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Lot 30 in DP 1198692
George Evans Road, Mundamia

Proposed Residential Estate

# Flora & Fauna Assessment Report

01 June 2015

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**LOT 30 in DP 1198692**
**GEORGE EVANS ROAD, MUNDAMIA**

**PROPOSED RESIDENTIAL ESTATE**

**FLORA & FAUNA ASSESSMENT REPORT**

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**GEORGE EVANS ROAD, MUNDAMIA**

**PROPOSED RESIDENTIAL ESTATE**

**FLORA & FAUNA ASSESSMENT REPORT**

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## 1 INTRODUCTION

### 1.1 Background

The land that is the subject of this *Flora & Fauna Assessment Report* (the 'subject land') consists of proposed Lot 30 in DP 1198692 George Evans Road at Mundamia (Figure 1). The subject land is located within the Local Government Area (LGA) of Shoalhaven City Council, and occupies a total area of approximately 40 hectares (ha).

The subject land is located to the west of the township of Nowra and to the south of the Shoalhaven River (Figures 1 and 2), between:

- private land south of the Shoalhaven River (located to the immediate north);
- the main part of the town of Nowra to the east (across the forested valley of Flat Rock Creek);
- private land north of Yalwal Road (to the immediate south); and
- a Crown Road Reserve and other private land (to the immediate west).

The subject land occupies a total area of approximately 40.45ha, and is characterised by a mosaic of remnant and regrowth native vegetation (in the north and east), and substantial areas of cleared agricultural land (Figure 2). The western and southern parts of the site, which are predominantly cleared and disturbed, are the focus of development activities.

Surrounding lands are predominantly forested or contain other native vegetation (variously disturbed), although there are small areas of farmed land, occasional dwellings and formed roads, particularly to the west and north (Figures 1 and 2).

Pursuant to *Shoalhaven Local Environmental Plan 1985* (SLEP 1985), the subject land was zoned predominantly *1(d) – General Rural*, with a strip of land along the eastern boundary zoned *7(d1) – Scenic Protection*. The *General Rural* land zoning occupied approximately 37.93ha (or 92%) of the site and the *Scenic Protection* land zoning occupied approximately 5.36ha (or 13%) of the site.

The subject site is now zoned mostly *R1 – General Residential*, with a band along the eastern and northern sides zoned *E2 – Environmental Conservation* – pursuant to SLEP 2014. The separate lot on the eastern boundary is also zoned *E2 – Environmental Conservation* (Figure 3).

## 1.2 Submissions on the Environmental Assessment

An earlier version of this report (the *Flora and Fauna Issues and Assessment Report*, SLR 2012) was prepared as a technical study to support an Environmental Assessment prepared pursuant to Part 3A of the NSW *Environmental Planning & Assessment Act 1979* (EP&A Act). The draft Environmental Assessment was placed on public exhibition from May to June 2013, and a number of submissions were received, including an array of comments on the SLR 2012 *Report* by government agencies.

Accordingly, this latest version of the *Report* has been prepared based on a review of those comments, and, where reasonable and relevant, these comments have been addressed in the current *Report*. Importantly, the relevant agency comments are listed in the accompanying Gunninah (2014) *Agency Response Report*, which should be read in conjunction with this Report by SLR Consulting.

An additional set of comments have been received (DoP 2015) which request more information, including with regard to provision of Section 5A Assessments of Significance and comment on the *Threatened Species Assessment Guidelines – the Assessment of Significance* (August 2007) in accordance with Part 4 development under the EP&A Act 1979. Appendix L has been prepared in reponse.

In addition this report has been updated on various occasions due to design changes to the development plan, most of which have resulted in a nett reduction in the impact areas on biodiversity.

## 1.3 Director-General's Requirements

The Director-General's Requirements for the Environmental Assessment identify *inter alia* a series of "*key issues*" with respect to flora and fauna, and their associated habitats, that need to be addressed in the Environmental Assessment for the proposal. These issues are addressed in detail in the ensuing parts of this *Report*.

## 1.4 Proposed Development

The proposal for the land, which is the subject of this *Report*, is:

- the rezoning of the majority of the subject land (31.03ha or 77% of the site) for residential purposes, in accordance with the *Nowra-Bomaderry Structure Plan* (2008) and the *Shoalhaven Local Environmental Plan 2014* (SLEP 2014);
- the creation of four onsite detention basins totalling 1ha in area, which for the purposes of this report have been included as part of the development area – but which would ultimately form part of the *Public Reserve*;
- the creation of two areas to be dedicated for biodiversity conservation, occupying approximately 9.42ha (or 23% of the land); and
- the subsequent subdivision of the land and the construction of a residential subdivision (of 319 lots, one commercial lot and four public reserves) with associated roads and other infrastructure.

Whilst previous designs for the proposed development have required APZ areas to encroach onto the adjoining proposed *Public Reserve*, design changes have enabled all APZ areas to be encompassed by the development footprint.

The proposed subdivision layout, including residential lots, internal roads, stormwater basins, and APZs, is provided in Appendix A. Specific elements of the proposal include:

- the subdivision of the land into roads, open space and residential allotments, within a 11 stage development program;
- the provision of a peripheral road system to provide access in the event of a bushfire and to provide a management interface between retained vegetation and the residential subdivision;
- the provision of stormwater controls and management features designed *inter alia* to mimic the existing surface hydrology and protect adjoining habitats and resources;
- the identification and dedication of land in the northern and eastern parts of the subject land for biodiversity conservation and environmental protection purposes; and
- the provision of *Asset Protection Zones* (APZs) within the proposed development footprint.

The area proposed for residential development (31.03ha or 77% of the subject land) is predominantly cleared or highly degraded agricultural land. The remainder of the subject land (*ie* the northeastern and southeastern portions of the land, occupying approximately 9.42 ha) is to be retained and managed for conservation purposes (in the proposed *Public Reserve*) with an additional 1ha for stormwater (on-site detention basins) to form part of the reserve following construction (Appendix A).

The proposal has been re-designed specifically to reduce impacts on the Nowra Heath-myrtle and also (in the southeast) to eliminate the impacts of APZs. This has involved a reduction in the extent of development in the northern part of the land, which significantly reduces the area of habitat for, and, the number of specimens of, the Nowra Heath-myrtle which will need to be removed or affected.

Areas used to calculate impact areas throughout this Report include:

- Subject land (Lot 30 in DP 1198692) of 40.45ha;
- Public Reserve (not inclusive of the onsite detention basins) 9.42ha; and
- Development Area (inclusive of the onsite detention basins) 31.03ha.

### 1.5 Scope and Aims of this Report

The scope of this *Flora & Fauna Assessment Report* with respect to the subject land at George Evans Drive, Mundamia includes:

- the collation of any available existing relevant information regarding the subject land and adjoining lands;
- undertaking a search of the *Atlas of NSW Wildlife* (Appendix D) maintained by the then Department of Environment, Climate Change & Water (DECCW);
- collating information obtained in ecological surveys of the subject land and of surrounding lands, conducted by BES for Shoalhaven City Council for the *Nowra-Bomaderry Structure*

*Plan*, and the supplementary data collected by Environmental InSites on the subject land itself and on adjoining lands (see Chapter 2);

- incorporating data from surveys undertaken by Council *inter alia* on the subject land for *Pterostylis vernalis*;
- collating and integrating information from other relevant sources (see Chapter 2);
- considering the likely impacts of future development of the subject land on the natural environment in general, and on threatened biota and their habitats in particular; and
- addressing the following relevant statutory requirements:
  - the *Environment Planning & Assessment Act 1979* (EP&A Act);
  - the *Threatened Species Conservation Act 1995* (TSC Act);
  - the *Water Management Act 2000*;
  - relevant *Matters of National Environmental Significance* (Appendix E) listed in the Commonwealth *Environmental Protection & Biodiversity Conservation Act 1999* (EPBC Act); and
  - *State Environmental Planning Policy No. 44 – Koala Habitat Protection* (SEPP 44).

The aims of this *Flora & Fauna Assessment Report inter alia* are:

- to provide an appropriate data base for the site to form the basis for addressing the potential impacts of the proposal;
- to provide input into the final subdivision design, with respect both to its footprint and its associated elements (APZs and stormwater treatment features);
- to identify a development design and footprint that satisfies both development aspirations and biodiversity conservation goals;
- to assist in designing a project that satisfies the goals of *Ecologically Sustainable Development* (ESD), as required by the legislation;
- to identify appropriate management measures which should be implemented within the Public Reserve on the subject land to facilitate biodiversity conservation;
- to facilitate the realisation of the goals and planning outcomes identified in SLEP 2014; and
- to provide additional information, as appropriate, in response to government agency comments on the original SLR FFAR (2012) and The original Environmental Assessment (2012).

This *Report* is based on the subdivision design illustrated in Appendix A, and assumes that all vegetation within that portion of the land *(ie* the *"subject site")* will be removed. Conversely, vegetation along the eastern and northern sides of the subject land, in the proposed *Public Reserve*, would be retained and managed for biodiversity conservation purposes.

### 1.6 DEC Guidelines

The proposal has been assessed with respect to two sets of draft *Guidelines* prepared by the then Department of Environment & Conservation (DEC 2004, 2005):

- the *Draft Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities* (DEC 2004); and
- the *Draft Guidelines for Threatened Species Assessment* (DEC and DPI 2005).

The *2004 Draft Guidelines* were addressed in the undertaking of investigations for this *Report* and in determining threatened biota of likely potential relevance. The *2005 Draft Guidelines* (with respect to impacts on threatened biota) have been addressed in detail in Chapter 7.3.5 of this *Report*.

It should be noted that both sets of *Guidelines*:

- remain draft *Guidelines*, notwithstanding the 9-10 year time period between their drafting and the present time; and
- are "*Guidelines*", and therefore open to interpretation and/or application to various extents depending on circumstances. Significantly, neither constitutes "*standards*" which must be applied, but rather provide guidance as to what may be applied under relevant circumstances.

Notwithstanding the draft nature of these documents, and their inherent limitations, this *Report* has taken those *Guidelines* into account, to the extent relevant to the proposal at Mundamia.

## 1.7 Assumptions

For the purposes of this *Report*, a number of assumptions have been made with respect to the proposed subdivision and future development of the subject land at Mundamia, including:

- all future development activities on the subject land will be undertaken in an environmentally responsible and sensitive manner, applying 'best practice' methods to minimise or avoid unnecessary direct or indirect impacts upon the natural environment;
- all appropriate methods to protect retained native vegetation and habitats on the subject land and adjoining lands will be implemented as identified in this *Report* and as documented in the attached *Vegetation Management Principles Plan* (VMPP); and
- the impact amelioration and environmental measures contained in this *Report* will be implemented.

## 1.8 Definitions

The definitions of relevant terms employed in this *Report* are:

- "*subject land*" Lot 3 in DP 568613 and Lot 384 in DP 755952 George Evans Road, Mundamia – now Lot 30 in DP 1198692.
- "*subject site*" the area proposed for the residential development and associated onsite stormwater detention..
- "*locality*" an area of 10km radius around the "*subject site*".

Other terms used in this *Report* (listed in the *Glossary*) conform to the definitions contained in the relevant legislation and planning instruments.

# 2 INFORMATION BASE

## 2.1 Field Investigations

### 2.1.1 Overview

A variety of previous surveys have been undertaken within the locality (including the subject land) and its environs for flora and fauna, including:

- ecological studies of Area 5 - Mundamia for the *Nowra-Bomaderry Structure Planning Study* by BES in 2004, including a supplementary survey for the endangered orchid *Pterostylis vernalis*[1]);
- flora and fauna surveys of the Wollongong University Shoalhaven Campus (to the immediate southwest of the subject land) by BES in 2004 and 2007;
- supplementary flora and fauna surveys of the subject land and of the proposed access road to it by Environmental InSites in 2008 and further supplementary inspections of those areas by Environmental InSites in 2010 and 2011;
- dedicated surveys for *Pterostylis vernalis* on the subject land and at Mundamia generally by Shoalhaven City Council (SCC) in 2010;
- dedicated surveys for *Pterostylis vernalis* on the subject land by Environmental InSites in 2010;
- two brief surveys by SLR Consulting in 2013 – including a dedicated search for *Pterostylis vernalis* in areas of Kunzea Heathland and a dedicated survey for Nowra Heath-myrtle and hollow-bearing trees in the vicinity of the existing dwelling off Jonsson Road (now Lot 31);
- dedicated surveys by SLR Consulting in 2014, involving a fauna trapping and nocturnal survey program and detailed mapping of the Nowra Heath-myrtle; and
- a supplementary investigation of Council land to the immediate west of the subject land by BES, involving flora and fauna surveys in November/December 2009 and February 2010.

Details of field survey effort and survey methods are provided in Appendix B.

### 2.1.2 Recent SLR surveys

Recent dedicated surveys by SLR Ecology on the subject land include:

- two brief surveys in 2013 – involving a dedicated search for the *Pterostylis vernalis* in areas of Kunzea Heathland and a dedicated survey for Nowra Heath-myrtle and hollow-bearing trees in the vicinity of the existing dwelling off Jonsson Road (now Lot 31);
- an updated flora and fauna survey for the whole of the subject land in 2014, involving:
  - detailed mapping of the Nowra Heath-myrtle, both as patches and as individual specimens;
  - supplementary mapping of hollow-bearing trees;

1 *Pterostylis vernalis* was previously known as *Speculantha vernalis*, the Spring Tiny Greenhood and *Pterostylis* sp. Flat Rock Creek.

- nocturnal spotlighting and call playback over three nights;
- infrared camera and Anabat recording over two nights;
- arboreal glider tube trapping over two nights; and
- terrestrial hair funnel analysis for traps left over 14 days.

A detailed method statement and accompanying maps of survey locations are provided in Appendix B.

Sampling of each native plant community was undertaken using a systematic botanical survey technique, in accordance with the draft DEC (2004) *Threatened Biodiversity Survey & Assessment Guidelines*.

This additional field work has been undertaken to address comments received on the exhibited *Environmental Assessment*.

### 2.1.3 BES Surveys

Details of previous Bushfire Environmental Services (BES) field surveys on and around the subject land are provided in Appendix B. The BES surveys of the *Mundamia Urban Expansion Area* in 2004 included an array of investigations in February – April, June and October of 2004, including:

- general vegetation surveys and targeted grid searches or targeted transects for flora in general, and for a range of potential threatened species;
- supplementary dedicated surveys specifically for the *Pterostylis vernalis* in October 2004;
- diurnal habitat searches for native fauna species and for indirect evidence;
- nocturnal spotlighting and call playback for gliders, forest owls, the Bush Stone-curlew and Giant Burrowing Frog;
- nocturnal Anabat recording of microchiropteran bats;
- trapping for native fauna using a variety of trapping and other survey techniques; and
- nesting assessments of hollow-bearing trees for large forest owls and the Glossy Black Cockatoo.

Maps prepared by BES in 2004 for the subject land are provided in Appendix C.

In November and December 2009 and February 2010, BES (now Eco Logical Australia) conducted further flora and fauna surveys on Council land to the immediate west of the subject land at Mundamia.

Those investigations included:

- dedicated transect surveys for threatened orchids known to occur in the locality;
- nesting assessments for the Gang Gang Cockatoo;
- stag watching surveys for nocturnal mammals and birds;
- nocturnal spotlighting, call playback and Anabat recording;
- 200 trap-nights for the Eastern Pygmy Possum and the White-footed Dunnart; and

- the use of remote cameras to survey particularly for Rosenberg's Goanna and the Tiger Quoll.

### 2.1.4 InSites Surveys

Further field surveys were undertaken from the 24th to the 26th of September 2008 by Environmental InSites, on the subject land at George Evans Road (Appendix B), which consisted of:

- targeted walked surveys for the threatened flora species Nowra Heath-myrtle *Triplarina nowraensis*;
- botanical surveys to verify or refine the vegetation mapping of BES (2004);
- GPS mapping of hollow-bearing trees within the proposed development and APZ areas;
- nocturnal fauna surveys including spotlighting, amphibian surveys, call playback and ultrasonic bat detection (mobile and all night recording); and
- diurnal avifauna, herpetofauna and habitat surveys, including searches for indirect evidence of threatened and other species.

Additional surveys and inspections of the subject land and nearby lands have also been conducted in 2010 and 2011 by Environmental InSites, and by Shoalhaven City Council (SCC), including:

- a supplementary inspection of the proposed road alignment for access into the Mundamia residential area, on the 4th of May 2010 (Environmental InSites);
- dedicated surveys for the *Pterostylis vernalis*, both on the subject land and in the immediate vicinity, by SCC and Environmental InSites (in late 2010); and
- two supplementary dedicated surveys of the subject land (in 2011) by Environmental InSites to refine vegetation mapping and to provide added information and detail regarding the distribution and densities of patches of the Nowra Heath-myrtle.

## 2.2 Other Sources of Information

In addition to the field investigations of the subject land (detailed above), additional information has been obtained from or on the basis of:

- the published scientific literature, particularly with respect to threatened biota;
- the experience and knowledge (local and general) of the SLR Ecology team;
- the information contained in the *Reports* from previous investigations (as documented above); and
- surveys for *Pterostylis vernalis* by Shoalhaven Council in 2010.

## 2.3 Other Considerations

### 2.3.1 Application of the DEC Guidelines

The field surveys undertaken for this *Report* by various ecological consultants were carried out in accordance with the *Draft Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities* (DEC 2004), to the extent that those *Guidelines* are relevant in the circumstances of the proposal and the subject land.

In that regard, the combination of the surveys undertaken for the *Nowra-Bomaderry Structure Plan* by BES in 2004 (and supplementary investigations in 2007, 2009 and 2010), and the investigations undertaken by Environmental InSites (in 2008, 2010 and 2011), provide a comprehensive and appropriate information base with respect to the ecological characteristics of the subject land, and the distribution of threatened biota and their habitats.

In addition, as the majority of the development is to be on cleared and highly degraded agricultural land, the array of resources or potential habitat for threatened biota is relatively limited. No such habitats or resources are confined to the development area (*ie* the "*subject site*").

As a consequence, many of the survey requirements detailed in the DEC 2004 *Guidelines* are either inappropriate or excessive. Furthermore, the experience and knowledge of the survey teams (both from the BES and from InSites) has been applied in determining the appropriate levels of field investigation and surveys required.

### 2.3.2 Limitations

It is a simple fact that all ecological investigations have inherent limitations. In particular, ecological surveys undertaken at any one point of time will necessarily fail to detect all of the species (flora and fauna) which utilise any particular site due to seasonal, climatic or temporal factors, variations in seasons and in the response of biota to seasonal conditions, variations in the detectability of certain biota, and the application of chance or happenstance.

Conversely, the conduct of investigations by different ecologists at different times increases the likelihood of detecting the presence of threatened and other native biota, as has been the case on the subject land. Investigations undertaken by BES in 2004, 2007, 2009 and 2010, and by Environmental InSites in 2008, 2010 and 2011, as well as the surveys in 2010 by SCC, provide a combined information base involving a variety of surveys of the subject land and immediately adjoining lands over a period of at least 8 years (Appendix B).

Further, the inherent limitations of ecological investigations can be overcome to a significant extent by consideration not simply of the biota detected but by including consideration of species either that are known to occur in the general locality or for which suitable habitat and resources are present on the subject land. In this regard, where suitable habitat for a threatened species is present on the subject land, the likelihood of that species being present and the likelihood or otherwise of a population of that species being dependent on the subject land has been taken into consideration.

Further, an assessment of the likely impacts of developments on the subject land upon a threatened species which has not been recorded but which may potentially be present (*eg* the Powerful Owl) can readily be undertaken on the basis of the effects on potential habitat and/or particular resources of

relevance for that species (both on the subject land and on surrounding or adjoining lands). In that instance, therefore, the potential for adverse impacts to be imposed upon such a species can be addressed based on an assumption that individuals of that species do utilise the land, even in the absence of any evidence to that effect.

Thus, the assessment of the potential for adverse impacts to be imposed on the natural environment in general, and on threatened biota or their habitats in particular, contained in this *Report* has involved a conservative approach to the issues. The recommendations contained in this *Report* assume that not all native biota have been recorded, and that an environmentally responsible approach to development of the land should be adopted.

## 3 EXISTING ENVIRONMENT

In broad landscape terms, the subject land (Figure 1) is located in the northeastern part of a broad plateau which is located between Flat Rock Creek (to the east), Cabbage Tree Creek (to the west) and the Shoalhaven River (to the north). Most of the subject land is located on the plateau, with the steep slopes down to Flat Rock Creek commencing along the eastern boundary of the land and further to the east, and in the northeastern corner.

The main residential area of the township of Nowra is located approximately 2km to the east of the subject land, with more recent residential development in West Nowra (across Flat Rock Creek) approximately 500m to the southeast of the subject land (Figure 1). The Nowra campus of Wollongong University is located approximately 500m to the southwest of the subject land, on the other side of George Evans Road (Figure 1).

The land is predominantly characterised by flat to gently sloping terrain, ranging in height from approximately 60m (AHD) in the southwestern corner to approximately 40m (AHD) along the eastern side, above the steeper slopes. The terrain along the eastern boundary of the land falls steeply on an easterly aspect towards Flat Rock Creek, which is situated in a steep gully on Crown Land to the immediate east (Figure 4), with the lowest part of the land below 20m (AHD) in the northeastern corner (within the *Public Reserve*). A small un-named tributary of Flat Rock Creek traverses the subject land in the northern section of Lot 3, draining to the northeast.

The subject land is vegetated by open farmland through the western half (approximately) and remnant native woodland and open forest displaying varying levels of disturbance along the eastern half and across the northern boundary (Figure 2).

Lands to the northwest, north and east of the subject land are predominantly vegetated with similar woodland and open forest communities to those present on the subject site (BES 2006). Lands to the southwest and south have been variously modified for agricultural or residential purposes and for the University campus (Figures 1 and 2).

In addition to the Crown Land surrounding Flat Rock Creek, a number of nature reserves are located in close proximity to the subject land including Triplarina Nature Reserve (adjacent to Flat Rock Creek Dam to the south of Yalwal Road) and Bamarang and Wongamia Nature Reserves to the west, in the suburb of Longreach (Figure 1). In addition, there are extensive areas of vegetation in the immediate vicinity of the subject land (much of it on crown land and/or on steep slopes and clifflines or along Flat Rock Creek). These areas are currently zoned *7(d1) – Conservation*, and are never likely to be developed.

# 4 FLORA and VEGETATION

## 4.1 Existing Vegetation

The subject land supports six main native plant community types (Figure 4), with the majority of native vegetation being restricted to the northern and eastern portions of the land. The plant communities identified in this *Report* are relatively consistent with the descriptions documented in the original BES *Report* (Appendix C) and include:

- Grey Gum – Blue-leaved Stringybark Open Forest;
- Spotted Gum – Blackbutt Forest;
- Scribbly Gum – Bloodwood Forest;
- Paperbark Closed Forest;
- Kunzea Heathland;
- Regrowth Woodland with Kunzea Heath and Mixed Woodland Strip; and
- Pasture.

The distribution of vegetation types within the subject land is shown in Figure 4 and the total area of each vegetation types is listed in Table 1. As indicated, the majority of the subject land consists of the cleared pasture and highly disturbed or degraded lands. The vegetation type that constitutes most of the remainder of the proposed development footprint on the subject land is the Grey Gum – Blue-leaved Stringybark Forest/Woodland community, although much of this vegetation is also to be retained within the *Public Reserve* in the northern and eastern parts of the subject land, and it is widely distributed in the immediate vicinity.

As discussed below with respect to individual communities, the peripheries of many of these vegetation types have been highly modified as a result of the agricultural activities in the cleared parts of the subject land. As a consequence, those portions of the native plant communities which are to be removed for the proposed development are in places already degraded to some extent.

**Table 1 Areas of vegetation types mapped on the subject land at Mundamia**

| Community | Ha | % of land | Comments |
|---|---|---|---|
| Grey Gum – Blue-leaved Stringybark Open Forest[#] | 14.40 | 35.61% | Widespread in vicinity and locality, including in reserved lands to east and in Triplarina Reserve |
| Spotted Gum – Blackbutt Forest | 1.62 | 4.00% | Common in vicinity and locality, including along Flat Rock Creek and in Triplarina Reserve |
| Scribbly Gum – Bloodwood Forest | 0.42 | 1.03% | Widespread in vicinity and locality, including in reserved lands to east and in Triplarina Reserve |
| Paperbark Closed Forest | 0.79 | 1.95% | Scattered (often small) patches widely distributed and common in vicinity and locality |
| Kunzea Heathland | 0.92 | 2.28% | Scattered (often small) patches widely distributed and common in vicinity and locality |
| Regrowth Woodland with Kunzea Heath and Mixed Woodland Strip | 0.88 | 2.18% | Abundant and widespread |
| Pasture | 21.42 | 52.96% | Abundant and widespread |
| **TOTAL** | **41.39** | **100.00** | |

# Includes Highly Disturbed Grey Gum – Stringybark Woodland.
% Percentage of the community present on the subject land.

**Grey Gum – Blue-leaved Stringybark Open Forest**

This plant community is located in the northern and eastern portions of the land (Figure 4), and is the largest and most common vegetation type within the subject land. The edges of this community adjacent to the cleared pasture and around the dwelling have been substantially disturbed or cleared, and have a modified and (in places) weedy understorey (see Photo 1).

