ii. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,**

Not applicable. The Eastern Grass Owl is not an endangered ecological community.

- d. in relation to the habitat of a threatened species, population or ecological community:**

- i. the extent to which habitat is likely to be removed or modified as a result of the action proposed, and**

Only a very minor area of potential habitat will be removed (300m² or >0.001% of native vegetation within the development site).

Only a small proportion of potential habitat in the form of exotic grassland will be directly impacted for the construction of the southern carpark.

- ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and**

No native vegetation will be removed that would result in potential habitat for this species to become fragmented or isolated from other areas of habitat as a result of the proposed action.

Consequently, the proposed action is not expected to cause any fragmentation or isolation of the habitat of the Eastern Grass Owl.

iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,

The Eastern Grass Owl has been observed on site on three occasions in a decade (2007, 2016 and 2017). The Parklands is not considered to be important to the long-term survival of the species. Furthermore, only a small area of potential habitat (mostly exotic grassland) will be removed.

Therefore, the proposed action is not considered likely to have an impact on habitats that are important to the long term survival of this species in the locality.

e. Whether the action proposed is likely to have an adverse effect on critical habitat.

No critical habitat has been declared by the Director-General of the NPWS for the Eastern Grass Owl.

f. Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

No recovery plan or threat abatement plan has been prepared for the Eastern Grass Owl.

g. The action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The proposed action may result in the following indirect impacts:

- Potential increased bushfire risk, considered low risk due to stringent bushfire management during events for public safety
- Increased human traffic associated with unauthorised access, considered low risk due to fencing and previously low incidence
- Increased weed invasion, considered low risk due to few event days and ongoing rehabilitation of the site

The proposed action is therefore unlikely to result in the establishment or contribute to any of the key threatening processes listed under Schedule 3 of the TSC Act that would pose a threat to this species in and adjacent to the development site.

12.6.1 Conclusion

The proposal is unlikely to have a significant impact on the Eastern Grass Owl given that:

- The species has been recorded within the Parklands on only two occasions in the previous decade (2007, 2016) despite intensive targeted survey
- Only a small area of vegetation representing known or potential habitat will be removed or fragmented
- Areas of potential habitat for these species will remain within the site and is present throughout the adjacent Billinudgel Nature Reserve and more broadly in the region
- The proposed action will result in a minor disturbance during events, but monitoring data has shown ongoing use of the site by fauna with no evidence of disturbance of remnant vegetation
- On-going benefits to habitat will continue to be realised through habitat restoration and conservation activities

On the basis of the above considerations, it is unlikely that the proposal would result in a significant impact on the Eastern Grass Owl. Consequently, a Species Impact Statement is not required for the proposal with respect to this species.

12.7 Eastern Osprey (*Pandion cristatus*)

The Osprey has a global distribution with four subspecies previously recognised throughout its range. However, recent studies have identified that there are two species of Osprey - the Western Osprey (*P. halietus*) with three subspecies occurring in Europe, Asia and the Americas and the Eastern Osprey (*P. cristatus*) occurring between Sulawesi (in Indonesia), Australia and New Caledonia. Eastern Ospreys are found right around the Australian coast line, except for Victoria and Tasmania. They are common around the northern coast, especially on rocky shorelines, islands and reefs. The species is uncommon to rare or absent from closely settled parts of south-eastern Australia. There are a handful of records from inland areas. They favour coastal areas, especially the mouths of large rivers, lagoons and lakes and feed on fish over clear, open water.

A single Eastern Osprey was observed during the Falls Festival 2013-14 event monitoring. It was flying over the site.

The OEH profile for this species list the following threats:

- Disturbance to or removal of large trees near the coast that have been or could be used as nest sites
- Disturbances to water quality, such as from the disposal of treated effluent or stormwater runoff that increases turbidity in feeding areas
- Ingestion of fish containing discarded fishing tackle
- Potential electrocution of individuals using powerline poles for nesting
- Disturbance to active nests potentially reducing reproductive success

- a. In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.**

This species has been sighted only once in 10 ecological surveys at the site and it was flying overhead. Therefore, it is not considered that there is a local population using the site nor that the proposed works are not likely to place any viable local population of this species at risk of extinction.

- b. In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.**

Not applicable. The Eastern Osprey is not an endangered population.