The upper stratum exhibits a variable cover of 25-40%, to a height of 30m. Dominant species are Grey Gum, Blue-leaved Stringybark and Red Bloodwood with less frequent Blackbutt and Spotted Gum. The upper mid-stratum contains Black She-oak with juvenile to semi-mature eucalypts.

The shrub stratum also exhibits a variable foliage cover, with disturbed regrowth areas ranging from 15% to 45% and undisturbed areas 40% to 60%. Heights range between 1m and 3m. Dominant species include Tick Bush, Nowra Heath-myrtle, Hairpin Banksia, Narrow-leaved Geebung, with Needlebush, Dagger Hakea, Nowra Tea-tree, Conesticks and Waratah occurring less frequently. Tick Bush and the Nowra Heath-myrtle are the dominant shrubs in the northern part of the land.

The lower stratum has a variable foliage cover, ranging from 25% to 75%. Variability is due to available light levels based on taller strata cover. Dominant species include Wiry Panic, Three-awn Spear-grass, Kangaroo Grass, Prickly Moses, Variable Sword-sedge, Raspwort, Many-flowered Mat Rush, Two-colour Panic, Spiny-headed Mat Rush, Pomax and Bracken.

The Grey Gum Blue-leaved Stringybark Forest/Woodland community is widely distributed in the immediate vicinity and general locality, predominantly on the mid to upper slopes at the boundaries of the plateau on which the subject land is located (BES 2006). It is not a listed "*threatened ecological community*" (TSC Act or EPBC Act).

**Photo 1 Grey Gum – Blue-leaved Stringybark Forest/Woodland**

**Spotted Gum – Blackbutt Forest**

This plant community occurs in the northeastern part of the land, and to its east (Figure 4). It is generally associated with areas of sandstone outcropping, cliffs and boulders.

The upper stratum of this community exhibits a variable foliage cover of approximately 40-55%, to a height of 25-30m. Dominant species are Spotted Gum, Blackbutt and Grey Gum, with occasional Blue-leaved Stringybark, Red Bloodwood and White Stringybark.

The mid-stratum is dominated by Tick Bush, Nowra Heath-myrtle, Old Man Banksia, Dagger Hakea, Narrow-leaved Geebung, Needlebush, Nowra Tea-tree, Waratah and Slender Tea-tree.

The lower stratum exhibits a foliage cover of approximately 40-75%. Dominant species include Kangaroo Grass, Wiry Panic, Three-awn Spear Grass, Variable Sword-sedge, Blue Flax Lily, Raspwort, Many-flowered Mat Rush, Two-colour Panic, *Glycine clandestina*, Spiny-headed Mat Rush, Pomax and Bracken.

The Spotted-Gum – Blackbutt Forest is located at lower to mid-slope locations and along the major watercourses through the general area, including along Flat Rock Creek to the immediate east of the subject land (see Photo 2). Again, this community appears well distributed in the general locality.

This community is not a listed "*threatened ecological community*" (TSC Act or EPBC Act).

**Photo 2 Spotted Gum – Blackbutt Forest**

**Scribbly Gum – Bloodwood Forest**

This vegetation type is located along the western boundary as a thin band along the fenceline (see Photo 3), but extends for a considerable distance to the west and south of the land (Figure 4).

The upper stratum of this community is dominated by the Hard-leaved Scribbly Gum with variable numbers of Red Bloodwood, as well as a number of other eucalypts scattered throughout. The canopy has foliage cover of 25-40%, and the trees in the upper stratum are to 20m in height.

The mid-stratum of this community is generally of xeric (dry) shrub species, and also includes patches of dense Tick Bush *Kunzea ambigua* which (where the tree canopy is absent) constitutes the Kunzea Shrubland/Heathland communities. Other mid-storey and shrub layer species include several Tea-tree and Wattle species, Dagger Hakea and Narrow-leaved Geebung.

The groundcover (or lower) stratum is characterised by a scattering of native grasses, herbs and small shrubs, including species such as Wallaby Grass, Kangaroo Grass, Wombat Berry and Ivy-leaved Violet.

The Scribbly Gum – Bloodwood community is not a "*threatened ecological community*" (TSC or EPBC Act).

**Photo 3 Scribbly Gum – Bloodwood Forest**

**Paperbark Closed Forest**

This community occurs in the central northern portion of the subject land (Figure 4), and is associated with a small drainage swale at this location (see Photo 4). Soils in the upper part of the swale are peaty and shallow. Once the drainage line begins to descend over exposed sandstone (below the Paperbark Closed Forest), it becomes more incised.

The upper stratum is dominated by Snow-in-Summer with a foliage cover of 50-75% and heights of 8-12m. The mid-stratum is variable based on available light levels associated with the upper stratum cover, with the main species being Prickly Tea-tree, Lemon-scented Tea-tree, Cheese Tree, Nowra Heath-myrtle, Sydney Golden Wattle, Narrow-leaved Geebung and Mock Olive.

The lower stratum consists of a diverse range of grasses, herbs, sedges and ferns including Tall Saw-sedge, Bracken, *Oplismenus aemulus*, Mat Rush, Blady Grass, Bordered Panic, Common Silkpod, Sweet Morinda, False Bracken Fern, Common Couch, Pennywort and Climbing Guinea Flower.

The Paperbark Closed Forest community was not mapped elsewhere within the urban release area addressed by BES (2004). Nevertheless, this plant community is widely distributed in the Shoalhaven LGA (*pers. obs.*), and is regularly recorded in relatively small patches along drainage lines where soil moisture levels are high.

This is not a listed "*threatened ecological community*" (TSC Act or EPBC Act - see Chapter 4.4.3).

**Photo 4 Paperbark Closed Forest along drainage swale**

**Kunzea Heathland**

This vegetation type is restricted to three patches in the northeastern and central eastern portions of the subject land (Figure 4), associated with areas of exposed sandstone and shallow skeletal soils (see Photo 5).

These communities are relatively treeless, although a small number of scattered Grey Gum, Red Bloodwood and Blue-leaved Stringybark are present, with a foliage canopy cover of less than 5%. The shrub stratum is dominated by White Kunzea, Needlebush, Nowra Tea-tree, *Epacris microphylla*, Dagger Hakea, Stiff Bottlebrush, Hairpin Banksia, Bushy Parrot-pea and *Acacia subtilinervis*.

The lower stratum exhibits a variable foliage cover ranging from 30-65%. Dominant species include Scale Rush, Wiry Panic, Three-awn Spear Grass, Oats Spear Grass, Prickly Moses, Nowra Heath-myrtle, Mat Rush, Slender Rice-flower, Two-colour Panic, *Melaleuca thymifolia*, and Silky Purple-Flag.

The Kunzea Shrubland/Heathland community is present only in small patches on the subject land at Mundamia. It occurs in various sized patches in the immediate vicinity and general locality, and is widely distributed throughout the Shoalhaven LGA.

There are scattered specimens of the Nowra Heath-myrtle in this community, and it constitutes potential habitat for the "*critically endangered*" *Pterostylis vernalis* orchid. However, no specimens of this species have been recorded on the subject site (see Chapter 4.4.1).

This vegetation type is not a listed "*threatened ecological community*" (TSC Act or EPBC Act).

**Photo 5 Kunzea Shrubland/Heathland**

In some places, where there is exposed bedrock adjacent to the Kunzea Shrubland, small 'moss gardens' are present (see Photo 6). These appear to be sustained, to some extent at least, by groundwater discharges along the top of the sub-surface bedrock, but are not strictly part of the Kunzea Shrubland community (although they are often, but not exclusively, located amongst or at the upper extremities of stands of Kunzea).

These small 'moss gardens' are the typical habitat of the critically endangered *Pterostylis vernalis* orchid. Dedicated surveys for this species by Shoalhaven City Council (SCC) and Environmental InSites in 2010 and 2011 identified populations of this species in 'moss gardens' to the south, west and northwest of the subject land.

However, none of the investigations by either Council or Environmental InSites recorded any specimens of *Pterostylis vernalis* on the subject land at Mundamia.

**Photo 6 Exposed bedrock with 'moss gardens'**

**Regrowth Woodland with Kunzea Heath and Mixed Woodland Strip**

Around the periphery of the cleared agricultural land, and along existing fence lines, there are scattered stands and individuals of native trees and shrubs, many of which are relatively young regrowth (Photo 7).

These areas of vegetation, including the narrow band of trees and shrubs along the fence line dividing the two existing lots (Figure 4), are of extremely limited ecological value, although they would be used by birds such as the Willie Wagtail, Grey Fantail and Rosellas which utilise perches adjacent to cleared grassland for foraging and shelter purposes.

The species present are a mix of the native plant species found in adjoining areas of native vegetation, as well as a number of introduced species including noxious weeds. In some places, a modest heath understorey of Tick Bush *Kunzea ambigua* is present, although few of these areas are located in areas of impeded drainage or high soil moisture.

This vegetation type does not constitute a "*threatened ecological community*" (TSC Act or EPBC Act), and is not regarded as of any particular conservation value or significance.

**Photo 7 Regrowth Woodland with Kunzea Heath and Scattered Trees**

**Pasture**

Detailed systematic botanical surveys were not conducted within this community, due to the scarcity of native plant species and dominance of exotic pasture grass species.

The agricultural (pasture) areas of the subject land, occupying the western half approximately of the land (Figures 2 and 4), have been cleared of most native vegetation (Photo 8). They now consist predominantly of pasture grasses and herbs, and an array of weed species. Native species are uncommon, with some scattered shrub regrowth and narrow bands of trees and tall shrubs along fence lines.

This vegetation is not a listed "*threatened ecological community*" (TSC Act or EPBC Act).

**Photo 8 Cleared pasture**

## 4.2 Vegetation to be Removed

Of the total area proposed for residential development of the subject land at Mundamia (occupying a total of 31.03ha, or 77% of the land), the majority (21.41ha or 69%) is pasture which has already been substantially modified, cleared or highly distributed for agricultural purposes (Table 2).

The land was previously identified in the *Nowra-Bomaderry Structure Plan* (see Chapter 7.12) as an appropriate location for future residential development activities around the Nowra-Bomaderry area, given that there is a requirement for further residential land to be made available. Similarly, the subject

land is identified as appropriate for rezoning for those purposes in SLEP 1985 and SLEP 2014, and in the *South Coast Regional Strategy* (DoP 2006).

In addition to development of the grazing lands, small areas of several native plant communities are also to be removed for the proposed development (Figure 4; Table 2). None of those vegetation types, however, are "*threatened ecological communities*" listed in either the TSC Act or the EPBC Act (see Chapter 4.4). Further, all of those communities are well represented in the immediate vicinity and general locality, including in the extensive conservation reserves in the vicinity and elsewhere within the Shoalhaven LGA.

**Table 2 Areas of vegetation types to be removed within the development area**

| Community | Ha | % | Comments |
|---|---|---|---|
| Grey Gum – Blue-leaved Stringybark Open Forest# | 6.87 | 47.72 | Extensive areas to be retained in *Public Reserve* and nearby |
| Spotted Gum – Blackbutt Forest | 0.00 | 0.00 | Widely distributed and common in vicinity and locality |
| Scribbly Gum – Bloodwood Forest | 0.42 | 100.00 | Widely distributed and common in vicinity and locality; highly degraded on site |
| Paperbark Closed Forest | 0.75 | 94.42 | Scattered and widely distributed in vicinity and locality |
| Kunzea Heathland | 0.87 | 94.03 | Scattered patches throughout vicinity and locality; widespread; common |
| Regrowth Woodland with Kunzea Heath and Mixed Woodland Strip | 0.73 | 82.39 | Widespread and of extremely limited ecological value |
| Pasture | 21.41 | 99.94 | Widely distributed and of no ecological value |

# Includes Highly Disturbed Grey Gum – Stringybark Woodland.

% Percentage of the community present on the subject land.

### 4.3 Plant Species

A total of 269 plant species have been recorded within the *Nowra-Bomaderry Structure Plan Study Area 5, Mundamia, West Nowra* (BES 2004), of which the subject land is a part (Appendix F). Systematic botanical surveys conducted as part of this *Report* have recorded a further 22 native plant species in addition to those recorded by BES (2004).

One threatened flora species, the Nowra Heath-myrtle *Triplarina nowraensis* (which is listed as "*endangered*" in Part 1 of Schedule 1 of the TSC Act, and also as "*endangered*" in the EPBC Act), was recorded on the subject land (as discussed in Chapter 4.4 of this *Report*).

Three *Rare or Threatened Australian Plants* (ROTAP) have been recorded on the subject land - *Acacia subtilinervis* (3RCa), *Leptospermum epacridoideum (*2RC) and *Leptospermum sejunctum (*2K). One species of regional significance within the Shoalhaven LGA (*Acacia hispidula*) has also been recorded from the subject land (see BES map in Appendix C). However, none of these species have any statutory protection, pursuant to either NSW or federal legislation.

Whilst individuals of some of these species, and habitat of known or potential relevance, is to be removed for the proposed residential development on the subject land at Mundamia, the *Public Reserve* proposed on the subject land will also contain individuals and/or suitable habitat for those species. The vegetation to be removed along the eastern and northeastern parts of the subject land for

the proposed residential development is the same as that to its immediate east, northeast and north, and there are further substantial areas of similar habitats in the immediate vicinity and general locality.

Given those circumstances, it is not likely that these species will be significantly adversely affected by the proposed development. As noted above, these species are not of particular biodiversity conservation concern.

### 4.4 Threatened Biota

#### 4.4.1 Threatened Species

Only one threatened plant species listed in the TSC Act has been recorded on the subject land at Mundamia to date, namely the Nowra Heath-myrtle *Triplarina nowraensis*, which is listed as "*endangered*" in Part 1 of Schedule 1 of the TSC Act, and as "*endangered*" in the EPBC Act.

This species is a small erect shrub (to 3.5m in height) with creamy-white tea-tree flowers. The Nowra Heath-myrtle is currently only known from five populations, three of which are located west of Nowra in the vicinity of the subject land. The other two populations are southwest of Nowra in the Boolijong Creek Valley, and on the plateau above Bundanon north of the Shoalhaven River (DECC 2008).

Habitat for the Nowra Heath-myrtle has been described as vegetation types that exhibit either a very open tree canopy or are treeless. Whilst the species occurs in areas of impeded drainage, it is not confined to such areas. And also occurs in drier woodland and shrubland communities.

The greatest stand of the Nowra Heath-myrtle on the subject land is located in the northern part of the subject site, in an area of dry ground conditions (*ie* sandy shallow soils with low soil moisture retention) and supporting dry sclerophyll vegetation. Whilst the DECC (2008) suggest that this species is generally located along drainage channels or on poorly drained flat to gently sloping sandstones of the Nowra group, the populations on the subject site are not confined to such areas.

Recent surveys by SLR Ecology have resulted in the mapping of 4.16 ha of patches of Nowra Heath Myrtle within the subject site, with an additional 198 individuals also scattered across the northeastern and eastern parts of the site (Figure 6). The 4.16 ha of Nowra Heath-myrtle includes a variety of understorey conditions, including:

- dense pure (monotypic) stands;
- a dense shrub layer comprising a mix of Nowra Heath-myrtle and other native understorey shrubs (mainly *Kunzea ambigua*); and
- moderately dense Nowra Heath-myrtle with other native understorey species.

The vast majority of Nowra Heath-myrtle patches and individuals (and suitable habitat for this species) are located within the proposed *Public Reserve* (Figure 6).

A large number of specimens of the Nowra Heath-myrtle have been recorded scattered across the Grey Gum – Blue-leaved Stringybark Forest/Woodland, Paperbark Closed Forest and Kunzea Shrubland/Heathland vegetation types. The largest patches of the Nowra Heath-myrtle were observed in disturbed areas of Grey Gum – Blue-leaved Stringybark Forest/Woodland in the northern portion of the land (Figure 6), which had been slashed a few years previously. It appears that this species favours

disturbed areas with increased available light levels, and its apparent ability to resprout from lignotubers means it can benefit from the slashing of vegetation (*eg* for the provision of APZs).

The majority of specimens of and habitat for the Nowra Heath-myrtle will be retained as part of this proposal in the proposed *Public Reserve* (Figure 6). The northern boundary of the residential area has been re-designed to substantially increase the retention of the Nowra Heath-myrtle, including the majority of the main northern patch of this species (Figure 6).

In addition to retaining 3.1ha (or 74.52%) of the patch size and 152 (or 76.77%) of the individuals of the Nowra Heath-myrtle population on the subject land, the ongoing management of the *Public Reserve* will be directed towards the protection and enhancement of this species.

The experience in the northern part of the land, where slashing has occurred (see Photo 9), indicates that relevant parts of the *Public Reserve* could potentially be managed using that technique to enhance the growth of Nowra Heath-myrtle. The proposal has also been designed to maintain the pre-development hydrological regimes immediately adjacent to the proposed development (Martens 2014), particularly with respect to soil moisture levels.

**Photo 9 Stand of regrowth Nowra Heath-myrtle in north of subject site**

### 4.4.2 Endangered Populations

No "*endangered population*" of any flora species has been recorded as part of this study, or during any previous investigations within the subject land (BES 2004).

### 4.4.3 Threatened ecological Communities

No "*threatened ecological communities*" have been recorded within the subject land.

The Paperbark Closed Forest vegetation on the subject land is not an example of the Swamp Sclerophyll Forest on Coastal Floodplains community, because the land is neither on nor is "*associated with*" a "*coastal floodplain*". Any "*coastal floodplain*" in the vicinity would be confined to the immediate floodplain of the Shoalhaven River and the lower parts of Flat Rock Creek. The subject land is not "*associated with*" those landscape features in any relevant way.

## 4.5 Groundwater Dependent Ecosystems

The *NSW State Groundwater Dependent Ecosystems Policy* (GDE Policy) identifies 'Groundwater Dependent Ecosystems' (GDEs) as *"ecosystems which have their species composition and their natural ecological processes determined by groundwater".* Of the vegetation types and ecosystems present on the subject land at Mundamia, only two are considered possible or likely to be dependent, in part at least, on groundwater discharges.

The nature of the subject land (as detailed in the *Stormwater Management Assessment* by Martens 2014) creates a close connection between surface waters and groundwater, because of the thin soils present and the relatively impervious sandstone bedrock (which is located generally less than 0.5m below the soil surface). Given that circumstance, much of the groundwater which could potentially traverse the subject land would be intercepted by plant roots, and would be transpired.

Of the two potential GDEs present on the subject land (the Swamp Paperbark Forest and the 'moss gardens'), only the latter is likely to be particularly dependent upon groundwater flows. However, given the interaction between surface flows and groundwater, even that 'dependence' is arguable. The Swamp Paperbark community (in the northeastern part of the subject site) is located at a low point along a drainage swale in this part of the land, and is likely to depend more on overland flows and incipient rainfall than on groundwater flows *per se*.

The 'moss gardens', by contrast, are located at the periphery of areas of soil where the sandstone bedrock is exposed (generally in large flat sheets). 'Moss gardens' constitute a narrow layer of thin moss vegetation sitting directly on top of the bedrock (see page 18), and it is assumed that at least some of the moisture required to maintain the 'moss gardens' is derived from groundwater flows which express themselves on top of the bedrock, where the surface soil ceases.

The 'moss gardens' tend to be located in the vicinity of stands of Kunzea Shrubland, but the Kunzea itself is not typically associated with areas of groundwater expressions. The Tick Bush *Kunzea ambigua* typically occurs on ridge tops and rock outcrops, and is not located in areas where the soil is permanently moist. Thus, it is not the Kunzea Shrubland that would constitute a GDE, but rather the 'moss gardens', which are in places coincident with Kunzea Shrublands.

The proposed development will remove some of the 'moss gardens' along the eastern boundary of the development, but will retain others. It is likely that additional areas of 'moss gardens' will develop naturally as a result of the bioretention swales along the eastern boundary of the development.

# 5 FAUNA and FAUNA HABITATS

## 5.1 Fauna Habitats

Vegetation on the subject land at Mundamia (as described above) consists in part of open farmland with scattered trees and in part of open forest and woodland with a generally dense shrubby understorey.

The open farmland is structurally simple and provides only very limited habitat opportunities for native fauna. Mammals (such as the Eastern Grey Kangaroo) and birds (such as the Australian Magpie Lark, Masked Lapwing, Willie Wagtail and Australian Magpie) which can use disturbed and/or more open environments were frequently observed in this part of the subject land, along with a number of introduced species (including the Red Fox and European Rabbit). Two small farm dams are also present within the open farmland, as well as a large 'sediment dam' in the southern part of the land, (a legacy of previous quarry operations (SLR Consulting 2012). These provide habitat for amphibian species which can use artificial environments (such as Haswell's Frog, the Striped Marsh Frog and Common Eastern Froglet).

The open forest within the northern and eastern parts of the subject land is structurally complex, and provides a diversity of habitat niches for forest-dependent native fauna, including threatened species such as the Yellow-bellied Glider. This vegetation has distinctive lower, middle and upper strata, and consequently there are abundant and varied foraging resources and shelter, nesting or roosting opportunities for a wide diversity of native fauna. There is a moderate number of tree-hollows of varying sizes, and an expansive sandstone outcrop area along the eastern boundary of the subject land and beyond (to the east), containing numerous small caves and rock overhangs.

## 5.2 Hollow-bearing Trees

Hollow-bearing trees have been re-mapped across the entire subject land as part of the 2014 surveys. Each hollow was located using GIS (iPhone Application 'GIS Roam') and mapped (with numbering). Each tree was also tagged with a silver metal tag nailed into the trunk and scripted with a unique number and SLR identification. Data recorded for each of the hollows is found in Appendix K.

The information collected for each hollow-bearing tree includes:

- tree species; and
- the number and size of visible hollows, with the following categories:
  1. Small large enough for a small arboreal species;
  2. Medium large enough for a medium arboreal species; and
  3. Large large enough for a large arboreal species.

A number of hollow-bearing trees are present within the subject land and subject site at Mundamia (Figure 5). More hollow-bearing trees are present within the *Public Reserve*, especially in the northeastern and eastern portions of the subject land, and on lands beyond, particularly the substantial reserved land to the east along Flat Rock Creek.

A total of 87 hollow-bearing trees and 222 hollows were recorded (inclusive of Lot 31), with the majority of hollows in the Grey Gum *Eucalyptus punctata*, Scribbly Gum *E. sclerophylla* and stag trees. Of these, 37 hollow-bearing trees would need to be removed to accommodate future residential development (Figure 5). However the proposal will involve the implementation of a '*Hollow-Bearing*

*Tree Protocol*' (see Chapter 8.2) which will ensure that there is no nett loss of tree-hollows as a consequence of the proposal.

In addition, there are substantial hollow-bearing tree resources in the immediate vicinity and locality, including for example in the Triplarina Reserve (to the southeast) and along Flat Rock Creek (to the immediate east).

### 5.3 Fauna Species

Field investigations on the subject land and on adjoining lands by SLR Ecology and by Environmental InSites and others (including BES) over a number of years have identified a fauna assemblage of 120 native species (7 amphibians, 8 reptiles, 78 birds and 25 mammals) and 8 introduced/domestic mammal species (Appendix G).

The number of species recorded is reflective of the habitat types present on the subject land and in the immediate vicinity. The forested sections of the subject land and adjoining lands in particular provide resources for forest-dependent fauna species (such as gliders and many of the bird species), whilst the cleared pasture areas provide habitat and resources for only a limited suite of native species.

*Amphibians*

Amphibian habitats on the subject land consist of two small farm dams and one large 'sediment' dam, an area of swampy ground and impeded drainage in the central part of the site, and the small sandstone creekline in the northeastern of the subject land (Figure 2). As noted above, seven amphibian species have been recorded within and surrounding the subject land, all of which are common in the habitat types present.

Three threatened amphibian species are known to occur in the local area (Appendix D). Whilst the small sandstone drainage swale in the northeast of the site provides some limited potential habitat for the Giant Burrowing Frog, no evidence of this species has been recorded during the previous surveys (BES 2004, Environmental InSites 2008) or current surveys (Appendix G). In any case, potential habitat for this species would be retained within the proposed *Public Reserve*.

No evidence for the Green & Golden Bell Frog has been recorded from the Mundamia area during any investigations undertaken to date. Whilst it is theoretically possible for Green & Golden Bell Frogs to utilise the farm dams present on the subject land, there has been no evidence on any such activity to date.

Whilst there is some potential habitat for the Littlejohn's Tree Frog in the upper reaches of the small drainage lines within forested areas at the east of the site, there are limited records of the species in the locality and the species has not been recorded during investigations undertaken to date.

*Reptiles*

Eight reptile species have been recorded on and around the subject land (Appendix G), all of which are common in the area. Given the structural diversity of habitats across the subject land, particularly within the eastern section along the sandstone escarpment, the reptile assemblage is likely to be more diverse than so far identified.

Two relevant threatened reptile species are known from the locality (Rosenberg's Goanna and the Broad-headed Snake).

With respect to Rosenberg's Goanna, none of the development area on the subject land supports any termite mounds (or 'termitaria'), and this species has not been recorded in the vicinity surveys by BES (2004), Environmental InSites (2008) and SLR (2014). Investigations for Rosenberg's Goanna on the adjoining land to the immediate west and specifically for the access road required for the Mundamia residential area (Environmental InSites 2009), as well as for this *Report*, provide no evidence of this species at this location. In addition, there are no records of Rosenberg's Goanna in the vicinity (Appendix D).

With respect to the Broad-Headed Snake, there are no records of this species on subject land or on other lands in the vicinity. Potential habitat for the Broad-Headed Snake on the subject land is of marginal quality, and in any case is essentially confined to the *Public Reserve*.

*Avifauna*

Seventy-eight bird species have been recorded within and surrounding the subject land (Appendix G), the vast majority of which are common to abundant, and widespread, and would utilise relevant habitats present within and adjoining the subject land.

The broad guilds of birds that have been recorded on or around the subject land at Mundamia include:

- species characteristic of open grasslands and agricultural pastures (*eg* the Masked Lapwing, Australian Magpie, Magpie-lark, Willie Wagtail and Galah);
- species typical of woodland environments (such as the Crimson Rosella, Glossy Black Cockatoo, Gang Gang Cockatoo, Rainbow Lorikeet, honeyeaters, thornbills and butcherbirds);
- raptors and carnivorous species (such as the Powerful Owl, Southern Boobook, Kookaburra and Square-tailed Kite);
- the smaller and more cryptic bird species which utilise dense shrubs and mid-storey vegetation for shelter (*eg* the Eastern Yellow Robin and Superb Fairy Wren); and
- wetland birds (ducks, grebes and herons), which would utilise the farm dams and areas of flooded pasture following heavy rains.

An array of additional bird species, beyond those listed in Appendix G, would be likely to utilise the subject land over a period of decades, particularly under different climatic or seasonal circumstances. However, given that the majority of the area proposed for development activities is cleared pasture, the number of such additional species which would be dependent upon those parts of the site proposed for development purposes is extremely limited.

*Mammals*

Thirty-one mammal species have been recorded within and adjacent to the subject land (Appendix G). Of these, four are listed as "*vulnerable*" pursuant to the TSC Act, one of which is also listed as "*vulnerable*" pursuant to the EPBC Act (Table 5). Of the mammals recorded, 23 are native, three are feral introduced species and five are domestic mammal species.

Of the 25 native mammal species recorded on the subject land and in the vicinity by BES, Environmental InSites and SLR:

- two are macropods, which would utilise the forest and woodland for shelter and the open pasture for grazing purposes;
- the three small terrestrial mammals (the Agile Antechinus, Swamp Rat and Long-nosed Bandicoot) would predominantly utilise areas of open forest and woodland;
- arboreal species (the Sugar Glider, Yellow-bellied Glider, Common Brushtail Possum and Common Ringtail Possum) would utilise woodland and forest areas for both shelter (hollow-bearing trees for the gliders and Brushtail Possum, and dense canopy for the Ringtail Possum) and areas of trees and shrubs for foraging purposes; and
- the Grey-headed Flying Fox would utilise the land to only an extremely limited extent, possibly when some trees are in flower; and
- the remaining 12 species are microchiropteran bats which would utilise the forest and woodland canopy for foraging purpose. In addition, most (but not all) of those microchiropteran bats would utilise tree-hollows on the subject site (as well as other such resources which are widely distributed through the landscape) for roosting purposes.

As indicated, six microchiropteran bat species were positively identified within the subject land, and a further six species were recorded to a lesser degree of certainty (Table 3). For most of these species, tree-hollows and or exfoliating bark on large trees constitute the preferred or required roosting habitat, and the forest canopy constitutes appropriate foraging habitat. Only a small proportion of such resources on the subject land, and a minute proportion of those present in the vicinity, will be affected by the proposed development.

Two threatened microchiropteran bat species were recorded on the land, although there is only a low level of certainty in respect of the Common Bent-wing Bat, due to the poor quality of the call sequences (Table 3). In any case, little or no potential roosting habitat for this species would be disturbed as a result of the proposed development. Extensive foraging habitat for this and other microchiropteran bat species will be retained in the proposed *Public Reserve* on the periphery of the land, and in the substantial other forested lands in the vicinity.

**Table 3 Summary of results of ultrasonic bat detection surveys**

| Common Name | Scientific Name | Status | Calls | Accuracy | | |
|---|---|---|---|---|---|---|
| | | | | Def | Pro | Pos |
| Eastern Free-tail Bat | *Mormopterus norfolkensis* | V | 2 | 1 | | 1 |
| White-striped Free-tail Bat | *Tadarida australis* | | 1 | 1 | | |
| Eastern Horseshoe Bat | *Rhinolophus megaphyllus* | | 5 | 6 | | |
| Gould's Wattled Bat | *Chalinolobus gouldii* | | 10 | 4 | 7 | |
| Chocolate Wattled Bat | *Chalinolobus morio* | | 1 | 1 | 1 | |
| Common (Eastern) Bent-wing Bat | *Miniopterus schreibersii oceanensis* | V | 5 | | | 5 |
| Long-eared Bat | *Nyctophilus* sp. | | 6 | 6 | | |
| Lesser Long-eared Bat | *Nyctophilus geoffroyi* | | | | | 6 |
| Gould's Long-eared Bat | *Nyctophilus gouldi* | | | | | 6 |
| Large Forest Bat | *Vespadelus darlingtoni* | | 43 | 1 | | 43 |
| Southern Forest Bat | *Vespadelus regulus* | | 3 | | | 3 |
| Little Forest Bat | *Vespadelus vulturnus* | | 27 | 16 | 11 | 1 |

**Key to Accuracy**

| | |
|---|---|
| Def | No doubt about the identification of the species making the call (Definite) |
| Pro | Most likely the species named, but there is a low probability of confusion with other species with similar calls (Probable) |
| Pos | The call is comparable with the listed species, but there is a moderate to high probability of confusion with species that emit similar calls (Possible) |

### 5.4 Threatened Fauna Species

Records of threatened fauna on the subject land are shown in Figure 7.

Four threatened bird species have been recorded utilising the subject land (Table 4), each of which are wide-ranging and highly mobile. None of these species (nor indeed even an individual of any such species) could be dependent on the subject site for their survival at this location. In any case, most of the highest quality habitat for these species would be retained in the proposed *E2- Environmental Conservation Zone* on the subject land, complementing the extensive areas of such habitat in the immediate vicinity and in the locality.

**Table 4 Threatened bird species recorded within the subject site at Mundamia**

| Family | Species | Common Name | TSC | BES 2004 | InSites 2008-2011 | SLR 2013-2014 |
|---|---|---|---|---|---|---|
| *Accipitridae* | *Lophoictinia isura* | Square-tailed Kite | V | X | | |
| *Cacatuidae* | *Callocephalon fimbriatum* | Gang Gang Cockatoo | V | X | | |
| *Cacatuidae* | *Calyptorhynchus lathami* | Glossy Black Cockatoo | V | X | X | X |
| *Strigidae* | *Ninox strenua* | Powerful Owl | V | X | | X |

*TSC = *Threatened Species Conservation Act* (TSC Act) V = Vulnerable

The threatened mammal species recorded on the subject land at Mundamia are all forest-dependent (Table 5), indicating that the most important habitat within the subject land is that within the northern and eastern portions of the subject land. The majority of that habitat will be retained in the proposed *Public Reserve* (Appendix A), with significant additional areas of suitable habitat on surrounding lands.

Of the four threatened mammal species identified, the Yellow-bellied Glider is likely to be a long-term resident of the subject land and surrounding lands. The other three species are highly mobile and more wide-ranging, although some microchiropteran bats could readily reside within the subject land.

**Table 5 Threatened mammals recorded within the subject land at Mundamia**

| Family | Scientific Name | Common Name | Legal status* | BES 2004 | InSites 2008 | SLR 2014 |
|---|---|---|---|---|---|---|
| *Petauridae* | *Petaurus australis* | Yellow-bellied Glider | V (TSC) | X | X | X |
| *Pteropodidae* | *Pteropus poliocephalus* | Grey-headed Flying Fox | V (TSC)<br>V (EPBC) | X | | |
| *Molossidae* | *Mormopterus norfolkensis* | East-coast Free-tail Bat | V (TSC) | | X | |
| *Vespertilionidae* | *Miniopterus schreibersii oceanensis* | Common Bent-wing Bat | V (TSC) | X | X | |

*TSC = *Threatened Species Conservation Act 1995* (TSC Act) V = Vulnerable
EPBC = *Environmental Protection & Biodiversity Conservation Act 1999* (EPBC Act) V = Vulnerable

Both the Yellow-bellied Glider and East-coast Free-tail Bat utilise tree-hollows for denning or roosting purposes. There are extensive tree-hollow resources within the northern and eastern portions of the subject land, the majority of which would be retained in the *Public Reserve.* Further, as detailed in Chapter 8.2, the *Hollow-Bearing Tree Protocol* will ensure that there is no nett loss of tree-hollows as a result of the proposal. Qualitative assessment of the adjacent land further to the east and north (and elsewhere in the vicinity) indicates that there are also extensive tree-hollow resources surrounding the subject land.

As indicated above, a total of 8 threatened fauna species have been recorded within and surrounding the subject land (Appendix G). Habitat for these species within the subject land is largely confined to the forest and woodland vegetation in the eastern and northern portions of the land, the majority which will be retained in the proposed *Public Reserve.* Significant areas of additional habitat for these species is also located on other lands to the east, north and southeast of the subject land, and in DECC and Forest NSW estates within 10-15km of the subject land (involving approximately 6,700ha of forested habitat).

# 6 ENVIRONMENTAL CONSTRAINTS

## 6.1 Fundamental Considerations

Development of the subject land at Mundamia will inevitably involve the imposition of some impacts upon elements of the natural environment in general, including on individuals of and/or habitat for a number of threatened biota.

On the other hand, the planning and impact assessment process requires the determination of an appropriate balance between development opportunities and biodiversity conservation outcomes. This approach involves the consideration of benefits which may be derived from the appropriate management of relevant portions of the land, as well as consideration of the adverse impacts (including the loss of habitat or resources for threatened biota) which will or may arise.

In this regard, it is not a requirement of any legislation that there be no adverse impacts on either the natural environment in general or upon threatened biota in particular. The mere presence of individuals of threatened species, or of habitat for such species, does not constitute an absolute constraint to development opportunities. Rather, these matters need to be taken into account when considering the extent of development (including the clearing of or loss of specimens or habitat for such biota which would ensue) and appropriate balance between the necessary urban development and biodiversity conservation aspirations.

In addition, as noted below, the *Nowra-Bomaderry Structure Plan* is a strategic planning tool which identifies those lands that are capable of urban development and those lands that should not be developed, but retained *inter alia* for biodiversity conservation purposes. The *Nowra-Bomaderry Structure Plan* has therefore established the biodiversity offsets for development of limited lands for urban expansion purposes, in a strategic and pre-considered manner.

## 6.2 Potential Ecological Constraints

The potential ecological constraints to development opportunities on the subject land at Mundamia include:

- individuals and patches of the threatened Nowra Heath-myrtle *Triplarina nowraensis*;
- the potential presence of *Pterostylis vernalis*, although this species has not been recorded on the site;
- hollow-bearing trees, which provide potential habitat for a number of threatened species;
- the loss (albeit relatively small) of foraging habitat and/or some potential roosting habitat (open forest/woodland and tall shrubland) for a number of threatened fauna species; and
- the potential direct and indirect impacts upon habitat for or individuals of a number of threatened biota.

Whilst *Groundwater Dependent Ecosystems* (GDEs) may theoretically constitute a constraint to development activities, the areas of vegetation which could potentially constitute GDEs on the subject land either are not solely dependent upon that water source or are not of particular significance.

The Swamp Paperbark Forest in the northeastern part of the land would not be entirely dependent upon groundwater discharges. The 'moss gardens' along the eastern side of the subject land are considered likely to be more dependent on groundwater (given their location), but would also be dependent (in drier times) on incipient rainfall. However, neither ecosystem is (in any case) restricted to the subject land.

Given the circumstances on the subject land, the presence of possible GDEs is not regarded as a constraint proposed to the development activities. The potential areas to be affected are small, and the ecosystems present are neither restricted in distribution nor restricted to the subject land. In any case, the stormwater management regime for the project includes measures designed specifically to maintain groundwater regimes downslope of the development.

It should be noted that the majority of the development area is already cleared and highly disturbed agricultural land. That portion of the subject land does not represent a relevant constraint to the development activities as proposed.

Further, that part of the proposed development footprint which contains either individuals of or habitat and resources for threatened species (predominantly confined to the eastern and north-eastern portions of the proposed development footprint) represents only an extremely small proportion of such species, populations or habitats in the immediate vicinity or locality (Figures 1 and 2). Given the extent of adjoining and nearby conservation reserves, the area of any resources or habitat for any such species to be affected is extremely small.

### 6.3 Strategic Approach

Consideration of the likely or probable biodiversity constraints to development opportunities on the subject land, and the assessment of impacts which will or may arise from the proposed development, are discussed in further detail in subsequent chapters of this *Report*.

In the first instance, however, it needs to be noted that the majority of the development activities are to be undertaken within the existing highly disturbed and modified agricultural parts of the subject land and/or in disturbed vegetation around the periphery of the agricultural areas. Most of the high quality habitats and/or resources for threatened biota present on the subject land have been retained within those parts of the land to be protected as the *Public Reserve* - along the eastern and northern boundaries (Appendix A).

There are no relevant or significant riparian issues associated with the proposed development of the subject land at Mundamia. A single small drainage line is located in the northeastern part of the subject land, through a stand of Paperbarks and draining more steeply in the northeastern part of the land (which is to be conserved).

However, the upper parts at least of that drainage line do not relevantly constitute a "*river*" pursuant to the *Water Management Act 2000*. The drainage line is small, gently sloping and does not have a defined bed or banks, other than below the proposed development area. It is located within a broad drainage swale through this part of the land, although once the 'drainage line' reaches the areas of sandstone rock outcropping, there are elements of a 'watercourse' or 'river' present. These elements of the 'drainage line', however, occur outside the proposed development area.

Nevertheless, the issues of stormwater quality, water volume discharges and the maintenance of ecological values along that watercourse downstream of the subject land have been taken into account

in the design of the stormwater management system for the project (for details, see the *Stormwater Management Assessment* by Martens 2014).

Further, and consistent with the *Nowra-Bomaderry Structure Plan* (see Chapter 7.12), the proposed development of the subject land at Mundamia "*will achieve a considered balance between urban development and the protection of environmentally significant areas*". The proposal has been designed and amended by the applicant to reduce or minimise potential adverse impacts upon threatened biota and their habitats on the land. .

It is important to note that the *Nowra-Bomaderry Structure Plan* had anticipated the development of the subject land (essentially as currently proposed) with an array of other lands identified within the *Structure Plan* for retention as biodiversity offsets. That is, the requirement for biodiversity offsets for the future development of *inter alia* the subject land at Mundamia has already been offset within the *Nowra-Bomaderry Structure Plan*. No further additional provision of land for biodiversity offsets is necessary.

A substantial area of land (9.42 ha, or 23% of the subject land) is to be dedicated for biodiversity conservation purposes, in the most appropriate parts of the land (the northern and eastern portions). In addition, once operational the 1ha of stormwater detention facilities will provide appropriate biodiversity features and will form part of the *Public Reserve*. These areas are adjacent to existing reserved or substantially vegetated lands, and will provide a 'buffer' to those conserved lands. They will also contribute in a positive manner to biodiversity conservation by maintaining areas of native vegetation (including habitat for and populations of threatened biota) which are to be managed for biodiversity conservation purposes.

Thus, the proposed development of the subject land at Mundamia, as currently designed, achieves an appropriate balance between development opportunities and biodiversity conservation outcomes.

# 7 POTENTIAL ENVIRONMENTAL IMPACTS

## 7.1 General Environmental Impacts

The proposed development predominantly involves the loss of agricultural (poor quality) pasture and weeds (21.41ha), as well as the removal of a number of small patches of native vegetation (of total area 9.62ha) comprising native vegetation types in poor to moderate condition including (Figure 4; Table 2):

- Grey Gum Blue-leaved Stringybark Open Forest;
- Spotted Gum – Blackbutt Forest;
- Scribbly Gum – Bloodwood Forest;
- Paperbark Closed Forest; and
- Kunzea Heathland.

A minor tributary to Flat Rock Creek is present in the northeastern section of the subject land, flowing in a northeasterly direction (Figure 2).

The removal of approximately 9.62ha of open forest and heathland (some of which is in a disturbed condition – particularly around the periphery of the current grazed land) is insignificant in relation to the large areas of high quality biodiversity value land proposed to be retained in the *Public Reserve,* and in the undisturbed Crown Land and Reserves surrounding the subject land. The area to be removed constitutes only a minute proportion of habitat in the immediate locality (ie within approximately 10km) of the land.

As noted above, the majority of the vegetation which is to be removed from the proposed development are has long been highly modified for agricultural purposes. Further, much of the native vegetation which is to be removed has been disturbed by 'edge-effects' and by incursions (of weeds and stock) from the adjoining agricultural land. Higher quality vegetation within the northern section of the land and along the eastern boundary will be retained and managed, and would likely ultimately be dedicated to Council.

Whilst the proposed development (as noted above) will require the removal of some areas of native vegetation from the subject land, there are a number of relevant considerations in assessing the potential or likely impacts of the proposal. Such considerations include *inter alia*:

- the modified nature of much of the native vegetation to be removed;
- the incorporation of measures to maintain native habitats and resources on the subject land, and to ensure their long-term viability, as a direct consequence of the project design (by retaining a large area of retained vegetation in the northern and eastern parts of the subject land), and by the management of the project (including *inter alia* the implementation of appropriate design and stormwater management and treatment measures);
- the protection of 9.42ha of native habitats and vegetation for biodiversity conservation purposes within the proposed *Public Reserve* along the eastern and northern sides of the land;
- the implementation of a *Vegetation Management & Habitat Restoration Plan* (VMHRP) within the proposed *Public Reserve* to control and/or limit adverse impacts; and
- controls on indirect impacts by the avoidance of inappropriate plant species in landscaping, and by the application of appropriate stormwater management regimes.

An important further consideration is that there is no requirement or imperative for the implementation of any habitat management, protection or enhancement measures under the current land management regime. By contrast, the proposed development concept will facilitate the implementation of a comprehensive management regime over approximately 9.42 ha (or 23% of the land), and its dedication for biodiversity conservation purposes in perpetuity.

As discussed in detail above (Chapter 4), that portion of the subject land at Mundamia proposed for development is characterised predominantly by open farmland. High quality vegetation is limited to the northern periphery and a narrow strip along the eastern boundary. The majority of this vegetation will be retained and managed for conservation purposes in the proposed *Public Reserve* as part of the re-zoning of the land.

The proposed development includes a perimeter road along the boundary to the *Public Reserve.* Whilst no residential activities will be located outside the proposed perimeter road, which provides a clearly defined management and land use boundary:

- adjacent woodland in the *Public Reserve* will be managed in places (in an environmentally sensitive manner) for bushfire protection purposes, in accordance with the requirements of the *Bush Fire Protection Assessment* (Eco Logical 2015), and in accordance with the *Vegetation Management & Habitat Restoration Plan* (VMHRP); and
- a peripheral bioretention swale system will be located on the outer edge of the perimeter road system, to maintain the existing moist soil regime by infiltration and 'over-topping' during major rainfall events.

Given those circumstances, and given the large areas of forested and riparian areas to be retained, it cannot be construed as likely that development of the land as proposed would adversely affect native biota (flora, fauna, habitats or communities) to any significant extent.

It is also to be noted that the potential impacts arising or which may arise from development of the subject land as proposed are to be considered in the light of the impact amelioration and environmental measures for the project, which are detailed in Chapter 8 of this *Report*. It is also to be assumed and anticipated that development of the subject land (including all necessary excavation, land clearing, construction and bush fire management requirements) will be undertaken in an environmentally sensitive manner, applying all appropriate current "*best practice*" methods and measures to maintain water quality, to protect adjoining natural vegetation, and to control sediment discharge and runoff.

### 7.2 Vegetation to be Removed or Modified

Whilst the majority of that area proposed for residential development activities on the subject land at Mundamia consists of existing cleared pasture and areas of degraded vegetation (modified open woodland with a degraded understorey and/or scattered trees or regenerating scrub), the development footprint also includes areas of extant native vegetation in poor to good condition.

All of these areas of native vegetation are located along the eastern and northern peripheries of the proposed development area (Figure 4), with the whole of the western and southern parts of the subject land (within which development activities are to occur) having long been cleared and modified for agricultural purposes. The narrow bands of 'woodland' along fencelines on the eastern side of the land and through the centre are not regarded as of any conservation value.

The proposed development footprint will require the removal of:

- a narrow band of Scribbly Gum - Bloodwood Woodland along the western boundary;
- a narrow strip (approximately 5m wide) of mixed woodland across the centre of the subject land, aligned from east to west;
- areas of Grey Gum - Blue-leaved Stringybark Woodland along the eastern side of the development area. Whilst most of this vegetation is in moderate condition, that located adjacent to the existing cleared pasture is often modified and degraded by grazing stock and/or weed infestation;
- an area of Paperbark Closed Forest along a minor drainage line in the central part of the subject land; and
- a small area of Kunzea Heathland along the eastern periphery of the development area. The patch of that vegetation close to the existing farmhouse in the northern part of the land is also highly modified and degraded.

Areas of vegetation to be removed are listed in Table 6. As noted above, most of the vegetation which is to be removed for the proposed development on the subject land at Mundamia has been modified or disturbed to various degrees over a long period of agricultural activities on the land. Nevertheless, a small proportion of the areas to be cleared are in at least moderate condition, and some parts of those areas of vegetation provide relevant habitat or resources for potential or known threatened species (see below).

It should be noted that the areas of vegetation to be removed constitute only a small proportion of those present in the general locality. In particular:

- there are substantial tracts of Grey Gum/Blue-leaved Stringybark forest and woodland in the immediate vicinity and general locality, including extensive areas in existing reserves (*eg* the adjoining Thompson Reserve, Council land and the Triplarina Nature Reserve), and/or on the subject land as well as on adjacent lands;
- whilst the Kunzea Shrubland/Heathland along the eastern periphery of the proposed development in the southern half of the subject land is to be removed, that vegetation type is common and widespread in the immediate vicinity and general locality, and is not regarded *per se* as of particular ecological value;
- the small area of Kunzea Shrubland/Heathland in the northeastern part of the land, which is to be removed, is already highly modified and degraded;
- the two narrow strips of trees in the central part of the land (along the western boundary and across the centre of the land) are highly modified and of poor quality; and
- the band of Paperbark Closed Forest along the upper drainage line in the northeastern part of the subject land will mostly be removed for the proposed development.