- c. in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:**

- i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
- ii. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

Not applicable. The Eastern Osprey is not an endangered ecological community.

- d. in relation to the habitat of a threatened species, population or ecological community:**

i. the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

Only a very minor area of potential habitat will be removed (300m² or >0.001% of native vegetation within the development site).

ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

No vegetation will be removed which would result in potential habitat for this species to become fragmented or isolated from other areas of habitat as a result of the proposed action.

Consequently, the proposed action is not expected to cause any fragmentation or isolation of the habitat of the Eastern Osprey.

iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,

This species has been sighted only once in 10 ecological surveys at the site and it was flying overhead. Therefore, it is not considered that the habitat on site is of any importance to Eastern Osprey. Therefore, the proposed action is not considered likely to have an impact on habitats that are important to the long term survival of this species in the locality

e. Whether the action proposed is likely to have an adverse effect on critical habitat.

No critical habitat has been declared by the Director-General of the NPWS for the Eastern Osprey.

f. Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

No recovery plan or threat abatement plan has been prepared for the Eastern Osprey.

g. The action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Only a very minor area of potential habitat will be removed (300m² or >0.001% of native vegetation within the development site). The extent of clearing represents an insignificant increase in a key threatening impact. Furthermore, all other habitat on site will be preserved and protected for the duration of the project whilst significant areas of bushland rehabilitation has occurred, and is planned to occur in the future.

The proposed action may result in the following indirect impacts:

- Potential increased bushfire risk, considered low risk due to stringent bushfire management during events for public safety
- Increased human traffic associated with unauthorised access, considered low risk due to fencing and previously low incidence
- Increased weed invasion, considered low risk due to few event days and ongoing rehabilitation of the site

The proposed action is therefore unlikely to result in the establishment or contribute to any of the key threatening processes listed under Schedule 3 of the TSC Act that would pose a threat to this species in and adjacent to the development site.

12.7.1 Conclusion

The proposal is unlikely to have a significant impact on the Eastern Osprey given that:

- The species has only been observed once in the last decade of monitoring and survey, and this was one individual flying over the site
- Only a very minor area of potential habitat will be removed (300m² or >0.001% of native vegetation within the development site).
- Large amounts of potential habitat for these species will remain within the site and is present throughout the adjacent Billinudgel Nature Reserve and more broadly in the region
- The proposed action will result in a minor disturbance during events, but monitoring data has shown ongoing use of the site by fauna with no evidence of disturbance of remnant vegetation
- On-going benefits to habitat will continue to be realised through habitat restoration and conservation activities

On the basis of the above considerations, it is unlikely that the proposal would result in a significant impact on the Eastern Osprey. Consequently, a Species Impact Statement is not required for the proposal with respect to this species.

12.8 Koala (*Phascolarctos cinereus*)

Koalas are solitary and territorial (particularly males) yet live in established sedentary polygynous breeding aggregates arranged in a matrix of overlapping home ranges whose size varies according to sex (males tend to be larger so that they overlap the ranges of several females) and carrying capacity of the habitat (usually measured in terms of density of primary browse species) (Phillips and Callaghan 1995).

Nationally, koalas have been observed feeding or resting in about 120 eucalypt species (66 in NSW) and 30 non-eucalypt (seven in NSW) species. Usage may also be determined by site-dependent edaphic factors e.g. soil type (Sharp and Phillips 1999), which affects the nutrient quality of forage. Forest consisting of primary browse species associations located on deep, fertile soils on floodplains, in gullies and along watercourses are generally considered preferred koala habitat. This may possibly be a reflection of the nutritional value of the foliage.

An established koala home range is usually occupied for several years or throughout its life (Phillips 1997, Sharp and Phillip 1999). Size of a koala home range may vary from a hectare to hundreds of hectares (eg Jurskis and Potter 1997 report home ranges of 38 ha to 520 ha with an average size of 169 ha, near Eden); varying with habitat quality (e.g. if primary browse species dominate the tree component, home range size is expected to be small and carrying capacity high), sex (males have larger territories and may make forays into other areas), age of the animals (e.g. sub-adults versus adults), and location (Jurskis and Potter 1997, Phillips 1997, Sharp and Phillip 1999).