**Table 6 Areas of vegetation to be removed and retained on the subject land**

| Vegetation Community | Removed (ha) | Public Reserve (ha) | Total(ha) |
|---|---|---|---|
| Grey Gum – Blue-leaved Stringybark Open Forest# | 6.87 | 7.53 | 14.40 |
| Spotted Gum – Blackbutt Forest | 0.00 | 1.62 | 1.62 |
| Scribbly Gum – Bloodwood Forest | 0.42 | 0.00 | 0.42 |
| Paperbark Closed Forest | 0.75 | 0.04 | 0.79 |
| Kunzea Heathland | 0.87 | 0.06 | 0.92 |
| Regrowth Woodland with Kunzea Heath and Mixed Woodland strip | 0.73 | 0.16 | 0.88 |
| Pasture | 21.41 | 0.01 | 21.42 |
| **Total** | **31.03** | **9.42** | **40.45** |

# Includes Highly Disturbed Grey Gum – Stringybark Woodland.

### 7.3 Potential Impacts on Threatened Biota

#### 7.3.1 Part 3A Considerations

The investigations of the subject land at Mundamia, including the incorporation of information from other sites in the vicinity, satisfactorily address the survey and assessment *Guidelines* for threatened biota prepared by the (then) Department of Environment & Conservation (DEC 2004; DEC & DPI 2005).

The Draft *Guidelines for Threatened Species Assessment*, prepared by the then Department of Environment & Conservation (DEC) and the then Department of Primary Industries (DPI) in 2005, have been addressed below with respect to the assessment and evaluation of likely impacts of the proposed development.

As noted above, it should be noted that the *Guidelines* identified above are:

- *Draft Guidelines* (*ie* they have not been finalised despite a substantial period between their initial 'release and the current time');
- are "*guidelines*", not statutory requirements or standards; and
- provide 'guidance' to the assessment process, which needs to be interpreted and applied appropriately depending on the circumstances of each individual application.

According to the 'requirements' of the *Draft Guidelines* (DEC and DPI 2005) identify a number of "*steps in the assessment process*":

- Step 1 Preliminary Assessment, which "*is primarily a desktop assessment involving searches of relevant databases and literature reviews to identify a list of threatened species which could potentially occur In the area*" (Chapter 2);
- Step 2 Field Survey and Assessment. The conduct of surveys for threatened biota is discussed in the DEC *Draft Guidelines,* and has been addressed in this *Report* (Chapter 2; Appendix B);
- Step 3 Evaluation of Impacts (Chapter 7);
- Step 4 'Avoid, Mitigate and Then Offset', which involves "*the description and justification of measures to mitigate any adverse effects*" (Chapter 18); and
- Step 5 Key Thresholds.

These steps and where they are addressed in the *Report*, are listed in Table 7.

Step 3 indicates *inter alia* that the "*magnitude and extent of impacts*", and their significance is "*related to the conservation importance of the habitats, individuals and populations likely to be affected*" by the proposal. The *Draft Guidelines* state that the "*impacts will be more significant*" if:

- "*areas of high conservation value are affected*"; or
- "*individual animals, and/or plants and/or sub populations that are likely to be affected by the proposal play an important role in the long-term viability of the species, population or ecological community*"; or
- "*habitat features that are likely to be affected by the proposal play an important role in maintaining the long-term viability of the species, population or ecological community*"; or
- "*the duration of impacts are long-term*"; or
- "*the impacts are permanent and irreversible*".

**Table 7 Assessment of Threatened Species under Part 3A – Steps**

| Relevant Items | Where and how addressed |
|---|---|
| Factors to consider when preparing a Development Application | • Threatened species are addressed throughout the *Report*, especially Chapters 4 and 5, Figures 6 and 7, and Appendices C, F and G.<br>• This *Report* constitutes the "*threatened species assessment report*" required by DEC/DPI. |
| **Steps in the Assessment Process** | |
| Step 1 Preliminary Assessment | • Chapters 2, 3, 4 and 5<br>• Appendices A-K |
| Step 2 Field Survey and Assessment | • Surveys by BES (2004a, b, 2007, 2009, 2010), Environmental InSites (2008, 2010 and 2011)<br>• Chapters 2, 4 and 5<br>• Appendix B<br>• Figures 4, 5, 6 and 7 |
| Step 3 Evaluation of Impacts | • Chapter 7<br>• Figures 4, 5, 6 and 7 |
| Step 4 Avoid, Mitigate and Then Offset | • Chapter 8<br>• Re-design of northern portion to retain Nowra Heath-myrtle |
| Step 5 Key Thresholds | • Chapter 7.3 |

**Areas of High Conservation Value**

The proposed development of the subject land at Mundamia has concentrated development activities primarily within those portions of the subject land which have been assessed in this *Report* as having lower conservation values by virtue of:

- the nature of the vegetation types present; and/or
- previous and existing disturbance; and/or
- the relevance of those areas of vegetation to threatened biota known or expected to occur in the general locality.

The approach which has been adopted generally retains areas of vegetation which have not been directly affected to a significant extent by previous agricultural land uses, located generally in the northern part of the subject land and along the eastern boundary. These areas contain the majority of the Nowra Heath-myrtle, as well as habitat and resources for threatened fauna species such as the Yellow-bellied Glider and the Glossy Black Cockatoo.

Given those considerations, the majority of the "*areas of high conservation value*" on the subject land have been retained in the proposed *Public Reserve* within the northern part of the land and along the eastern boundary. The development activities on the land are appropriately located in areas of greater disturbance or modification and/or in areas of lower conservation value (*eg* areas of native vegetation which have been affected by adjacent agricultural activities).

Arguably, the only "*area of high conservation value*" on the subject land at Mundamia is that which supports the high densities of the Nowra Heath-myrtle. This species has a restricted distribution, unlike the other threatened species known or likely to occur on the land which are wide-ranging and highly

mobile and/or are distributed much more widely through the immediate vicinity and general locality. Thus, the only "*area of high conservation value*" is in the northern part of the subject land, and the proposed development in this area has been re-designed to avoid impacts on the overwhelming majority of the Nowra Heath-myrtle population.

It is to be noted in considering the assessment of potential impacts on threatened biota that the conclusions of this *Report* by Environmental InSites reflect, in essence, the conclusions which have been reached by Shoalhaven City Council (SCC) and the then Department of Planning (DoP) with respect to the appropriate development of Mundamia for residential purposes. The *Nowra-Bomaderry Structure Plan* (which was adopted by the Council and endorsed by the DoP) recognises the appropriateness of residential development at this location (including on the subject land).

Given that circumstance, the proposed development of the subject land at Mundamia is clearly an appropriate response to the assessment of potential impacts upon the threatened biota, as had previously been considered by the SCC and the then DoP.

**Importance of Individual Biota**

As noted above, most of the important and significant habitats and resources for the relevant threatened biota are to be maintained within the proposed *Public Reserve* in the northern and eastern sections of the subject land at Mundamia.

Furthermore, for those threatened species known or likely to occur on the subject land at Mundamia, there are substantial areas of suitable habitat and resources in the immediate vicinity and general locality, including extensive areas of potentially suitable habitat and resources within the Crown Land surrounding Flat Rock Creek and within Triplarina Nature Reserve and Shoalhaven State Forest to the south (Figure 1). The natural and modified habitat proposed to be removed from the subject land (*ie* approximately 9ha of native vegetation) comprises only a minute proportion of the total available habitat within an approximate 10km radius of the land in the form of National Parks Reserves and State Forests.

The most significant or "*important*" biota present on or likely to occur on the subject land at Mundamia, no doubt, are those species which have been identified as "*threatened*", and are listed in the TSC Act and/or the EPBC Act. The proposed development of the subject land at Mundamia for residential purposes has been particularly cognisant of those relevant threatened biota, both in the investigations conducted for the *Nowra-Bomaderry Structure Plan* (as endorsed by SCC and the DoP) and in the investigations undertaken for this *Report* for the proposed development of the subject land. Of particular relevance in this regard are the Nowra Heath-myrtle, Yellow-bellied Glider, Glossy Black Cockatoo and relevant or potentially relevant habitats and resources (such as hollow-bearing trees and specific food trees).

The most important habitat for the Nowra Heath-myrtle on the subject land (in the northern and eastern sections of the site), and the overwhelming majority of the population of the species, are to be retained and protected. This outcome is to be achieved by their inclusion in the proposed *Public Reserve* and by the implementation of a *Vegetation Management Plan* for the *Public Reserve* with specific measures to enhance the survival of the species. As a consequence, it is not likely that the population of this species would be so adversely affected by the proposed development as to render the "*local population*" of that species "*at risk of extinction*".

The majority of suitable habitat for the Yellow-bellied Glider is also contained within the proposed *Public Reserve* in the northern and eastern parts of the subject site, particularly in the northeast. It is not likely that individuals of that species would be adversely affected by the proposed development of the land such that the "*long-term viability*" of that species and/or the "*local population*" of the species would be adversely affected.

Only very small areas of potential foraging habitat and resources for the Glossy Black Cockatoo will be removed for the proposed development of the subject land. In this regard, there are substantial foraging resources within the *Public Reserve* on the subject land and on adjoining lands, and the Glossy Black Cockatoo (in any case) is highly mobile and wide-ranging, and is abundant in the Shoalhaven LGA.

Similarly, most of the suitable foraging resources and habitat of particular value for microchiropteran bats will be retained within the *Public Reserve.* In addition to the habitat retained within the *Public Reserve*, there are a substantial suitable foraging habitat and roosting resources through the general locality, which will ensure that individuals of those species are not so affected as to reduce the "*viability*" of any local populations.
Given the considerations above, and the implementation of an appropriate management regime within the *Public Reserve* on the subject land at Mundamia, development of the subject land as proposed does not represent an activity likely to have a significant adverse impact upon either "*individual animals and/or plants and/or subpopulations*" of threatened biota or on "*the long-term viability of the* [any] *species, population, or ecological community*".

It should be noted that the *Nowra-Bomaderry Structure Plan*, which was the result of a substantial investigation and analysis *inter alia* with respect to threatened biota on behalf of Shoalhaven City Council (SCC), had determined that Mundamia was an appropriate location for residential development. Those investigations and the subsequent *Structure Plan* (which have been endorsed by SCC and the then DoP) had concluded that the likely impacts on threatened biota were not such as to preclude development *inter alia* of the subject land for residential purposes. Indeed, the *Nowra-Bomaderry Structure Plan* recommends *inter alia* residential development of the subject site at Mundamia.

**Importance of Habitat Features**

Most of the relevant habitats and habitat features on the subject land at Mundamia have been retained in the *Public Reserve* within the northern and eastern parts of the land. The following habitat features are to be substantially retained and managed in the proposed *Public Reserve*:

- the majority of nesting and foraging habitat for the Yellow-bellied Glider;
- the majority of foraging and potential nesting resources for the Glossy Black Cockatoo;
- the overwhelming majority of individuals of and habitat for the Nowra Heath-myrtle, particularly as a result of the re-design of the northern part of the proposal; and
- most of the hollow-bearing trees within the forest communities.

Parts of the areas of the subject site at Mundamia which are proposed for development activities support some of the vegetation types and habitat resources which are present in the proposed *Public Reserve* on the land. However, the development area does not contain significant or important habitat or resources that will not be retained within the proposed *Public Reserve*. Further, many of those habitats and habitat features which are to be removed have been modified or disturbed, in any case.

The array of investigations which have been undertaken on the subject land demonstrate that the development will not involve the removal of any wildlife habitats or the loss of any resources which are regarded as of particular "*importance*" for any native, including threatened, species. In addition, the long-term management of the proposed *Public Reserve* will ensure that the relevant "*habitat features*" of the subject land are retained and protected for biodiversity purposes. That situation constitutes a significant nett environmental benefit over current circumstances.

The biodiversity conservation value of various habitat features and resources, both on the subject site itself and in its immediate vicinity, have been considered in determining the appropriate development footprint of the subject land at Mundamia. In addition, those matters and features had been taken into account in the *Nowra-Bomaderry Structure Plan* (as adopted by SCC and endorsed by the then DoP), which determined *inter alia* that development of the subject land, essentially as now proposed, was an appropriate outcome.

On the basis of the various investigations which have been undertaken on the subject site (by SCC, BES/ELA, Environmental InSites and SLR Ecology), an appropriate balance between sensible development opportunities and the conservation of important habitat features has been achieved.

**Duration of Impacts**

In respect of those parts of the subject land proposed for development, the impacts (in terms of the removal of habitat and resources) will obviously be permanent. The relevant issues, therefore, are:

- whether those impacts are acceptable; and
- whether additional permanent or long-term impacts will be imposed on adjoining habitats.

The proposed development of the subject land at Mundamia has been designed, and is to be undertaken, in an environmentally sensitive manner. The *Concept Plan* has been designed *inter alia* to avoid the imposition of long-term adverse impacts upon the retained natural environment on the subject land and/or upon adjoining habitats and resources for native (including threatened) biota.

Implementation of the design features of the proposal, and of the *Vegetation Management Plan* (VMP) within the retained portions of the land would ensure that the areas of land to be retained, protected and enhanced are not adversely affected in either the short-term or the long-term.

As discussed above with respect to various matters, the *Nowra-Bomaderry Structure Plan* (which has been adopted by SCC and which was endorsed by the then DoP) has identified the subject site *inter alia* for development purposes. That analysis and assessment (by SCC and the then DoP) had taken into account and considered the likelihood of ongoing impacts of urban development, and clearly had concluded that, on balance, development of the subject land was appropriate.
As also discussed in some detail above, the proposed development of the subject land at Mundamia has, *inter alia*:

- addressed the importance and/or significance of adverse impacts which might be imposed upon the natural environment;
- been designed specifically to limit or ameliorate those potential adverse impacts;
- been modified and amended in an iterative process that has been sensitive to the environmental constraints of the land;

- involved a development design which predominantly uses previously modified and/or disturbed degraded areas of the subject land for residential purposes; and
- deliberately and specifically incorporates a range of impact amelioration and environmental management measures designed in particular to minimise or limit adverse impacts upon the natural environment, and upon threatened biota and their habitats.

Those outcomes reflect the expectations contained within the *Nowra-Bomaderry Structure Plan* (as adopted by SCC and endorsed by the then DoP), and in the *South Coast Regional Strategy* (recently promulgated by the DoP/DPI).

**Permanent and Irreversible Impacts**

As with "*cumulative impacts*", the impacts upon habitats and resources within the development footprint of the subject land at Mundamia will be "*permanent and irreversible*". That is an inevitable, and obvious, consequence both of the proposal and of the considerations contained in the *Nowra-Bomaderry Structure Plan* (as adopted by SCC and endorsed by the DoP), and is a matter which had been taken into account by those authorities. Further, that matter has been taken into consideration in addressing the significance of the likely or potential impacts of the proposed development on the natural environment in general, and on threatened biota in particular, as documented in this *Report*.

In respect of both the "*duration of impacts*" and the imposition of "*permanent or irreversible impacts*", the proposed development design has been cognisant of the ecological constraints imposed by important elements of the environment on the subject land, and adjacent to it. The project has:

- identified areas of relatively '*high conservation*' value;
- confined the proposed development to those areas which are of lesser conservation significance or value; and
- incorporated an array of environmental management and impact amelioration measures designed specifically to avoid the imposition of adverse impacts upon retained natural vegetation and habitats, both on the subject land itself and in the immediate vicinity.

The only threatened plant species present on the subject land is the Nowra Heath-myrtle. The majority of the population of and habitat for this species is being conserved with the proposed *Public Reserve* (Figure 6). Further, the stormwater bioretention swales have been designed to minimise any effect on this species in the northeastern portion of the land. That approach will both protect individuals of the species, and ensure the maintenance of soil moisture conditions necessary for its survival.

Relevant threatened fauna species are addressed in Chapters 5 and 6 of this *Report*. Whilst the proposed development will doubtless remove some areas of habitat for a number of threatened fauna species, no such species would be confirmed to the proposed development area. The relevant threatened fauna are highly mobile and wide-ranging and/or are widely distributed in the locality, including on adjoining lands. Thus, adverse impacts on those species will be localised and limited, given the extent of habitat in the locality.

There are no "*threatened ecological communities*" or "*ecological populations*" present and no *Recovery Plans* are of relevance to the land or the threatened biota which are known or likely to be present.

### 7.3.2 Threatened Ecological Communities

There are no "*threatened ecological communities*" (TECs) present on the subject land at Mundamia.

As discussed in Chapter 4.4.3, the Paperbark Closed Forest vegetation present in the northeastern part of the subject land is not an example of the Swamp Sclerophyll Forest on Coastal Floodplains "*endangered ecological community*" (EEC), because the subject land is not located on a "*coastal floodplain*". Nor is it relevantly "*associated with … a coastal floodplain*".

### 7.3.3 Threatened Species

**Relevant Threatened Species**

As detailed in Chapters 4 and 5 of this *Report*, there are a number of threatened species which will or are likely to be affected by the proposed development on the subject land at Mundamia.

The Nowra Heath-myrtle is known to occur within the development footprint, as well as within the *Public Reserve* (see below). *Pterostylis vernalis* occurs nearby, and some potential habitat exists in the Kunzea Heathland on the subject land. Dedicated searches for the orchid did not reveal any records of the orchid.

There are records (either direct or indirect) of several threatened fauna species, including the Yellow-bellied Glider, Glossy Black Cockatoo, Gang Gang Cockatoo, Grey-headed Flying Fox and two threatened microchiropteran bats.

Two additional threatened fauna species have been recorded in the vicinity of the development area – the Powerful Owl (recorded in the northeastern part of the subject land, in the *Public Reserve*) and the Square-tailed Kite (which was recorded flying over the land).

There will unavoidably be adverse impacts imposed upon at least some individuals of some of these various threatened biota. For the threatened fauna species, those impacts will predominantly be indirect (*ie* through the removal of resources or habitat features such as hollow-bearing trees or preferred food trees), whereas for the Nowra Heath-myrtle, there will be both direct impacts (by the loss of individuals) and indirect impacts (by the loss of some areas of habitat).

An *Assessment of Significance* - taking into consideration the relevant matters identified in Appendix 3 of the DECC 2005 *Draft Guidelines* – for relevant threatened biota is provided in Chapter 7.3.5 (below).

**Nowra Heath-myrtle**

Recent surveys by SLR Ecology have resulted in the mapping of 4.16 ha of patches of Nowra Heath Myrtle within the subject land, with an additional 198 individuals also scattered across the northeastern and eastern parts of the site. The current proposed layout will require the removal of 0.93ha (22%) of patches and 69 (35%) individual specimens of the Nowra Heath-myrtle (Figure 6).

The greatest density of the Nowra Heath-myrtle on the subject land is located in the northern part of the property, in particularly within the northern Public Reserve. There are also a series of dense stands associated with drainage lines in the southern Public Reserve, particularly in the southeastern corner.

Whilst there will be some loss of specimens of the Nowra Heath-myrtle as a result of the proposed development on the subject land at Mundamia, that loss is offset by:

- the careful management of stormwater to mimic current conditions (Chapter 7.4);
- the retention of the majority of the population and most of the suitable habitat for the species within the *Public Reserve* on the subject land;
- the proposal to implement a dedicated *Vegetation Management Plan* within the *Public Reserve*, designed specifically *inter alia* to protect and enhance populations of the Nowra Heath-myrtle; and
- a commitment within the *Statement of Commitments* to monitor the population of the Nowra Heath-myrtle within the *Public Reserve*, and to provide data and information to Council and/or the OEH until the *Public Reserve* is dedicated to Council or the OEH for biodiversity conservation purposes.

**Threatened Fauna**

With respect to the threatened fauna species known or likely to occur within those areas of vegetation to be cleared for the proposed residential development of the subject land:

- a small proportion of resources which are of relevance for the Yellow-bellied Glider (including some hollow-bearing trees and a few sap feed trees) are located within the development footprint;
- however, these resources are also abundant within the *Public Reserve* on the subject land and in the adjoining vegetated lands (the Thompson Reserve to the north, the crown land along Flat Rock Creek to the east, and additional crown land and the Triplarina Nature Reserve to the south and southeast);
- the total area of open forest and woodland to be removed for the proposal represents only a minute portion of that present in the locality and identified in the *Nowra-Bomaderry Structure Plan* as being retained for biodiversity conservation purposes;
- with respect to microchiropteran bats, the loss of hollow-bearing trees as roost sites and of open forest or woodland habitat for foraging purposes will represent only a minor reduction in the extent of those resources and habitats in the locality;
- further, the proposal incorporates a *Hollow-bearing Tree Protocol*, which is to be implemented as part of the project to salvage, re-use and/or replace any tree-hollows which need to be removed;
- similar considerations apply to the Glossy Black Cockatoo, for which there will be a minor reduction in potential and/or recorded feed trees (*Allocasuarina* species), noting also that there are substantial such resources within the *Public Reserve* on the subject land and in other areas of vegetation which are to be retained in the locality;
- only a very few potential nest trees for the Glossy Black Cockatoo will be removed (perhaps one or two), noting also that there is no evidence for any breeding by Glossy Black Cockatoos on the subject land;

- the proposal will remove a small area of habitat within which the Powerful Owl could potentially forage on arboreal mammals. However, there are no hollow trees with suitable features for breeding by the Powerful Owl; and
- the removal of some woodland vegetation will have little or no impact upon either the Grey-headed Flying Fox or the Square-tailed Kite, given that both species are highly mobile and very wide-ranging, and that there are no specific resources of particular value for these species present on the subject land.

As is the case with the Nowra Health Myrtle, the potential significance of the imposition of adverse impacts on those threatened fauna species needs to be considered in the light of the relevant impact amelioration and environmental management measures proposed as part of the activity, and (particularly) the protection of a substantial portion of high quality native vegetation on the subject land within a *Public Reserve*. The proximity of the subject land to other areas of native vegetation to be retained in the vicinity and locality is also of particular relevance in this case.

### 7.3.4 Impact Analysis

With respect to threatened fauna and/or habitats or resources for threatened species, the proposed development on the subject land at Mundamia will involve:

- the removal of 39 hollow-bearing trees of various sizes. Most of the hollow-bearing trees, however, are of only moderate size at best, and there are very few large tree-hollows which will require removal (see discussion below regarding the salvage and re-use of tree-hollows);
- the removal of a number of Yellow-bellied Glider food trees in the eastern part of the proposed development footprint;
- the loss of a number of Glossy Black Cockatoo feed trees; and
- the loss of a small proportion of the Nowra Heath-myrtle population, which extends well into the proposed *Public Reserve*, particularly in the north and northeast of the subject land (where the development has been re-designed to reduce the loss of Nowra Heath-myrtle required).

Whilst the proposed development as detailed in the *Concept Plan*, and as discussed above, will require the removal of some areas of native vegetation and of habitat and resources for threatened biota (as well as individuals of the Nowra Heath-myrtle), there are a number of relevant considerations when assessing the significance of potential or likely environmental impacts of the proposal.
In this regard, it is relevant to include consideration of:

- the extent of retention of habitat, resources and individuals of threatened biota, as well as significant areas of native vegetation, within the *Public Reserve* in the eastern and northern parts of the subject land (Figure 6);
- the extent of habitat and resources, as well as populations and individuals of threatened biota, on surrounding lands, much of which have been designated for biodiversity conservation purposes in the *Nowra-Bomaderry Structure Plan* (Figure 9; Chapter 7.12);
- the implementation of a program to capture and relocate threatened species during any clearing of the subject land;

- the protection of most of the Nowra Heath-myrtle population within the *Public Reserve*, following modifications to the design of the northern part of the proposal (Figure 6);
- the implementation of a *Hollow-bearing Tree Protocol*, including the salvage and re-use of tree-hollows which require removal for the proposed residential development, with the relocation of salvaged tree-hollows into the *Public Reserve* and/or their use as hollow logs, and the replacement by artificial nest boxes of any tree-hollows lost, in the *Public Reserve*;
- the implementation of a 'best practice' stormwater management regime within the project to ensure, both during construction and during subsequent occupation, that discharge stormwater quality and quantities are appropriate (see Chapter 7.4);
- the provision of supplementary habitat through the careful design of detention basins;
- the implementation of a *Vegetation Management Plan* (VMP) for the whole of the *Public Reserve*, designed specifically to protect and manage habitat and resources, as well as native vegetation and threatened biota, within the *Public Reserve* (see the VMPP in Appendix I); and
- the long-term management of the *Public Reserve* for biodiversity conservation purposes by its dedication to Council to expand the adjoining *Flat Rock Creek Reserve* (to the east).

Detailed consideration of the impact amelioration and environmental management measures that are included as integral parts of the project are provided in Chapter 8 of this *Report*.

### 7.3.5 Assessments of Significance

The *Draft Guidelines for Threatened Species Assessment for Major Projects* (DEC and DPI 2005) identify a series of matters to be taken into account in assessing the likely impacts of a proposal on threatened biota. That *Assessment of Significance* addresses matters that otherwise would be considered pursuant to Part 3A of the EPA& Act.

The matters raised in the *Draft 2005 Guidelines* include the following.

- How is the proposal likely to affect the lifecycle of a threatened species and/or population?
- How is the proposal likely to affect the habitat of a threatened species, population and/or community?
- Does the proposal affect any threatened species or populations that are at the limit of its known distribution?
- How is the proposal likely to affect current disturbance regimes?
- How is the proposal likely to affect habitat connectivity?
- How is the proposal likely to affect critical habitat?

As noted elsewhere in this *Report*, there is one threatened plant species of relevance (the Nowra Heath-myrtle) and several threatened fauna of some relevance (the Yellow-bellied Glider, Glossy Black Cockatoo, Powerful Owl, Grey-headed Flying Fox and several threatened microchiropteran bats). These species are considered below and have also been addressed in detailed Section 5A Assessments of Significance at Appendix L.

With respect to Section 5A of the EP&A Act and any additional threatened species not recorded on the site but with some potential to occur (such as occasional threatened birds and bats):

- There is no possibility of a "*viable local population*" of any threatened species being reliant or dependent upon on the subject site. Accordingly, the proposed activity is not likely to render any such population at "*risk of extinction*" – Factor (a).
- There is no "*endangered population*" of any species known or likely to occur or be present on the subject site – Factor (b).
- There is no "*endangered ecological community*" present on the subject site – Factor (c).
- The proposal will not involve the removal or modification of any known or potential areas of important habitat for threatened species, will not result in any potential habitat becoming "*fragmented or isolated from other areas of habitat*" and will not result in any disturbance to important or significant habitat for those species - there is no likelihood of any adverse impact upon the "*long-term survival*" of any threatened species, population or endangered community "*in the locality*". – Factor (d).
- There is no "*critical habitat*" on the subject site – Factor (e).
- There are no relevant Recovery Plans or Threat Abatement Plans – Factor (f).
- There are no relevant "*key threatening processes*" (KTPs) with regard to the proposed development – Factor (g).

**Nowra Heath-myrtle**

In considering the Nowra Heath-myrtle, the proposed development will doubtless remove a small part of the population that exists on the subject site and on adjoining lands, and will remove a small proportion of the habitat for this species. Relevantly, however, the population extends onto adjoining lands and is apparently widely distributed at Mundamia.

In respect of the matters for consideration pursuant to the *Draft 2005 Guidelines*:

- the proposal is not likely to affect the life cycle of the Nowra Heath-myrtle - other than to a limited extent within the development footprint (which is just a small proportion of the total population present);
- the proposal is not likely to affect the habitat of Nowra Heath-myrtle - other than to a limited extent within the development footprint (which is just a small proportion of the total habitat present);
- the Nowra Heath-myrtle is not "*at the limit of its known distribution*";
- the proposal is not likely to affect current disturbance regimes (other than within the development footprint), as the *Public Reserves* will be managed for biodiversity conservation purposes, and potential disturbances (associated with ongoing use of the land for agricultural purposes) will cease;
- the proposal will not affect any "*habitat connectivity*"; and
- there is no "*critical habitat*" for the Nowra Heath-myrtle on the subject site at Mundamia.

Given those considerations, the proposed Jemalong Mundamia residential development project is not likely to impose a "*significant effect*" on the Nowra Heath-myrtle.

**Threatened Fauna Species**

With respect to the threatened fauna species recorded on the subject site and/or likely to occur (the Yellow-bellied Glider, Glossy Black Cockatoo, Powerful Owl, Grey-headed Flying Fox and several threatened microchiropteran bats), it is noted that all of the relevant species are reliant on the forest and woodland canopy, and most are dependent on tree-hollows for nesting or roosting. Most of the relevant species also have moderate to extremely large home ranges. There is no possibility that a "*viable local population*" of any of those threatened fauna species could be dependent on the subject site itself for their survival at this general location.

In considering those threatened fauna species, it is accepted that the proposed development will remove a small part of the habitat for these species from the subject site. Relevantly, however, there is substantial habitat for these species on adjoining lands and at Mundamia, and throughout the immediate vicinity and general locality. The proposal will affect only a small proportion of the habitat and resources for these species, and significant areas of suitable habitat have been zoned for environmental protection.

In respect of the matters for consideration pursuant to the *Draft 2005 Guidelines*:

- the proposal is not likely to affect the life cycle of any of the relevant threatened fauna species - other than to a limited extent within the development footprint (which would constitute just a small proportion of the total population present in the vicinity and locality);
- the proposal is not likely to affect the habitat of any of the relevant threatened fauna species - other than to a limited extent within the development footprint (which is just a small proportion of the total habitat present in the vicinity and locality);
- none of the relevant of any of the relevant threatened fauna species is "*at the limit of its known distribution*";
- the proposal is not likely to affect current disturbance regimes for any of the relevant of any of the relevant threatened fauna species (other than within the development footprint), as the *Public Reserves* will be managed for biodiversity conservation purposes, and potential disturbances (associated with ongoing use of the land for agricultural purposes) will cease;
- the proposal will not affect any "*habitat connectivity*" for any of the relevant of any of the relevant threatened fauna species; and
- there is no "*critical habitat*" for any of the relevant of any of the relevant threatened fauna species on the subject site at Mundamia.

Given those considerations, the proposed Jemalong Mundamia residential development project is not likely to impose a "*significant effect*" on any of the relevant threatened fauna species identified at Mundamia.

**Conclusions**

The proposed development of the Jemalong Mundamia project will remove a small proportion of the population of the Nowra Heath-myrtle and a very small proportion of the habitat for any relevant threatened species from the subject site. Relevantly, however, there is substantial habitat for these species on adjoining lands and at Mundamia, and throughout the immediate vicinity and general locality.

Given those considerations, the proposed Jemalong Mundamia residential development project is not likely to impose a "*significant effect*" on any of the relevant threatened biota identified at Mundamia.

## 7.4 Impacts of the Stormwater Management Regime

### 7.4.1 Stormwater Management Assessment

A *Stormwater Management Assessment* has been prepared (Martens 2014), which addresses issues relating to the management of stormwater during construction activities for future development on the subject site, as well as ongoing management of stormwater once residential development has been completed. The assessment concludes that the site requires the following stormwater structures to minimise the effects of the development on local stormwater hydrology:

- rainwater tanks and dedicated on-site detention (OSD) storages on all residential lots;
- roadside 'bioretention swales', which will also allow for groundwater recharge; and
- end-of-line OSD basins combined with bioretention filters.

The proposed OSD basins are shown in Appendix A.

Bio-retention swales are proposed along the perimeter roads and along internal roads, with individual lots being provided with rainwater tanks and extra OSD storage. The stormwater management system aims to ensure that the existing groundwater conditions downslope of the development are maintained, insofar as is possible. This will involve a combination of infiltration of stormwater into the groundwater layer and the 'over-topping' of the swales to maintain soil moisture and hydrological conditions with the *Public Reserve*.

Runoff from site areas is to be directed to OSD basins located on the eastern margins of the development area, with underlying bio-infiltration functionality for OSD Basins C2a and C2 to capture and attenuate stormwater flows from the developed site to pre-development discharge rates, whilst providing further mechanism for groundwater recharge. Basins C1a and C1 will not have underlying bio-infiltration due to potentially limited soil depth in proposed basin areas. The proposed OSD basins will have the following dimensions:

- southern area, with potential detention area of 1,000 $m^2$;
- central area, with potential detention area of 2,000 $m^2$; and
- northern area with potential detention area of 7,000 $m^2$. This basin will be located within the *Public Reserve* and will require clearing of vegetation to allow construction.

### 7.4.2 Impacts on vegetation (including GDEs)

There are two vegetation types which would appear to be partially dependent upon groundwater drainage and discharges – the Swamp Paperbark community contained within and adjacent to a shallow drainage line in the northeastern part of the subject land, and some small 'moss gardens' on the eastern side of the land. Both of those communities will be partially removed as a result of the proposed development of the subject land at Mundamia.

However, neither of those communities is restricted to the subject site, and neither is regarded of particular conservation concern. Furthermore, neither is considered to be entirely reliant on groundwater, as incipient rainfall is also doubtless an important and necessary resource for both communities.

Nevertheless, vegetation adjacent to the eastern side of the subject land is proposed to be maintained by the use of bio-retention swales within and adjacent to the development. These are designed *inter alia* to maintain groundwater conditions downslope of the subject land, and would facilitate the maintenance of areas of those vegetation types which are to be retained within the *Public Reserve*.

It is noted that whilst the Nowra Heath-myrtle often occupies moist areas and areas of impeded drainage, there are many areas on the subject land where specimens of the Nowra Heath-myrtle, and substantial stands of species, are present in locations with xeric (or dry) soil conditions. Furthermore, the overwhelming majority of the population of that species on the subject land is located to the north of the proposed development area, on a slope which is outside of the catchment of the development. Thus, there will be no adverse impacts upon the overwhelming majority of that population as a consequence of the proposal.

As noted above, the proposed stormwater management measures contained within the concept design for the residential development at Mundamia have incorporated a range of measures intended specifically *inter alia*:

- to capture and re-use stormwater throughout the development;
- to utilise on-site infiltration and bio-retention swales to return stormwater to the soil;
- to incorporate measures to minimise the discharge of phosphorus, nitrogen and other contaminants (including sediment) during construction activities and throughout occupation of the subject land; and
- to provide supplementary habitat for native biota (in bio-retention swales) and to provide for maintenance of the soil and moisture regime downslope of the development.

Whilst the proposed development will doubtless result in some impacts as a result of changes to stormwater discharges, particular attention has been paid during the design phase to limit the potential for adverse impacts by the implementation of a stormwater management regime which is cognisant of and sensitive to the potential for adverse impacts to be imposed. The proposal has sought to implement appropriate measures for the management and treatment of stormwater discharges from the development.

The stormwater management regime which is to be implemented as part of the residential development of the subject land will not involve the imposition of a significant impact on any native biota, threatened or otherwise. In particular, as noted above:

- no threatened biota listed in the TSC Act will be adversely affected to any significant extent, by virtue of the areas of vegetation to be retained both on the subject land itself and in its immediate vicinity (particularly to the east);
- the stormwater management regime is intended *inter alia* to maintain (insofar as is possible) existing soil moisture levels to the north and east of the development area; and
- there will be no significant impact upon any *Matters of National Environmental Significance* (MNES) as a consequence of the stormwater management regime for the proposed development of the subject land (see Chapter 9).

## 7.5 Impacts of Bushfire Protection Measures

The Asset Protection Zones have been incorporated into the proposed development footprint, thereby eliminating the need for any additional clearing within areas of retained vegetation.

## 7.6 Cumulative Impacts

All development involves a contribution to the imposition of "*cumulative impacts*". More houses, more people and more infrastructure in any location inevitably lead to an increase in general impacts (both direct and indirect) on the natural environment.

However, the imposition of adverse impacts upon the natural environment in general and upon threatened biota in particular (including those present on the subject land), has been taken into account:

- in the *Nowra-Bomaderry Structure Plan*, which *inter alia* identified the subject site as an appropriate location for residential development;
- in the *South Coast Regional Strategy* (DoP 2006) which *inter alia* reinforces the development potential of the subject land; and
- in the assessment process contained in this *Report* for the current proposal.

As noted above, the Department of Planning (DoP) itself, through the vehicle of the *South Coast Regional Strategy* (the *Strategy*), is actively promoting the development for urban purposes of the subject land itself and land to its west – as Area 5 in the *Nowra-Bomaderry Structure Plan* (Figure 9).

Furthermore, as additional residential development throughout New South Wales is inevitable, it is proper to determine the most appropriate places for such development to occur. Generally speaking, it can reasonably be assumed that most further residential development would best be located adjacent or close to existing residential areas. That is precisely what is being promoted by the DoP in the *South Coast Regional Strategy* and the *Nowra-Bomaderry Structure Plan*.

In addition, it should be noted that the zoning of most of the subject land and all of the land proposed for residential development purposes has recently been reinforced by virtue of the *Shoalhaven Local Environmental Plan 2014* (SLEP 2014). This recent rezoning has been approved in the knowledge of what is being proposed on the subject site at Mundamia.

That there will inevitably be "*cumulative impacts*" on the natural environment and on threatened biota as a result of the proposed development on the subject land, as well as on the adjoining lands to the west, is acknowledged and accepted. Each of those developments will inevitably contribute to the "*cumulative impacts*" in the locality. However, it cannot be the requirement of any one development to address and deal with the "*cumulative impacts*" of all development in the vicinity. Nor is it possible to avoid the imposition of "*cumulative impacts*" in any such development.

In any case, the proposed development of the land at Mundamia has sought to limit and/or ameliorate impacts (both potential and real) which would or might arise from the proposed urban development of the land *inter alia* so as to minimise the contribution of the project to "*cumulative impacts*".

In this regard, the proposed development:

- has been confined substantially to areas which had previously been identified in the *Nowra-Bomaderry Structure Plan* as being appropriate for residential development, and which reflects both the original SLEP 1985 zoning of the land and the recent rezoning of the site for these purposes (pursuant to SLEP 2014);
- has involved an iterative approach, which has reduced the development *inter alia* to protect additional stands and individuals of the Nowra Heath-myrtle;
- incorporates specific stormwater regime design elements intended to maintain water quality and soil moisture levels; and
- provides for an increase in conserved lands by a commitment to dedicating the *Public Reserve* to Council.

### 7.7 Wildlife Corridor Values

Item 9.4 of the DGEARs requires:

- the consideration of "*measures for the conservation of existing wildlife corridor values and/or connective importance of any vegetation on the subject land*";
- "*the remnant line of trees running east-west across the property*"; and
- "*opportunities to conserve or enhance local and regional corridors and important habitats*".

The proposed development will not impinge upon any relevant existing corridors within the subject land itself, or in the immediate vicinity (Figure 2).

In this regard, the subject land is located on the western fringe of a large urban area and the Flat Rock Creek Reserve, but is separated from the suburbs of Nowra by a deep vegetated valley containing Flat Rock Creek, which extends from the Shoalhaven River (in the north) to the Triplarina Nature Reserve (to the south of Yalwal Road). Lands to the north of the subject land are also largely forested, although with scattered dwellings.

Whilst there are also areas of native vegetation to the west and south of the subject land, these are fragmented and do not constitute relevant or effective habitat links (or so-called 'wildlife corridors'), other than through vegetated lands to the north or south of the subject land.

Further, the area proposed for development is predominantly cleared agricultural land, and the proposal will maintain bands of vegetated land along its northern and eastern sides, contiguous with adjoining vegetated lands.

The *Nowra-Bomaderry Structure Plan*, endorsed by both Shoalhaven City Council and the then DoP (Figure 9), had identified a 'wildlife corridor' to the west of the lands considered appropriate for development activities. No 'wildlife corridor' is identified in the *Structure Plan* within those areas proposed for residential development on the subject land, and no such 'wildlife corridor' is either present or likely to be affected.

The narrow band of trees running east-west across the middle of the subject land provides only marginal habitat, at best, and then only for highly mobile species. There are no hollow-bearing trees within this line of vegetation, and there are no other particularly relevant resources for native fauna.

The loss of this narrow disjunct band of trees will not impede the movement of any fauna within the local area. Substantial intact areas of vegetation are present immediately to the north and east of the subject land, as well as to the south, which will maintain the east-west connectivity in the local context. Highly mobile species (such as bats and birds) will still be able to move across the land, even after residential development.

Further, it would be totally inappropriate for a thin, ineffective and ecologically meaningless east-west 'wildlife corridor' to be provided at this location through the middle of any area. Even if retained, the narrow band of trees would provide little (or more likely no) benefit for any fauna.

The proposed development of the subject land will have no adverse impacts upon any local, regional or other real, or purported, "*wildlife corridors*" or vegetated linkages through the landscape. The most relevant vegetation on the subject land (in the eastern and northern parts of the land) is to be retained. These areas are contiguous with adjoining areas of native vegetation, and have the potential to contribute in a meaningful sense to the maintenance of "*wildlife corridors*" or vegetated linkages through the immediate landscape.

The proposed development will not adversely affect the protection and maintenance of any "*wildlife corridors*", or other vegetated linkages, through the general landscape or in the immediate vicinity.

### 7.8 Watercourses and Wetlands

Item 9.5 of the DGEARs requires a description of "*all aquatic environments (watercourses, wetlands) located on or adjacent to the site, and their regional significance*".

The watercourses and wetlands on the subject land (limited as they are) are described in Chapters 3 – 5 of this *Report.*
The only "*wetlands*" in the area proposed for development purposes on the subject land are artificial farm dams, although there is an area of moist soils and apparently impeded drainage at the head of the small watercourse located in the northeastern part of the land. There are a variety of wetlands along the Shoalhaven River and doubtless others along Flat Rock Creek, but these are at some considerable distance from the land, and will not be affected by the development as currently proposed.

The small watercourse in the northeastern part of the land (as noted above) does not flow continuously, and the upper parts of the watercourse support a band of Swamp Paperbark, as well as mesic groundcover species and part of a patch of the Nowra Heath-myrtle. Although possibly in part sustained by groundwater, this area of vegetation doubtless also depends on incipient rainfall and overland flows during and following high rainfall events.

The lower parts of this watercourse will be retained in the proposed *Public Reserve*, and the stormwater management regime devised by Martens (2014) is proposed to protect water quality within that drainage feature.

There are two small vegetated farm dams and a large 'sediment dam' on the subject land at Mundamia. Of these, the 'sediment dam' is of little or no environmental value, and the two small farm dams provide only extremely limited habitat or resources for native biota.

Whilst the proposed development of the subject land for residential purposes will require the removal of the three farm dams, those features are not regarded as of particular ecological or environmental value.

There is no likelihood that any threatened biota would be present in or dependent on those features, and it is not considered likely that any significant adverse environmental impact will result from the removal of the farm dams.

Flat Rock Creek is the only notable local watercourse in the immediate vicinity of the proposed development which has the potential to be affected by activities associated with the proposed development. However, this watercourse is some considerable distance from the development area (140 – 300m), and will be protected by broad bands of intervening native vegetation. In addition, the stormwater management regime has been designed to mitigate any potential adverse impacts which could potentially or theoretically arise from the proposal.

The proposal will have no adverse impacts upon the Shoalhaven River or upon any habitats associated with that watercourse. Further, there are no SEPP 14 Wetlands in the vicinity of the subject land, and there is no likelihood of adverse impacts being imposed upon any SEPP 14 Wetlands in the locality.

### 7.9 Impacts on Aquatic Environments

Item 9.6 of the DGEARs requires a prediction of the "*impacts upon aquatic environments on or adjacent to the site*" and "*upon water quality and aquatic threatened species, populations, ecological communities*". Additionally, Item 9.7 of the DGEARs requires:

- information regarding "*measures and safeguards to protect adjacent aquatic habitats*"; and
- "*full details and widths of proposed riparian buffer zones for Flat Rock Creek*".

The only "*aquatic environments*" of note in the vicinity are the Shoalhaven River and downstream parts of Flat Rock Creek, as well as the large dam in the upper part of the Flat Rock Creek (to the southeast of the subject land). The proposed development of the subject land will have no adverse impacts upon those "*aquatic environments*".

As discussed above, the only *"aquatic"* and *"riparian"* habitats present within the subject land itself are confined to:

- two small farm dams in the agricultural parts of the subject land;
- a large degraded and poor quality 'sediment' dam in the southwestern corner of the land; and
- mesic vegetation located immediately adjacent to the small drainage line in the northeastern part of the land.

None of these habitats are regarded as of conservation value or significance. In this regard:

- the 'sediment' dam in the southwestern corner of the subject land has essentially no vegetation, and is clearly both artificial and in very poor condition;
- the two small farm dams on the land, being artificial nature are readily re-created. In any case, these two features do not represent significant habitat for any relevant native biota; and
- the small area of riparian vegetation along the upper part of the watercourse in the northeastern part of the subject land is not of particular conservation significance, although this area does support a small part of a stand of the Nowra Heath-myrtle. Conversely, that

patch constitutes only a very small proportion of the total population of Nowra Heath-myrtle on the subject land, and the riparian vegetation *per se* is not of particular significance or conservation value.

The proposed development of the subject land at Mundamia will require the removal of the farm dams and the upper part of the riparian habitat in the northeastern part of the subject land. However, those impacts are not regarded as of particular conservation significance because:

- supplementary aquatic habitat will be provided in bio-retention swales associated with the proposal;
- those artificial features will be managed specifically *inter alia* for the provision of habitat for native biota;
- the riparian habitat in the northeastern part of the subject land *per se* is not of particular relevance to any threatened biota, or any other native biota; and
- substantial areas of such habitats and resources (both aquatic and riparian) will be maintained in lands adjoining and surrounding the subject land.

Further, the proposal is not likely to impose significant impacts upon any relevant aquatic or riparian habitats in the immediate vicinity given:

- the distance to any such resources in most instances (*ie* the Shoalhaven River and Flat Rock Creek);
- the presence of intervening 'buffer' areas of native vegetation; and
- the water quality and quantity controls incorporated in the project.

The need for "*buffers*" between development and retained vegetation is inversely proportional to the care taken in design of the proposal and the adequacy of impact amelioration and environmental management measures applied, as well as to the sensitivity of any habitats or resources likely to be affected. In other words, intelligent design and appropriate management measures minimise the need for "*buffers*".

In this regard, the proposed development incorporates a peripheral road and bio-retention swale system that provides a management interface between the residential development and the *Public Reserve.* This is intended *inter alia* to reduce the likelihood of impacts on the adjoining retained vegetation by:

- providing a physical break between the development and retained vegetation;
- providing for visual monitoring of the interface by residents;
- providing supplementary habitat (in the bio-retention swales) which will also absorb any discharged nutrients; and
- facilitating the appropriate management of vegetation to ensure the amelioration of potential impacts.

No further requirements for the use of 'buffers' are warranted for this proposal. Rather, the development has been designed, and will be constructed, to ensure appropriate management of the potential 'edge effects' which might otherwise be imposed.

The proposed development and management of the proposed *Public Reserve* in the eastern and northern parts of the subject land specifically provides for adequate conservation and setbacks to Flat

Rock Creek (of 140m-300m). The proposed *Public Reserve* and the retained vegetation in the adjoining land (along Flat Rock Creek) provide a substantial buffer to Flat Rock Creek itself, involving both riparian areas and xeric woodland.

### 7.10 Indirect Impacts

Indirect impacts that are likely to be imposed by the proposed development include those associated with construction activities and those associated with long-term residential occupation.

The construction phase will potentially impose the following indirect impacts on adjoining retained vegetation and habitats:

- increased noise levels – particularly during the construction of perimeter roads and stormwater treatment and detention basins. These impacts, however, will be temporary and predominantly confined to daylight hours. These impacts are not likely to be of particular consequence;
- increased dust levels – again particularly associated with the construction of the perimeter roads and detention basins. Again, these will be short-term and of limited concern. Dust suppression measures would be anticipated as part of a *Construction Environment Management Plan* (CEMP);
- increased light levels – these will be short-term and localised as most of the construction activities will occur during daylight hours; and
- potential reductions in stormwater discharges – due to sediment in stormwater runoff and possible contaminants (cement, oils, paints *etc*). However, this potential indirect impact will be minimised or avoided through the implementation of stormwater discharge controls as a standard element in any CEMP for the site.

Occupation of the residential development will potentially impose the following indirect impacts on adjoining retained vegetation and habitats – all of which will be long-term in their effect:

- increased noise levels – human activities, barking dogs, motor vehicles *etc*. Whilst these noise impacts will materially increase over existing circumstances, residential areas do not generally generate high levels of 'noise pollution', and relatively high levels of noise are generally localised and temporary. Nevertheless, some native fauna are likely to be dissuaded from using woodland and forest habitats in close proximity to the residential areas once occupied as a consequence of the higher noise levels;
- movement disturbance – vehicles and humans or their pets. Some native species would be deterred from utilising habitats immediately adjacent to the residential development because of the movements of people, animals and/or vehicles;
- increased light levels – from street lighting and dwellings facing the retained vegetation. Light 'spill' from dwellings into retained vegetation will be limited – as the dwellings will be at least 25m from any retained vegetation in most instances. Further, street lighting is recommended to be directional – avoiding notable light spill into the adjoining retained vegetation; and
- changes in stormwater discharges. Water quality and quantity discharges (including the need for detention) is addressed in detail in the Martens (2014) *Hydrological Report*. The stormwater discharge regime for the proposal is intended to maintain groundwater

recharge, to control peak discharge volumes and to maintain water quality discharged from the site. Accordingly, indirect effects of stormwater discharge on the surrounding environment (including flora and fauna) are likely to be minimal.