The site use of the Parklands by koala has been variable over time. Targeted koala surveys provided the following indication of site usage:

- 2007 – small area of core Koala habitat (3 ha) mapped on site; Koala scats observed at four locations within the Parklands; results suggest use of the site by 1 – 2 Koalas

- 2008 – significantly reduce evidence of activity, such that activity level does not reach the threshold that indicates active, ongoing use by resident animals
- 2013 – no evidence of Koala within the Parklands
- 2016 – evidence of Koala (scats and scratches) at 7 sites, primarily in the north-west corner of the Parklands and within Billindugel Nature Reserve. Mixed age scats suggest repeat use of sites by Koala individuals with home ranges that encompass the north-west corner of the Parklands

a. In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

All potential habitat for the Koala on site will be preserved and protected for the duration of the project. All areas of remnant vegetation will be fenced during events to prevent disturbance and strict fire management procedures are also implemented. These measures have been in place during the trial period. During this time, monitoring has detected no adverse impacts to the native vegetation on site. Ongoing vegetation management and restoration measures will continue across the site with the objective of improving the ecological condition of the vegetation and therefore its value as Koala habitat over time.

Indirect impacts to Koala are also unlikely. Koalas have moved back into the Parklands area during the trial period (i.e. there was no evidence of Koala in 2013 compared to evidence of repeat use of north-west corner of the site in 2016). This suggests the ongoing use of the site for events has not precluded the area from providing suitable habitat for Koala.

Therefore, the proposed works are not likely to place any viable local population of this species at risk of extinction.

b. In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.

In addition to being listed as a threatened species, the Koala population between the Tweed and Brunswick Rivers east of the Pacific Highway is also listed as an endangered population.

As discussed in (a) above, the events are not likely to have an impact on either the local habitat or koalas using the Parklands site. There is some uncertainty as to whether the koalas on site comprise a 'viable local population'. However, ongoing habitat improvements and effective management and mitigation measures will ensure any local population is not put at risk of extinction.

c. in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

- i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
- ii. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,

Not applicable. The Koala is not an endangered ecological community.

d. in relation to the habitat of a threatened species, population or ecological community:

i. the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

The proposed action will not result in clearing of koala habitat within the Parklands.

ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

No vegetation will be removed which would result in potential habitat for this species to become fragmented or isolated from other areas of habitat as a result of the proposed action.

Consequently, the proposed action is not expected to cause any fragmentation or isolation of the habitat of the Koala.

iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,

The proposed action will not result in any removal of koala habitat. All areas of remnant vegetation will be fenced during events to prevent disturbance and strict fire management procedures are also implemented. These measures have been in place during the trial period. During this time, monitoring has detected no adverse impacts to the native vegetation on site. Ongoing vegetation management and restoration measures will continue across the site with the objective of improving the ecological condition of the vegetation and therefore its value as Koala habitat over time.

The importance of vegetation within the Parklands to Koala is unclear. However, Koalas have moved back into the Parklands area during the trial period (i.e. there was no evidence of Koala in 2013 compared to evidence of repeat use of north-west corner of the site in 2016). This suggests the ongoing use of the site for events has not precluded the area from providing suitable habitat for Koala.

Therefore, the proposed action is not considered likely to have an impact on habitats that are important to the long term survival of this species in the locality.

e. Whether the action proposed is likely to have an adverse effect on critical habitat.

No critical habitat has been declared by the Director-General of the NPWS for the Koala.

f. Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

The Approved Recovery plan for the koala (DECC 2008) provides a framework for localised recovery efforts throughout NSW through a number of recovery actions. The actions include:

- Conserving Koalas in their existing habitat, rehabilitate and restore Koala habitat and populations;
- Develop a better understanding of the conservation biology of Koalas;
- Ensure that the community has access to factual information about the distribution, conservation and management of koalas at a national, state and local level;

- Manage captive, sick or injured Koalas and orphaned wild Koalas to ensure consistent and high standards of care;
- Manage over browsing to prevent both koala starvation and ecosystem damage in discrete patches of habitat; and,
- Coordinate, promote the implementation, and monitor the effectiveness of the NSW Koala Recovery Plan across New South Wales.