## 7.11 SEPP 44 – Koala Habitat Protection

### 7.11.1 Application of SEPP 44

*State Environmental Planning Policy No. 44 - Koala Habitat Protection* (SEPP 44) aims to protect the Koala and its habitat by identifying matters for consent authorities to consider during the assessment of relevant *Development Applications* (DAs) or proposals. In particular, SEPP 44 contains definitions of "*potential koala habitat*" and "*core koala habitat*" to be applied in the consideration of developments within those Local Government Areas (LGAs) listed in Schedule 1 of the *Policy*.

The Shoalhaven LGA is listed in Schedule 1 of SEPP 44 as an area to which the *Policy* applies, and the subject land is greater than 1ha in area. Consequently, SEPP 44 applies (at least theoretically) to the subject land.

### 7.11.2 Potential Koala Habitat

SEPP 44 defines "*potential koala habitat*", as native vegetation in which trees listed in Schedule 2 of the SEPP "*constitute at least 15% of the total number of trees in the upper or lower strata of the tree component*".

Schedule 2 of SEPP 44 provides a list of tree species which are recognised as food trees utilised by the Koala. Only one of the relevant tree species is present on the subject land at Mundamia (the Grey Gum *Eucalyptus punctata*), but this species does not constitute more than 15% of the "*tree component*" of the forested parts of the land. As a consequence, the subject land does not constitute "*potential koala habitat*", as defined in SEPP 44.

### 7.11.3 Core Koala Habitat

SEPP 44 defines "*core koala habitat*", as "*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*".

There are no recent records of Koalas on the subject land or in the locality. There is, consequently, no "*resident population*" of Koalas. The subject land cannot therefore constitute "*core koala habitat*".

### 7.11.4 Conclusions

The subject land does not represent "*potential koala habitat*" as defined in SEPP 44, or "*core koala habitat*" as defined in the SEPP. Given those circumstances, there is no requirement pursuant to SEPP 44 for the preparation of a *Koala Plan of Management* (KPoM) for the subject land.

### 7.12 Nowra-Bomaderry Structure Plan

The *Nowra-Bomaderry Structure Plan* was adopted by Shoalhaven City Council (SCC) on the 24th of October 2006, and endorsed by the then Department of Planning (DoP), now the Department of Planning & Environment (DP&E), on the 26th of February 2008.

As indicated at the beginning of that document, the *Nowra-Bomaderry Structure Plan* "*is not a legal planning document but rather one that provides strategic direction and guidance*". Nevertheless, the *Structure Plan* does identify areas that are considered appropriate by SCC and the DoP for future residential purposes (amongst other things), which had been identified through a process of investigation and survey prior to adoption of the *Structure Plan.*

The *Nowra-Bomaderry Structure Plan* identifies new living areas within the Nowra-Bomaderry area, included amongst which is the Mundamia area. The eastern part of the area identified as a "*future living area*" at Mundamia corresponds substantially to the development which is proposed and considered in this *Report*. The identification of lands considered appropriate for residential development activities was based *inter alia* on flora and fauna investigations of the Mundamia area. Those studies (BES 2004) included investigations of the subject land, which have been supplemented for this *Report*.

The *Structure Plan* identifies a number of features of the Mundamia area, and notes *inter alia* that:

- the "*neighbourhood of Mundamia will be a contained area of residential development to the west of Nowra, within an area of abundant native bushland. This is an asset to be preserved and protected as a significant part of the biodiversity and natural processes in the area*";
- development at Mundamia "*will achieve a high level of environmental performance to ensure the quality of watercourses in close proximity to the neighbourhood, being the Shoalhaven River, Flat Rock Dam, Flat Rock Creek, Cabbage Tree Creek and numerous tributaries into the creeks*"; and
- the "*neighbourhood will achieve a considered balance between urban development and the protection of environmentally significant areas. Threatened species and valuable ecological communities will be retained and protected through appropriate land use zones, continuous riparian corridors, stormwater and drainage management. The natural bushland adjoining the neighbourhood will be conserved*".

The proposed residential development of the subject land at Mundamia, addressed in this *Report*, achieves the goals established in the *Nowra-Bomaderry Structure Plan*. As discussed elsewhere in this *Report*, most of the development area is located in areas of previously highly disturbed agricultural land, and the most significant elements of the natural landscape (including threatened biota and their habitats) are to be retained and protected. In addition, the stormwater management regime has been designed *inter alia* to ensure the maintenance of soil moisture conditions and the maintenance of water quality in Flat Rock Creek and the Shoalhaven River.

Further, the *Nowra-Bomaderry Structure Plan* anticipated the development of the subject land (essentially as currently proposed) with an array of other lands identified within the *Structure Plan* for retention as biodiversity offsets. As a consequence of the *Structure Plan*, the requirement for biodiversity offsets for the future development of *inter alia* the subject land at Mundamia has already been offset, and no further additional provision of land for biodiversity offsets is considered necessary.

# 8 IMPACT AMELIORATION and ENVIRONMENTAL MANAGEMENT

This chapter provides a discussion of impact amelioration and environmental management measures in accordance with the hierarchy of 'Avoid, Mitigate and Then Offset', which involves "*the description and justification of measures to mitigate any adverse effects*" under Step 4 of the *Draft Guidelines for Threatened Species Assessment* (DEC and DPI 2005).

## 8.1 Avoidance Measures

### 8.1.1 Fundamental Assumptions

Appropriate impact avoidance measures would be anticipated as a standard feature of any future development of the subject land for residential purposes. This approach has been adopted notwithstanding:

- the degraded nature and condition of most of the development area on the subject land;
- the lack of unique or restricted resources or habitat features of particular relevance for (particularly threatened) native biota, within the proposed development footprint; and
- the retention of substantial areas of habitat within the subject land, and on adjoining lands (*eg* the Crown Land containing Flat Rock Creek to the immediate east).

It is a fundamental assumption and approach embodied in this *Report* that, whilst impacts upon the natural environment are doubtless inevitable, it is appropriate to incorporate into both the development design and into the development concept an array of impact amelioration and environmental management measures which are designed *inter alia* to avoid, ameliorate and/or offset impacts upon the natural environment which will inevitably arise.

As discussed elsewhere in this *Report*, it is also a fundamental precept of this *Report* that the identification of an appropriate balance between development opportunities and conservation aspirations and goals is required to satisfy both the requirements and expectations for biodiversity conservation in the landscape generally and the requirements (economic, social and recreational) of the local and wider Australian community.

### 8.1.2 Avoidance Measures

The area proposed for residential development and onsite detention basins (31.03 ha or 77% of the subject land) is predominantly cleared or highly degraded agricultural land. The remainder of the subject land (*ie* the northeastern and southeastern portions of the land, occupying approximately 9.42 ha) is to be retained and managed for conservation purposes (in the proposed *Public Reserve*) (Appendix A). In addition the 1ha stormwater detention basins will be rehabilitated and dedicated as part of the *Public Reserve*.

The proposed subdivision represents the culmination of a collaborative and iterative process between the designers of the subdivision layout and the advice of specialist environmental consultants. In this regard, ecological constraints identified early in the design process by SLR (see Chapter 6), as well as

hydrological (stormwater), bush fire and topographical constraints, have shaped the layout and the features of the proposal. In particular, the layout has been re-designed specifically to reduce impacts on the Nowra Heath-myrtle and also to eliminate the impacts of APZs. This has involved a reduction in the extent of development in the northern part of the land, which significantly reduces the area of habitat for, and, the number of specimens of, the Nowra Heath-myrtle which will need to be removed or affected.

Specific avoidance measures incorporated into the design include:

- retraction of proposed lots in the northern part of the site in a southward direction, including removal of some proposed lots, to reduce clearing of Nowra Heath-myrtle;
- re-shaping the lot configuration to allow for greater retention of Nowra Heath-myrtle (individuals and habitat) in the northeastern portion of the subject land;
- retraction of the development area in the southeastern portion of the site, to shift the required APZ further west - to eliminate impacts of the APZ on native vegetation and Nowra Heath-myrtle in the *Public Reserve* at this location; and
- positioning of the layout to avoid the incised gully and riparian zone of the watercourse traversing through the northeastern parts of the site, which contains habitats for threatened fauna, including the Yellow-bellied Glider and the Powerful Owl.

### 8.2 Mitigation Measures

A comprehensive *Statement of Commitments* is provided in the Environmental Assessment prepared by Cowman Stoddart (2014). That *Statement of Commitments* includes, as appropriate, the impact amelioration and environmental management measures that are identified in this section of the *Report*.

#### 8.2.1 Impact Amelioration

Impact amelioration is the process of incorporating design features and ongoing management measures into a development to limit or minimise potential adverse impacts.

Elements of the proposal at Mundamia which have involved the incorporation of impact amelioration measures include:

- the design and the subsequent management of stormwater control features, both during construction activities and following completion and occupation of the land - to limit the potential discharge of contaminants and to maintain existing hydrologic regimes within the *Public Reserve*. These features will be constructed and managed according to current 'best practice' principles, and as outlined in the *Stormwater Management Assessment* (Martens 2014);
- the implementation of 'Water Sensitive Urban Design' principles, including the capture and re-use of stormwater runoff, the treatment of water to be discharged from the development, and the avoidance of the use of potable water for other purposes; and
- detailed design of the bioretention swale and detention basin system to maintain soil moisture and groundwater regimes, and to provide supplementary habitat for native biota (particularly in the peripheral detention basin system on the eastern side of the proposal). It is noted that the peripheral road system is to be constructed so that groundwater flows

form the drainage swale system and other recharge areas west of the road will continue beneath the road – thus ensuring maintenance of the groundwater regime downslope of the development.

It is recommended that street lighting around the peripheral road system be specifically designed to direct light away from the adjacent retained vegetation. Road lights should be located on the outer side of the road, with shielding to prevent light spill into the adjoining vegetation. Alternatively, most of the peripheral street lighting could be of a bollard-style design – thus reducing the potential for light spill into the adjoining bushland.

The impact amelioration measures which have been incorporated into the design of the proposed development at Mundamia, using an iterative process, are intended to minimise the potential for adverse impacts to be imposed on the natural environment, and to identify an appropriate balance between development opportunities and biodiversity constraints.

The approach which has been adopted with respect to the proposed residential development of the subject land at Mundamia has been one of identifying the most important biodiversity aspects of the subject land (amongst other relevant elements) and determining an appropriate development footprint based on those constraints. That approach constitutes impact amelioration as an integral element of the proposal.

### 8.2.2 Environmental Management Measures

Relevant issues and matters which have been taken into account in determining the appropriate and relevant environmental management measures for the proposed residential development at Mundamia have included:

- a desire to manage and control human access into the *Public Reserve* and into retained habitats for threatened biota;
- an opportunity for the maintenance of stormwater treatment features (outlet structures, bioretention swales *etc*) *inter alia* as habitat for native biota;
- a desire to appropriately and effectively manage interactions and interfaces between the development and the *Public Reserve*;
- a need to establish mechanisms which facilitate ongoing management of the adjoining natural environment, and
- the desirability of engaging the local community in ongoing management of the natural environment.

In addition to impact amelioration as discussed above (*ie* minimising the potential for adverse impacts to be imposed), specific environmental management measures should be incorporated into all future development activities on the subject land at Mundamia.

Specific impact amelioration and environmental management measures to be implemented as part of the proposed development at Mundamia (in addition to the retention and management of the *Public Reserve*) include:

- the use of sediment fences and other appropriate control measures during construction activities to manage and/or avoid erosion and sediment discharge or the discharge of other

contaminants;

- the ongoing management of stormwater discharge volumes and water quality from the development area, both during construction activities and following completion and occupation of the site (see Martens 2014);
- the ongoing management of the peripheral bioretention swale system to maintain water quality, soil moisture and groundwater regimes, and to provide supplementary habitat for native biota;
- the implementation of a management regime during the construction process to ensure that no wastes (including building rubble, garbage, contaminants, fuels, oils, paints or other chemicals) are discharged from the construction area, and that all such wastes and contaminants are contained and are appropriately managed;
- the implementation of a *Vegetation Management Plan* (VMP) for the proposed *Public Reserve*, in accordance with the attached *Vegetation Management Principles Plan* (Appendix I) to ensure the long-term viability of flora and fauna populations which utilise the land, particularly the Glossy Black Cockatoo, Yellow-bellied Glider and Nowra Heath-myrtle.
- the collection of native vegetation removed from development areas and its re-use within the *Public Reserve* for bushland rehabilitation and/or landscaping purposes and/or the provision of that material to Council for bushland management and rehabilitation purposes;
- the destruction or appropriate removal of weeds from the development footprint and from the *Public Reserve*, with specific weed management measures to be included in the VMP; and
- the implementation of a *Hollow-bearing Tree Protocol*, involving:
    - the segmental 'dismantling' by professional tree experts of hollow-bearing trees in order to salvage tree-hollows, wherever possible;
    - the placement of salvaged tree-hollows on existing large trees or dedicated poles in the *Public Reserve*;
    - alternatively, the placement of salvaged tree-hollows on the ground as hollow log habitat, where placement in existing trees is not practical; and
    - the use of artificial nest boxes to replace tree-hollows which cannot be salvaged and to supplement that resource on the site.

### 8.2.3 Threatened Species Management

**Threatened Flora**

The proposal is unlikely to have any adverse implications for the *National Recovery Plan for the Nowra Heath-myrtle Triplarina nowraensis* (OEH 2011).

Detailed mapping of the population of Nowra Heath-myrtle on the subject land have been conducted as part of this recent study. This mapping confirms that the species is present in large numbers along the northern and eastern parts of the subject land which are largely set-aside for conservation.

The relevant key threatening processes associated with this species include the threat of clearing for development, as well as impacts of water run-off and weeds associated with development in the upper catchment. These processes have been carefully considered and minimised, as outlined in the Recovery Plan. Actions include reducing the development footprint, preparation for the long-term management of the vegetation in the *Public Reserve* (including weed control and regeneration of native vegetation) and the careful design of stormwater features.

Whilst the proposed development will require the removal of individuals of and habitat for the Nowra Heath-myrtle, the proposed *Public Reserve* encompasses the overwhelming majority of the population. Further, the riparian corridor to Flat Rock Creek (to the east) is likely to contain many (as yet unmapped) additional specimens, which would form part of the population on the subject land (particularly to the southeast).

Specific management measures for threatened flora include:

- monitoring of the Nowra Heath-myrtle population within the Public Reserve, with adaptive management measures implemented where required, and periodic reporting on the status of the on-site population;
- pre-clearing surveys for *Pterostylis vernalis*, conducted during the known flowering period; and
- other general measures to be outlined in the VMP, as noted above.

**Threatened Fauna**

The proposal is unlikely to have any adverse implications for the *Recovery Plans* of the Yellow-bellied Glider, Grey-headed Flying Fox or Powerful Owl (each recorded on the subject land).

The key threatening processes associated with each species (predominantly vegetation and habitat tree clearing) will be minimal in the areas in which each of the species was recorded.

Whilst the development footprint is expected to require the removal of native vegetation and possibly some hollow-bearing trees, the proposed *Public Reserve* encompasses the overwhelming majority of habitat suitable for the threatened mammals and birds recorded on the subject land. Further, the proposed *Public Reserve* contains the majority of the hollow-bearing trees and 'dead wood' features observed during habitat surveys.

In addition, the proposal includes implementation of the *Hollow-bearing Tree Protocol* – which is designed to ensure there is no nett loss of tree-hollows.

Relevantly, the area of vegetation to be removed from the subject site represents only a minute proportion of suitable habitat for the threatened biota known or likely to occur on the subject site at Mundamia. There are very substantial areas of suitable habitat and resources in the immediate vicinity and general locality, including in extensive reserves in the locality and region. None of the threatened biota recorded on the site are likely to be reliant or dependent on the habitat and resources present in the areas to be affected by the proposal.

Further consideration of the relevant *Recovery Plans* for each species is provided below.

***Yellow-bellied Glider***

The *Recovery Plan* for the Yellow-bellied Glider (NPWS 2003) highlights native vegetation clearing, habitat fragmentation and loss of mature eucalypt forest as the major key threatening processes of this species. As discussed above, the development footprint is situated predominantly on the upper areas of the subject land, which is largely cleared and where eucalypts are generally small and lacking large hollows.

Recent and previous records of this species on the subject land (Figure 7) indicate that individuals prefer the areas of old growth eucalypts found on the eastern and northern areas of the subject land – predominantly below the escarpments and within the proposed *Public Reserve*. Much of the upper areas of the subject land is cleared and disturbed, and already acts as a barrier for the movement of this species. Consequently, construction of the proposed development will not exacerbate this east-west barrier. For these reasons, the proposal does not contravene the aims and objectives of the *Recovery Plan* for this species.

***Forest Owls***

Similarly, the *Recovery Plan for the Large Forest Owls* (DECC 2006) states that loss of native vegetation, hollow-bearing trees and removal of dead wood and dead trees are the major key threatening processes affecting such species.

Again, the majority of these features on the subject land are located within the *Public Reserves*, and will not be removed by the proposed development. Furthermore, there are no hollows suitable for nesting by the Powerful Owl on the site, and there are substantial areas of suitable foraging habitat for this species in the immediate vicinity and general area – including in substantial conservation reserves in the locality.

***Grey –headed Flying Fox***

The *Draft National Recovery Plan for the Grey-headed Flying-fox* (DECC 2009) states that key threatening processes of this species are the loss of foraging habitat, loss of roosting habitat and shooting by commercial fruit growers.

The proposal will involve clearing of some eucalypts and other flowering native plants on the subject land, which theoretically may reduce food production and foraging habitat for individuals of this species. However, the high mobility of this species and its large home range mean that it is unlikely that even individuals would be reliant upon the subject land for survival. Nonetheless, removal of vegetation in the development footprint will be offset by the presence of winter and spring foraging habitat (*ie* flowering eucalypts) for the Grey-headed Flying Fox within the proposed *Public Reserve*, and the extensive areas of suitable foraging habitat for this species in the immediate vicinity and general area – including in substantial conservation reserves in the locality.

Specific management measures for threatened fauna are included in Section 8.2.2 above and include:

- implementation of a VMP for the proposed *Public Reserve* to ensure the long-term viability of fauna populations, particularly the Glossy Black Cockatoo, Yellow-bellied Glider, Powerful Owl and microchiropteran bats; and

- the implementation of a *Hollow-bearing Tree Protocol*.

## 8.3 Biodiversity Offsets/Outcomes

### 8.3.1 No Requirement for Further Biodiversity Offsets

The *Nowra-Bomaderry Structure Plan* had anticipated the development *inter alia* of the subject land for residential purposes (essentially as is currently proposed), with an array of other lands identified within the *Structure Plan* for retention as biodiversity offsets for such development. That is, the requirement for biodiversity offsets for the future development of the subject land at Mundamia (amongst other portions of land) has already been offset within the *Nowra-Bomaderry Structure Plan*. It is the position of the proponent that no further additional provision of land for biodiversity offsets is necessary.

In considering the assessment of potential impacts on threatened biota, the conclusions of this *Report* reflect, in essence, the conclusions reached by Shoalhaven City Council (SCC) and the then Department of Planning (DoP) with respect to the appropriate development of Mundamia for residential purposes. The *Nowra-Bomaderry Structure Plan* (which was adopted by the Council and endorsed by the DoP) recognises the appropriateness of residential development at this location (including on the subject land).

In addition, both the *Shoalhaven Local Environmental Plan 1985* (SLEP 1985) and the recent SLEP 2014 have identified those parts of the site considered appropriate for development purposes, and have zoned the land accordingly. The ecological information presented in the SLR Consulting 2012 *Report* was available through the creation of SLEP 2104, and presumably reflects the considerations contained in the *Nowra-Bomaderry Structure Plan*.

### 8.3.2 Biodiversity Outcomes at Mundamia

The retention, rehabilitation (where required) and dedication of the two *Public Reserves* on the subject site at Mundamia will achieve an array of environmental benefits:

- the retention of areas of native vegetation within the 9.42 ha *Public Reserve*. The *Public Reserves* will contain most of the vegetation in moderate to good condition, as well as some regrowth and degraded vegetation that will benefit from rehabilitation measures (to be documented in the VMP for the *Public Reserves*);
- the retention of general fauna habitat. The native vegetation within the proposed *Public Reserves* comprises a mix of dry sclerophyll vegetation, flowering native trees, shrubs and groundcovers, ground litter and organic matter, hollow logs and canopy trees (including hollow-bearing trees) that would provide habitat for an array of native fauna groups;
- conservation within the site itself of most of the vegetation types that are to be affected by the proposal – noting that all of these vegetation types are widespread in the immediate vicinity and general locality, and are generally well-conserved in the Shoalhaven Region;
- retention of 3.1ha (or 74.52%) of the patch size of Nowra Heath-myrtle mapped across the subject site, as well as 152 (or 76.77%) of the 198 individuals mapped (separately) across the subject land. It is noted that this species occurs on other lands in the vicinity and through the Mundamia/West Nowra area – including in conservation reserves and on lands not likely ever to be developed (there are extensive areas of land zoned E2 and E3 to the

north, east and south of the subject site);

- the relocation of some specimens of the Nowra Heath-myrtle from within the development footprint to appropriate habitat to be rehabilitated in the *Public Reserve* (consistent with actions discussed in the *National Recovery Plan for the Nowra Heath-myrtle*, and the donation of recovered plants to Council for relocation elsewhere; and
- retention of 37 of the 87 (43%) of the total number of HBTs mapped across the subject site. In this regard, the *Hollow-bearing Tree Protocol* will be implemented during development of the site, to be complemented by the installation of nest boxes if required, to ensure that there is no nett loss of tree-hollows as a consequence of the proposal).

Overall, the retention, rehabilitation (where necessary) and dedication of the two *Public Reserves* on the subject land at Mundamia will facilitate the protection and management of the most important biodiversity values and resources for native flora and fauna recorded on the subject land.

It is also relevant to note that the *Public Reserves* proposed in this application are larger than those identified in either SLEP 1985 or SLEP 2014. In this regard, the current proposal is to dedicate 9.42ha as *Public Reserves* with an additional 1 ha dedicated as part of the stormwater detention areas, whereas:

- SLEP 1985 only identified 5.36ha as Scenic Protection zoning; and
- SLEP 2014 proposes only 8.19ha as the E2 zoned land.

### 8.3.3 Consideration of Biodiversity Offset Principles

There are 13 *Principles* identified by OEH (2014) intended to guide the use of biodiversity offsets for proposals in NSW (other than those for state significant development or state significant infrastructure). An overview of how these principles are addressed in the current assessment is provided below.

As noted above, it is the position of the proponent that no further additional provision of land for biodiversity offsets is necessary - because the requirement for biodiversity offsets for the development of the subject land at Mundamia (amongst other portions of land) has already been offset within the *Nowra-Bomaderry Structure Plan*. Nevertheless, the proposal is assessed below with respect to the *Biodiversity Offset Principles* enunciated by the OEH.

**Principle 1 Impacts must be avoided first by using prevention and mitigation measures**

Impact avoidance measures are described in Section 8.1. The proposed development at Mundamia has, to the extent reasonably practicable, avoided impacts on the national environment by:

- concentrating development activities in areas where vegetation has been highly or moderately disturbed or modified;
- reducing the extent of development in the northern part of the site to reduce impacts upon the threatened Nowra Heath-myrtle and its habitat; and
- implementing stormwater management measures designed to avoid adverse impacts on adjoining natural native vegetation.

**Principle 2 All regulatory requirements must be met**

All regulatory and statutory requirements regarding development consent are being addressed in the Part 3A assessment process for the proposal.

The 'offsets' which have been identified are not being "*used to satisfy approvals or assessments under other legislation*".

**Principle 3 Offsets must never reward ongoing poor performance**

The proposed 'offsets' as part of the Mundamia development project have not, and will not, result in any deliberate degradation or mismanagement of offset areas "*in order to increase the value from the offset*".

**Principle 4 Offsets will complement other government programs**

The proposed *Public Reserves* adjoin private land which is zoned E2 and will therefore be protected, and also adjoins the Triplarina Nature Reserve. There are substantial areas of land around the subject site which are also zoned either E2 or E3, and the dedication of the *Public Reserves* on the subject land for biodiversity conservation purposes will act to complement the conservation of other lands in the immediate vicinity.

**Principle 5 Offsets must be underpinned by sound ecological principles**

The ecological values of vegetation on the subject land have been taken into account when determining the final residential subdivision design, and in the management of stormwater discharges.

In addition, the proposed 'offsets' in the *Public Reserves* on the subject land at Mundamia are "*suitable offsets*", as they contain relevant "*biodiversity management actions, such as enhancement of existing habitat and securing managing land of conservation value for biodiversity*". The proposal satisfies Principle No. 5.