The proposal does not conflict with any of the objectives outlined in the recovery plan.

g. The action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The proposed action may result in the following indirect impacts:

- Potential increased bushfire risk, considered low risk due to stringent bushfire management during events for public safety
- Increased human traffic associated with unauthorised access, considered low risk due to fencing and previously low incidence
- Increased weed invasion, considered low risk due to few event days and ongoing rehabilitation of the site
- Increased risk of vehicular strike during events, if koalas disperse away from noise and light sources. This is considered low however. Furthermore, all internal roads within the development site are limited to 25km/hr and the nearby highway has fauna exclusion fencing/barriers.

The proposed action is therefore unlikely to result in the establishment or contribute to any of the key threatening processes listed under Schedule 3 of the TSC Act that would pose a threat to this species in and adjacent to the development site.

12.8.1 Conclusion

The proposal is unlikely to have a significant impact on the Koala given that:

- No vegetation representing known or potential habitat will be removed
- Large amounts of potential habitat for these species will remain within the site and is present throughout the locality.
- No habitat would be isolated of known habitat from currently interconnecting areas of potential habitat for this species
- The proposed action will result in a minor disturbance during events, but monitoring data has shown koalas have moved back into the Parklands in 2016 over the time that events have been running
- On-going benefits will continue to be realised through habitat creation and preservation through bush regeneration

On the basis of the above considerations, it is unlikely that the proposal would result in a significant impact on the Koala. Consequently, a Species Impact Statement is not required for the proposal with respect to this species.

12.9 Mitchell's Rainforest Snail (*Thersites mitchellae*)

This species is restricted to coastal lowlands occurring between the Tweed and Richmond Rivers in NSW. The species is currently only known from five locations between Banora Point and Lennox Head, within an 80 km long stretch of coastline. The estimated total number of mature individuals is less than 500 (DoE, 2017c).

The preferred habitat for the species is lowland subtropical rainforest and swamp sclerophyll forest with a rainforest understorey on alluvial soils with a basaltic influence (DoE, 2017c). The species is found in areas with deep leaf litter and an intact forest canopy and are known to shelter under palm fronds, leaf litter and bark during the day.

Three shells of Mitchell's Rainforest Snail have been found in Billinudgel Nature Reserve and suitable habitat exists within the patches of remnant vegetation at the Parklands. The long history of forest clearing, fragmentation and trampling by cattle suggests the species would not be present found in the event areas. The species has not been detected during targeted survey and monitoring. However, given the close proximity of the Billinudgel Nature Reserve and suitable habitat on site, there is potential for the species to be present within areas of remnant vegetation at the Parklands.

The OEH profile for this species list the following threats:

- Clearing of lowland rainforest, swamp forest and wetland margins for agriculture.
- Clearing of lowland rainforest, swamp forest and wetland margins for urban development.
- Damage to remnant areas of habitat from grazing by domestic stock.
- Damage to remnant areas of habitat by fire.
- Damage to remnant areas of habitat by weed invasion.
- Predation of snails by introduced rats.
- Habitat fragmentation increasing edge effects including increasing the severity of disturbance from fire, weeds and predation by introduced rats.
- Use of herbicides and pesticides in and near areas of habitat.
- Impacts on habitat as a result of dieback caused by root rot fungus (*Phytophthora cinnamomi*).
- Loss of coastal populations from sea level rise and climate change
- Damage to habitat from changes in hydrology
- Poor knowledge of species distribution
- Lack of awareness of the species within the community

a. In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

All potential habitat for the Mitchell's Rainforest Snail on site will be preserved and protected for the duration of the project. All areas of remnant vegetation will be fenced during events to prevent disturbance and strict fire management procedures are also implemented. These measures have been in place during the trial period. During this time, monitoring has detected no adverse impacts to the native vegetation on site. Ongoing vegetation management and restoration measures will continue across the site with the objective of improving the ecological condition of the vegetation and therefore its value as Mitchell's Rainforest Snail habitat over time.

Therefore, the proposed works are not likely to place any viable local population of this species at risk of extinction.

- b. In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.**

Not applicable. Mitchell's Rainforest Snail is not an endangered population.

- c. in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:**

- i. is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**
- ii. is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction,**

Not applicable. The Mitchell's Rainforest Snail is not an endangered ecological community.

- d. in relation to the habitat of a threatened species, population or ecological community:**

- i. the extent to which habitat is likely to be removed or modified as a result of the action proposed, and**

Only a very minor area of potential habitat will be removed (300m² or >0.001% of native vegetation within the development site).

- ii. whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and**

No vegetation will be removed that would result in potential habitat for this species to become fragmented or isolated from other areas of habitat as a result of the proposed action.

Consequently, the proposed action is not expected to cause any fragmentation or isolation of the habitat of the Mitchell's Rainforest Snail.

- iii. the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality,**

Only a very minor area of potential habitat will be removed (300m² or >0.001% of native vegetation within the development site).

All areas of remnant vegetation will be fenced during events to prevent disturbance and strict fire management procedures are also implemented. These measures have been in place during the trial period. During this time, monitoring has detected no adverse impacts to the native vegetation on site. Ongoing vegetation management and restoration measures will continue across the site with the objective of improving the ecological condition of the vegetation and therefore its value as the Mitchell's Rainforest Snail habitat over time.

The importance of habitat at the Parklands for Mitchell's Rainforest Snail is uncertain, however, given the very minor clearing that is planned and the habitat rehabilitation that is taking place, the proposed action is not considered likely to have an impact on habitats that are important to the long term survival of this species in the locality.

Regarding the impacts of noise, gastropods do not have a sense of hearing, though do feel vibrations. The potential impact of event generated vibrations is unclear and dependant on distance to the source of noise. It is predicted that vibrations would not be at levels that could cause harm to this species.

e. Whether the action proposed is likely to have an adverse effect on critical habitat.

No critical habitat has been declared by the Director-General of the NPWS for the Mitchell's Rainforest Snail.

f. Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

A recovery plan was prepared in 2001 by NSW National Parks and Wildlife Service for Mitchell's Rainforest Snail. The objectives outlined in the plan include:

- Objective 1: to assist identification of potential habitat for Mitchell's Rainforest Snail
- Objective 2: to assist identification of additional populations of Mitchell's Rainforest Snail
- Objective 3: to maximise the protection of the population of Mitchell's Rainforest Snail on Stotts Island
- Objective 4: to encourage community participation in the recovery of Mitchell's rainforest snail

The proposed works do not conflict with any of the objectives of the recovery plan.

g. The action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

The proposed action may result in the following indirect impacts:

- Potential increased bushfire risk, considered low risk due to stringent bushfire management during events for public safety
- Increased human traffic associated with unauthorised access, considered low risk due to fencing and previously low incidence
- Increased weed invasion, considered low risk due to few event days and ongoing rehabilitation of the site

The proposed action is therefore unlikely to result in the establishment or contribute to any of the key threatening processes listed under Schedule 3 of the TSC Act that would pose a threat to this species in and adjacent to the development site.

12.9.1 Conclusion

The proposal is unlikely to have a significant impact on the Mitchell's Rainforest Snail given that:

- Only a very minor area of potential habitat will be removed (300m² or >0.001% of native vegetation within the development site).
- Large amounts of potential habitat for these species will remain within the site and is present throughout the adjacent Billinudgel Nature Reserve and more broadly in the region
- The proposed action will result in a minor disturbance during events, but monitoring data has shown ongoing use of the site by fauna with no evidence of disturbance of remnant vegetation
- On-going benefits to habitat will continue to be realised through habitat restoration and conservation activities

On the basis of the above considerations, it is unlikely that the proposal would result in a significant impact on the Mitchell's Rainforest Snail. Consequently, a Species Impact Statement is not required for the proposal with respect to this species.

Appendix N – EPBC Act Referral Determination



Notification of

REFERRAL DECISION – not controlled action North Byron Parkland Cultural Events, NSW (EPBC: 2017-7973)

This decision is made under Section 75 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Proposed action

Person proposing to take the action	The trustee of Billinudgel Property trust ABN: 52031674697
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proposed action	To use the Parklands site, located on Tweed Valley Way and Jones Road in the Yelgun Valley NSW as a cultural events centre and construct associated event infrastructure including a number of site enhancements [See EPBC Act referral 2017/7973].
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Referral decision: Not a controlled action

status of proposed action	The proposed action is not a controlled action.
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Person authorised to make decision

Name and position	Kim Farrant Assistant Secretary Assessments (NSW, ACT) and Fuel Branch
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signature

date of decision	27 July 2017
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