**Principle 6 Offsets should aim to result in a net improvement in biodiversity over time**

The area of vegetation to be set aside for biodiversity conservation purposes on the subject land exceeds the area of more degraded vegetation which is to be removed. Furthermore, the biodiversity Public Reserves are in better condition generally than the areas of vegetation which requires removal for the project.

Other relevant matters to take into account when considering the improvements in biodiversity which will result from the proposed management of the *Public Reserves* on the subject land at Mundamia include:

- rehabilitation works which are to be undertaken within the *Public Reserves* to remove existing weeds and to rehabilitate any areas previously affected;
- the dedicated management of the *Public Reserves* for enhancement of the Nowra Heath-

myrtle and its habitat, and the relocation of specimens of the Nowra Heath-myrtle from development areas on the land;

- the removal of grazing and other agricultural activities which constitute a threat to remaining bushland on the subject land and in the Flat Rock Creek to the east;
- the re-use of tree-hollows from the development area to ensure there is no nett loss of tree-hollows;
- the removal of weeds (including noxious species) from degraded parts of the subject land; and
- the ultimate dedication of the *Public Reserve* and onsite stormwater detention basins to Council for biodiversity conservation purposes.

**Principle 7 Offsets must be enduring**

The dedication and management of the *Public Reserves* on the subject land for biodiversity conservation purposes will be "*enduring*" insofar as those lands will be rehabilitated and dedicated to Council.

**Principle 8 Offsets should be agreed prior to the impact occurring**

The proposed 'offsets' for the development at Mundamia, and the provision of a detailed *Vegetation Management Plan* (consistent with the in-principle VMP provided in this *Report*) will be conditions of the approval of the proposed Mundamia residential development by the Department of Planning & Environment (DP&E), pursuant to Part 3A of the EP&A Act.

The 'offsets' will be subject to scrutiny pursuant to the Part 3A assessment process, and will form part of the conditions of the approval and the commitments associated with the approval.

**Principle 9 Offsets must be quantifiable**

The proposed 'offsets' contained in this *Report* have been quantified in terms of area (9.42ha of land plus 1ha of onsite detention basins to be dedicated for biodiversity conservation purposes) and in terms of management measures to be applied to the *Public Reserves*.

**Principle 10 Offsets must be targeted**

As discussed elsewhere in this *Report*, the majority of the lands which are being dedicated for biodiversity conservation purposes are in better condition than those which are being removed. The proposed development area was determined, both through the previous Council/DoP process and through this investigation, by identifying degraded vegetation and land suitable for development purposes.

In this regard, the vegetation present within the development footprint is already in a moderately to significantly degraded condition, and is of less conservation value than the vegetation to be retained in the *Public Reserves*.

**Principle 11 Offsets must be located appropriately**

The *Public Reserves* on the subject land are located in the northern and eastern parts of the land, adjacent to the land (zoned 2E) containing Flat Rock Creek to the immediate east. This circumstance results in an increase in the overall area of conserved land and vegetation at this location, and the maintenance of a wildlife corridor along Flat Rock Creek and its gorge.

**Principle 12 Offsets must be supplementary**

The proposed *Public Reserve* 'offsets' on the subject land at Mundamia are not currently the subject of any funding, and have no security of either tenure or management activities. The proposed development of the subject land at Mundamia will provide funding for the rehabilitation and management of the *Public Reserves*, which would otherwise not be funded.

**Principle 13 Offsets and actions must be enforceable**

The 'offsets' activities and actions associated with *Public Reserves* on the subject site will be the subject of a *Vegetation Management Plan* (VMP) - the implementation of which will be a condition of approval. In addition, management of the *Public Reserves* is part of the *Statement of Commitments* for the project, and therefore enforceable under the EP&A Act.

Dedication of the rehabilitated *Public Reserves* to Council will ensure the long-term conservation of those lands.

**Conclusions**

As noted above, it is the position of the proponent that no biodiversity offsets are necessary - because this requirement has already been addressed within the *Nowra-Bomaderry Structure Plan*.

Nevertheless, the proposed retention, rehabilitation and management of the *Public Reserves* on the subject land, and their subsequent dedication to Council for permanent biodiversity conservation purposes, is considered an appropriate 'offset' for the proposed development of part of the subject land (essentially in accordance with the *Structure Plan* and SLEP 2014).

# 9 ENVIRONMENT PROTECTION & BIODIVERSITY CONSERVATION ACT

## 9.1 Introduction

The *Environment Protection & Biodiversity Conservation Act 1999* (EPBC Act), of the Commonwealth of Australia, seeks *inter alia*:

- "*to provide for the protection of the environment, especially those aspects of the environment that are Matters of National Environmental Significance*";
- "*to provide ecologically sustainable development*"; and
- "*to promote the conservation of biodiversity*".

Implementation of the EPBC Act requires *inter alia* consideration as to whether a development or activity is likely to impose a "*significant impact*" on "*Matters of National Environmental Significance*" (MNES), which include:

- listed threatened biota (ecological communities and species);
- alleged "*migratory species*" listed in international treaties (JAMBA, CAMBA, the Bonn Convention);
- actions relating to "*nuclear activities*";
- actions on Commonwealth lands or Commonwealth marine areas;
- actions in or affecting RAMSAR Wetlands; or
- activities in or which affect World Heritage sites.

## 9.2 Relevant EPBC Act Considerations

The proposed development of the subject land at Mundamia will have no relevant effect with respect to nuclear activities, Commonwealth lands, World Heritage properties, Ramsar wetlands or the Commonwealth marine environment.

A search of the EPBC Act website for *Matters of National Environmental Significance* (MNES) has identified an array of items listed on the EPBC Act within 10km of the subject land (Appendix E). However, the overwhelming majority of those MNES are of no relevance to the subject land, or the proposed development thereon, because either:

- many of the MNES are distant from the subject land and will not be affected in any way;
- there is no habitat of any relevance present for most of the listed threatened species or 'migratory' species listed;
- the proposal will have no impact upon the species or their habitats (*eg* in the case of "*listed marine species*"); and/or
- there is no evidence for, and little likelihood that, even individuals of most of those species would occur on the subject land.

The Grey-headed Flying Fox, which was recorded flying over the subject land (BES 2004), is listed as "*Vulnerable*" on the EP&A Act, and four other species listed as "*Migratory*" on the EPBC Act have also been recorded on the land (Appendix E). Although it is possible that development of the subject land

could affect some individuals of some species which are listed as "*migratory*" on the EPBC Act, it should be noted that:

- many of those species are not in fact "*migratory*" at all, but are listed on international agreements regarding "*migratory*" species (*eg* the Cattle Egret and the White-bellied Sea Eagle); and
- the area of land to be affected by the proposed development constitutes either a minute fraction of that available in the locality for those species or, in some instances, does not represent preferred habitat at all.

All of the fauna species which either are or could potentially be of relevance with respect to the EPBC Act are highly mobile and wide-ranging. Many are migratory or nomadic, and none (other than individuals of extremely common and cosmopolitan species such as the Masked Lapwing) would reside in or be dependent on those portions of the subject land proposed for development.

Further, that part of the subject land proposed for development activities does not constitute a significant element of the potential resources for any individuals of the species listed on the EPBC Act within their normal home ranges. It is not likely that even an individual of any such species would be reliant on those parts of the subject site proposed for development activities for their survival, even on a local basis (again with the exception of abundant and cosmopolitan species of no conservation concerns, such as the Masked Lapwing).

The subject land supports a substantial population of the endangered Nowra Heath-myrtle *Triplarina nowraensis*. This species occurs predominantly in the northern part of the subject land but also as scattered small patches of individuals in the northeastern part of the land. The proposed development has been re-designed to reduce the extent of residential development in the northern parts of the land so as to ensure the retention and protection of the overwhelming majority of the species. The re-design has reduced the loss of specimens and/or habitat for the Nowra Heath-myrtle so that 3.1ha (or 74.52%) of the total patch area on the subject land, as well as 152 (or 76.77%) of the additional 198 mapped individuals, are now to be retained.

Given the re-design of the proposed development to retain the overwhelming majority of the Nowra Heath-myrtle, and appropriate management of the *Public Reserve* to enhance habitat for and populations of the species, the proposed development will not involve the imposition of a "*significant impact*" on the Nowra Heath-myrtle.

A "*critically endangered*" plant species has also been recorded in the immediate vicinity. *Pterostylis vernalis* has been recorded at a number of sites around the subject land, but has not been recorded on the subject land itself. Dedicated searches by officers from Shoalhaven City Council (SCC) as well as the previous authors of this *Report* in potentially suitable habitat did not identify any specimens of *Pterostylis vernalis* on the subject land. It is noted this species was recorded flowering in suitable habitat to the southeast and west of the subject land at the same time. Given those circumstances, there will be no "*significant impact*" imposed upon *Pterostylis vernalis* as a result of the proposed development of the subject land at Mundamia.

There is no likelihood of a "*significant impact*" being imposed on any biota listed in the EPBC Act as a result of the proposed development of the site at Mundamia.

### 9.3 SEWPaC Decision

It is the conclusion of the EPBC Act assessment contained in this *Report* that the proposed subdivisions and development of the site at Mundamia is not "*likely*" to impose a "*significant impact*" upon any MNES.

The proposal, nevertheless, had been referred to the Commonwealth Department of Sustainability, Environment, Water, Population & Communities (SEWPaC). The Department has determined that the proposed development is not a "*Controlled Action*" pursuant to the EPBC Act (Appendix H), and that consequently no approval from the Federal Minister for the Environment is required.

## 10 CONCLUSIONS

The *Nowra-Bomaderry Structure Plan* was adopted by Shoalhaven City Council (SCC) on 24 October 2006 and endorsed by the then Department of Planning (DoP) on 26 February 2008. The *Structure Plan* anticipated the development of the subject land (essentially as currently proposed), with an array of other lands identified for retention as biodiversity offsets. As a consequence of the *Structure Plan*, the development of *inter alia* the subject land at Mundamia has already been offset and no further additional provision of land for biodiversity offsets is considered necessary.

With respect to relevant threatened biota, the proposed development will remove only a small proportion of the population of the Nowra Heath-myrtle and a very small proportion of the habitat for threatened species from the subject site. Relevantly, the area of vegetation to be removed from the subject site represents only a minute proportion of suitable habitat for the threatened biota known or likely to occur on the subject site at Mundamia.

There are very substantial areas of suitable habitat and resources in the immediate vicinity and general locality, including in extensive reserves in the locality and region. None of the threatened biota recorded on the site are likely to be reliant or dependent on the habitat and resources present in the areas to be affected by the proposal. Given those considerations, the proposed development is not likely to impose a substantial adverse effect on any of the relevant threatened biota identified at Mundamia.

The proposed retention, rehabilitation and management of the *Public Reserves* on the subject land, and their subsequent dedication to Council for permanent biodiversity conservation purposes, is considered an appropriate 'offset' for the proposed development of part of the subject land (essentially in accordance with the *Structure Plan* and SLEP 2014).

The proposed residential development of the subject land at Mundamia, addressed in this *Report*, achieves the goals established in the *Nowra-Bomaderry Structure Plan*. Most of the development area is located in previously highly disturbed agricultural land, and the most significant elements of the natural landscape (including threatened biota and their habitats) are to be retained and protected. In addition, the stormwater management regime has been designed *inter alia* to ensure the maintenance of soil moisture conditions and the maintenance of water quality in Flat Rock Creek and the Shoalhaven River.

The proposed residential development at Mundamia achieves an appropriate balance between development opportunities and conservation aspirations and goals - which satisfy both expectations for

biodiversity conservation in the landscape generally and the requirements (economic, social and recreational) of the local and wider community.

**GLOSSARY**

| | |
|---|---|
| Activity | Relevantly means:<br>(a) the erection of a building;<br>(b) the carrying out of a work in, on, over or under land;<br>(c) the use of land or of a building or work. |
| AHD | Australian Height Datum |
| Bioregion | "*a bioregion defined in a national system of bioregionalisation that is determined (by the Director-General by order published in the Gazette) to be appropriate for those purposes*" (TSC Act) |
| DA | *Development Application* prepared pursuant to the EP&A Act |
| Development | Relevantly means:<br>(a) the erection of a building on that land;<br>(b) the carrying out of a work in, on, over or under that land; and<br>(c) the use of that land or of a building or work on that land. |
| DEC | the Department of Environment & Conservation (part of the DECCW) |
| DECC | the Department of Environment & Climate Change (part of the DECCW) |
| DECCW | the Department of Environment, Climate Change & Water (now part of the OEH) |
| DoP | New South Wales Department of Planning |
| DPI | New South Wales Department of Primary Industries |
| DP&I | New South Wales Department of Planning & Infrastructure |
| Endangered Ecological Community | "*an ecological community specified in Part 3 of Schedule 1*" of the TSC Act |
| Endangered Population | "*a population specified in Part 2 of Schedule 1*" of the TSC Act |
| EP&A Act | *Environmental Planning & Assessment Act 1979* |
| Key Threatening Process | "*a threatening process specified in Schedule 3*" of the TSC Act |
| Locality | an area of 10km radius around the "*subject site*" |
| NPWS | NSW National Parks & Wildlife Service |
| OEH | Office of the Environment & Heritage, which is part of the Department of Premier & Cabinet, and which incorporates most of the DECCW |
| Recovery Plan | "*a plan prepared and approved under Part 4*" of the TSC Act |
| SIS | *Species Impact Statement* prepared pursuant to Sections 109, 110 and 111 of the TSC Act |
| Study Area | the "*subject site*" and adjoining land which will or may be affected, directly or indirectly, by the proposal |
| Subject Land | Lot 3 in DP 568613 and Lot 384 in DP 755952 George Evans Road Mundamia |
| Subject Site | The area proposed for development activities within the "*Subject Land*" |
| Threatened Ecological Community | "*an ecological community specified in Part 3 of Schedule 1, Part 2 of Schedule 1A or Part 2 of Schedule 2*" of the TSC Act |
| Threatening Process | "*a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, populations or ecological communities*" (TSC Act) |
| Threatened Species | "*a species specified in Part 1 or 4 of Schedule 1 or in Schedule 2*" of the TSC Act |
| TSC Act | *Threatened Species Conservation Act 1995* |

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# Figure 1 Location of the subject land at Mundamia


**LEGEND**

Subject Land


0 150 300 600 900 1,200
Metres

N

**NOTES**

1. Aerial photography courtesy of Nearmap 27/11/2011
2. Map locator courtesy of ESRI basemap, Streets
3. All features are approximate only and subject to detailed survey


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Project No: **610.14258**

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| Drafted | Approved |
|---|---|
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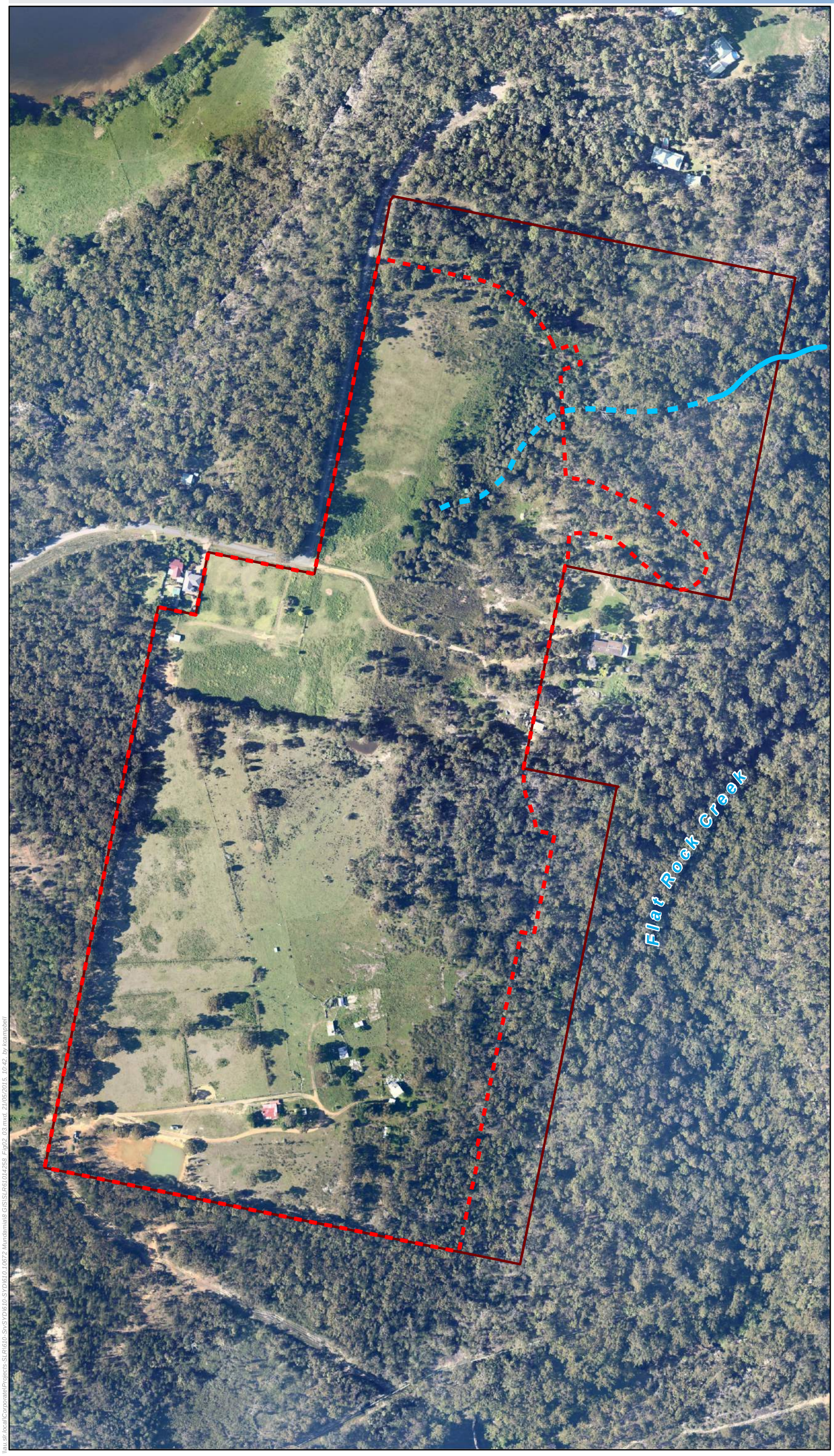
# Figure 2 Details of the subject land at Mundamia, and its immediate context




**LEGEND**

- Drainage Swale
- Incised Watercourse
- Development Footprint
- Subject Land

0 25 50 100
Metres

N

**NOTES**

1. Aerial Photography courtesy of Nearmaps
2. All features are approximate only and subject to detailed survey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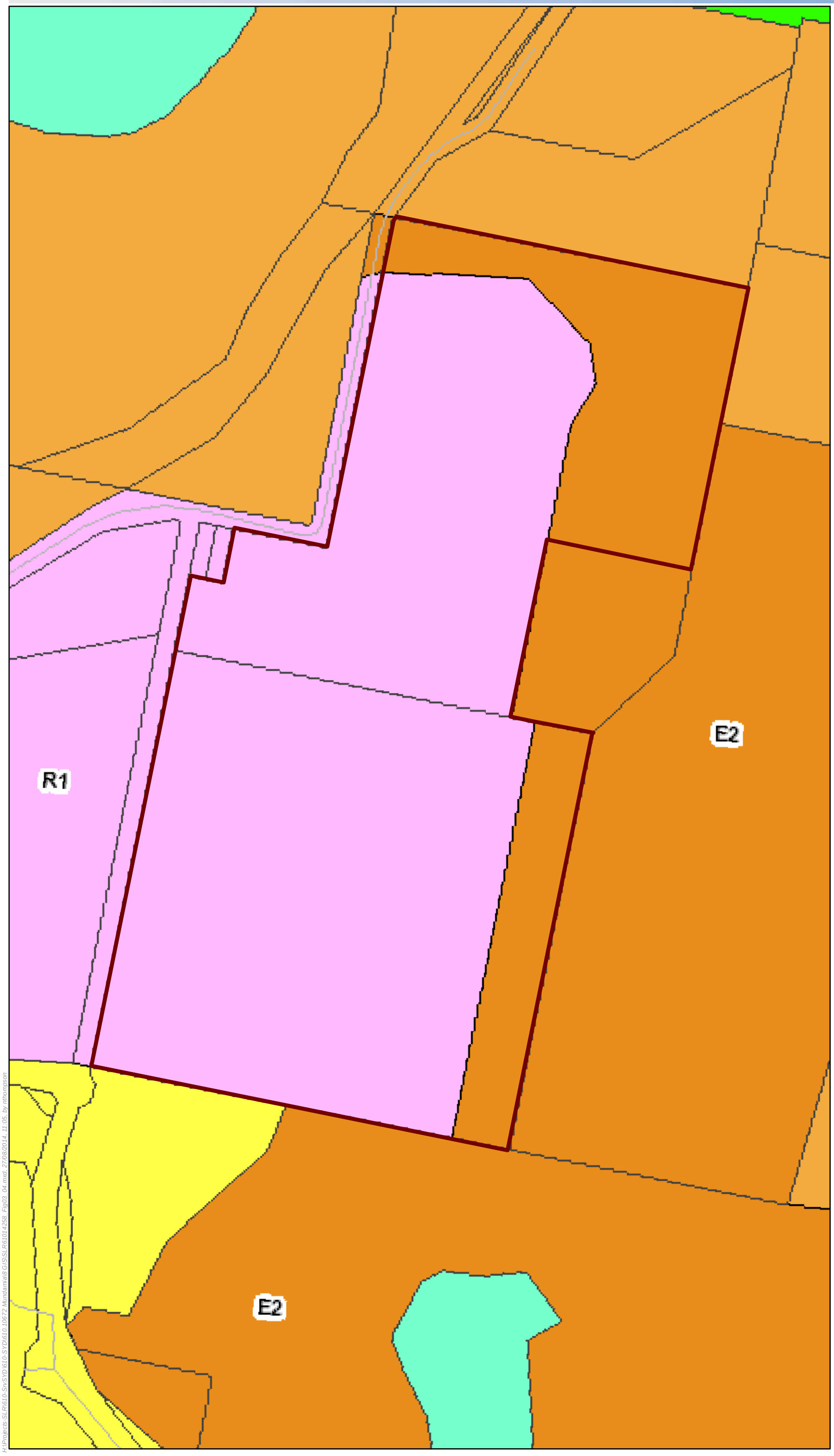
## Figure 3 Existing zoning on the subject land at Mundamia (SLEP 2014)




**LEGEND**

Subject Land

**Zoning (SLEP 2014)**

E2 - Environmental Conservation

R1 - General Residential

0 50 100
Metres

N

**NOTES**

1. All features are approximate only and subject to detailed survey
2. SLEP 2014 Zoning courtesy of Shoalhaven City Council Interactive SLEP 2014 Web Maps.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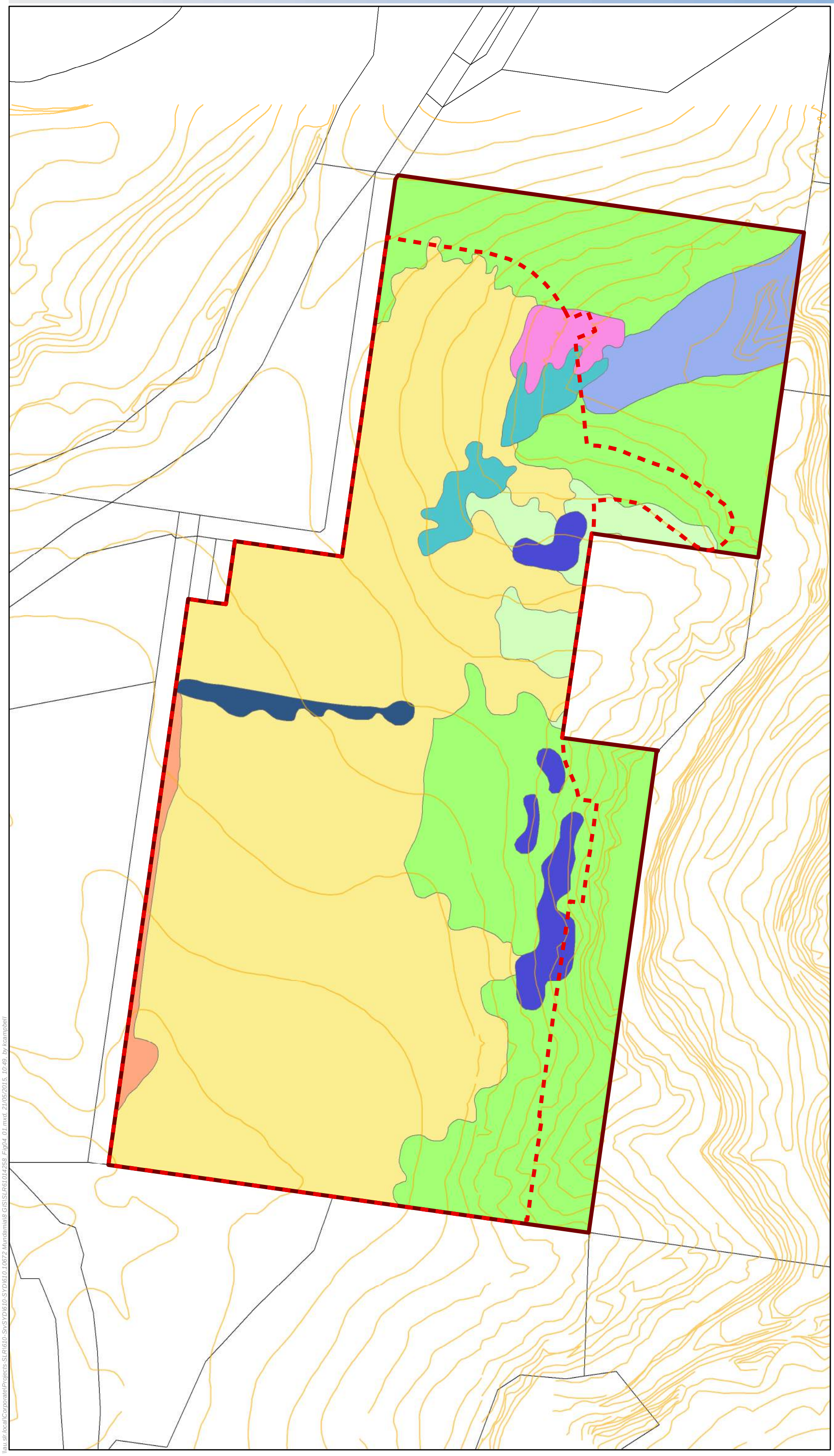
# Figure 4 Vegetation and topography on the subject land at Mundamia



**LEGEND**

- Development Footprint
- Subject Land
- Contours
- Grey Gum - Blue-leaved Stringybark Open Forest
- Highly disturbed Grey Gum - Stringybark Woodland
- Kunzea Heathland
- Paperbark Closed Forest
- Pasture
- Regrowth Woodland with Kunzea Heath
- Mixed woodland strip
- Scribbly Gum - Bloodwood Forest
- Spotted Gum Blackbutt Forest

0 20 40 80 120
Metres

N

**NOTES**

1. All features are approximate only and subject to detailed survey
2. Proposed zoning courtesy of MALBEC Properties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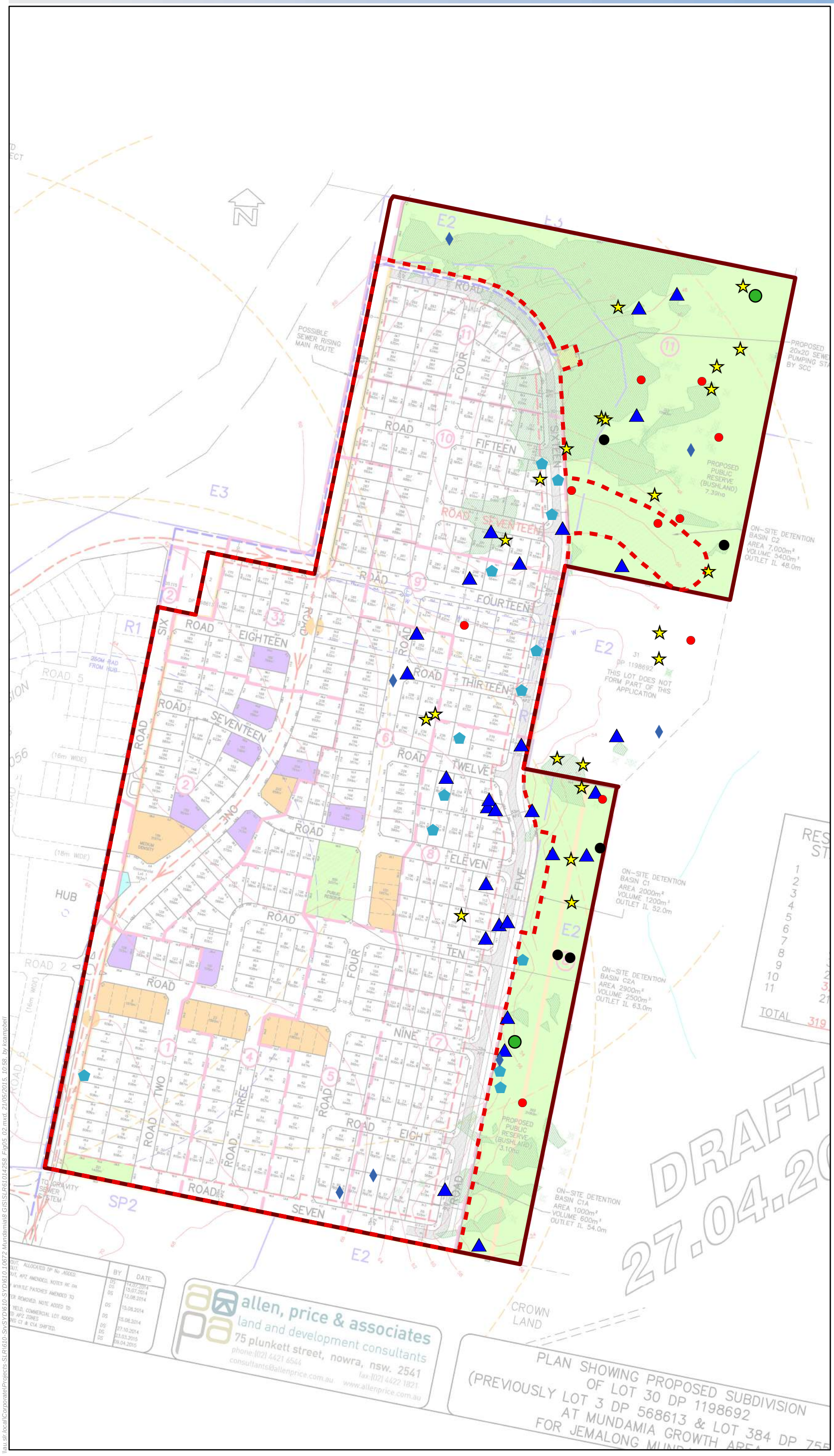
# Figure 5 Hollow-bearing trees within the subject land




## LEGEND

- Subject Land
- Development Footprint

**Hollow-bearing trees**

- Blackbutt
- Red Bloodwood
- Grey Gum
- Scribbly Gum
- Spotted Gum
- Stag
- Blue-leaved Stringybark

0 25 50 100
Metres

N

## NOTES

1. All features are approximate only and subject to detailed survey
2. Proposed zoning courtesy of MALBEC Properties
3. Hollow-bearing tree data by SLR 2013-2014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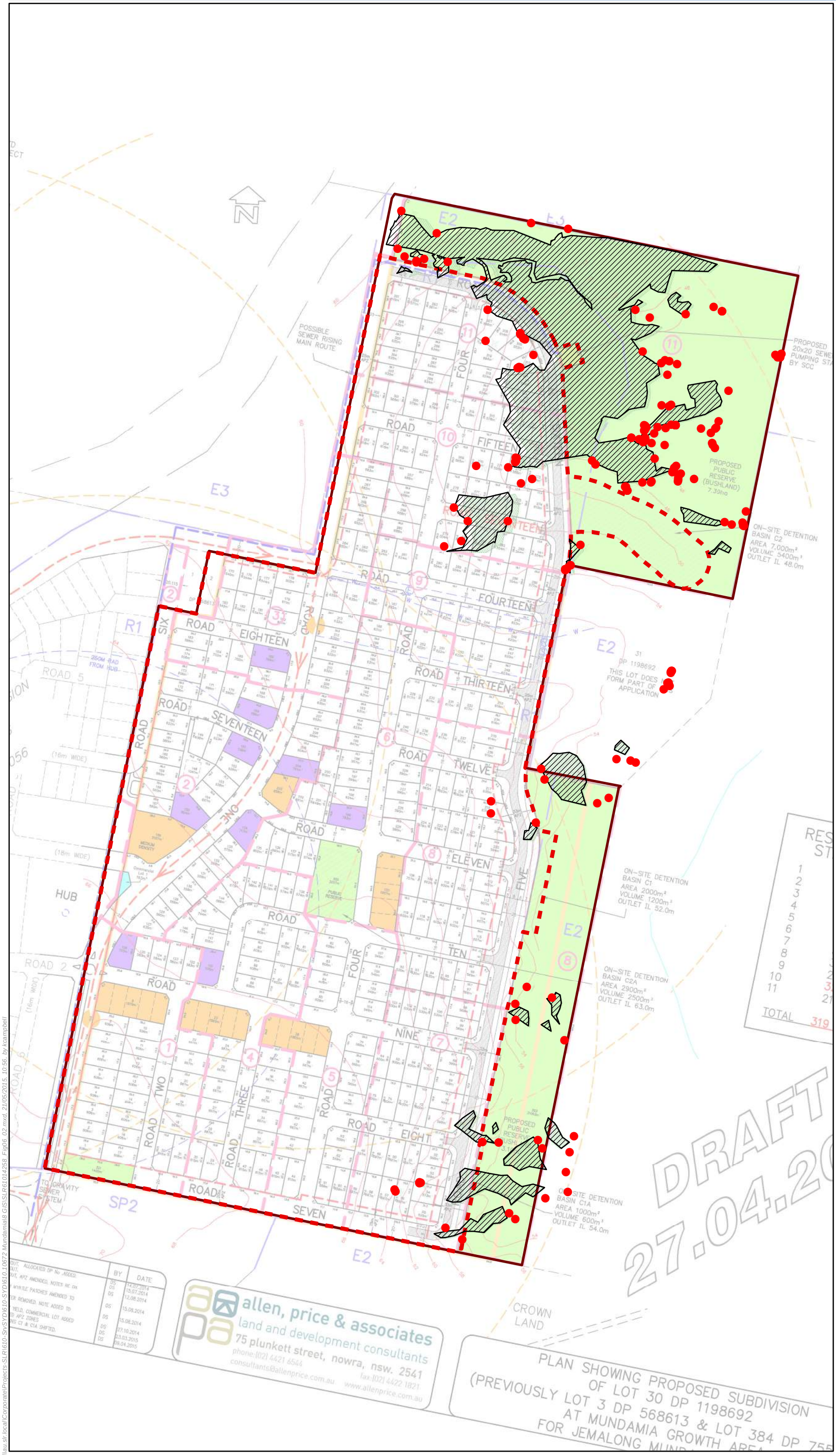
# Figure 6 Distribution of the Nowra Heath-myrtle on the subject land




**LEGEND**

- Subject Land
- Development Footprint
- Nowra Heath-myrtle patches
- Nowra Heath-myrtle Individual Specimens

0 25 50 100
Metres

**NOTES**

1. All features are approximate only and subject to detailed survey
2. Proposed zoning courtesy of MALBEC Properties
3. Nowra Heath-myrtle data modified from past (BES and InSites) and current (SLR) survey data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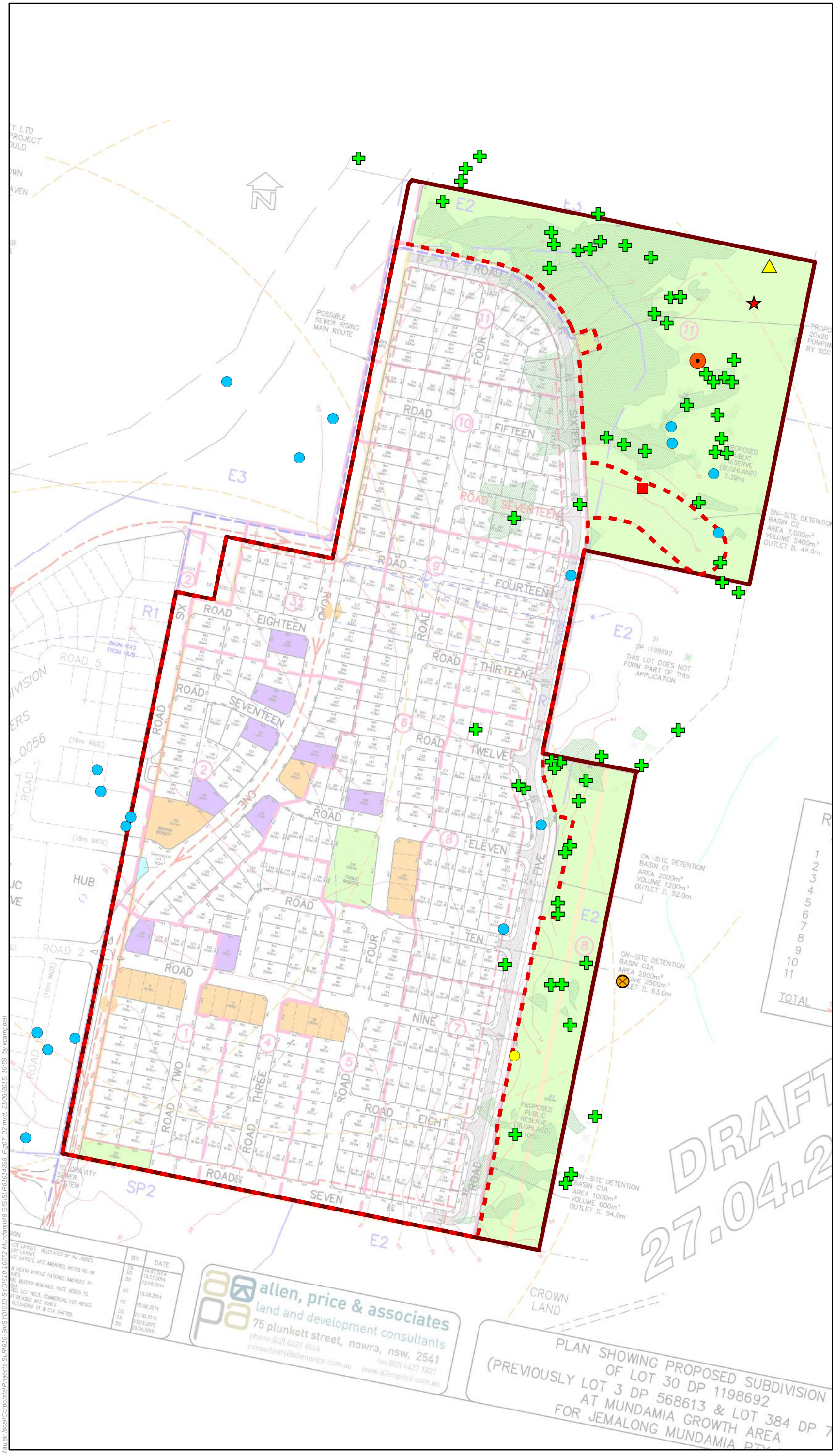
| Kelly Campbell | Fiona Iolini |

# Figure 7 Threatened Fauna Species recorded on and near the subject land at Mundamia




## LEGEND

- Subject Land
- Development Footprint

**Threatened Species**

- Glossy Black-Cockatoo food tree
- Powerful Owl heard
- Powerful Owl heard (SLR)
- Square-tailed Kite (observed)
- Yellow-bellied Glider heard (BES)
- Yellow-bellied Glider heard (InSites)
- Yellow-bellied Glider incised tree (BES)
- Yellow-bellied Glider observed (SLR)

0 25 50 100
Metres

N

## NOTES

1. All features are approximate only and subject to detailed survey
2. Proposed zoning courtesy of MALBEC Properties
3. BES Threatened species information digitised from Flora and Fauna Assessment (BES 2004 Ref: 04069)
4. InSites survey conducted 23-26 September 2008
5. SLR Ecology survey conduced April and August 2014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Project Name: Mundamia Residential Subdivision DA

Prepared for: **Jemalong Mundamia Pty Ltd**

Project No: **610.14258**

| Scale | Date |
|---|---|
| 1:3,500 @ A3 | 21/05/2015 |

| Drafted | Approved |
|---|---|
| Kelly Campbell | Fiona Iolini |

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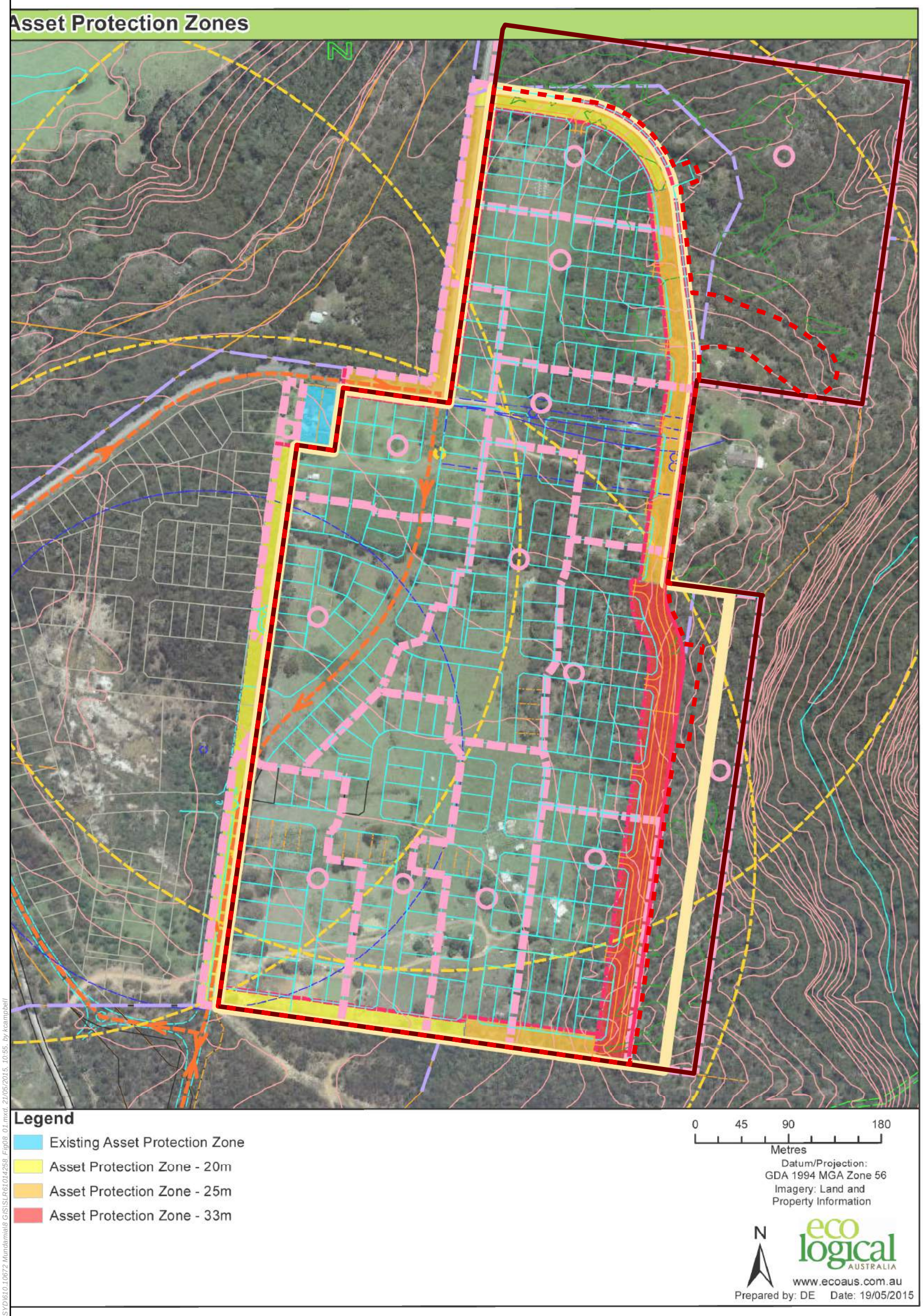
# Figure 8 Bushfire Protection Measures around the subject land




**LEGEND**

- Development Footprint
- Subject Land

N

**NOTES**

1. Plan courtesy of Eco Logical Australia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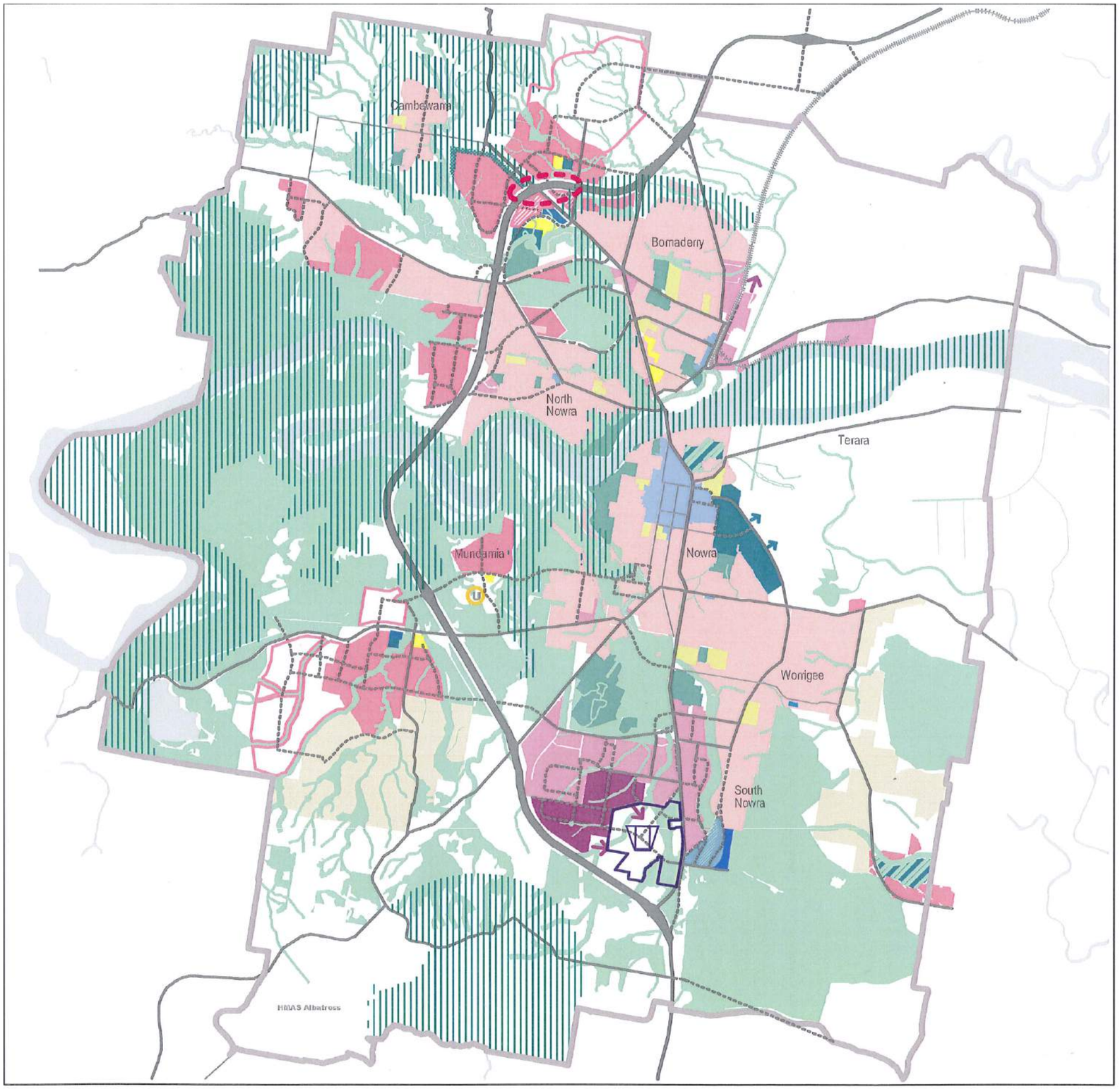
# Figure 9 — Nowra - Bomaderry Structure Plan

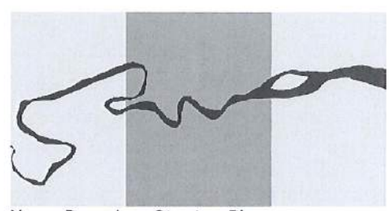



## Legend

- Structure Plan Boundary
- Existing Living Area
- Future Living Area
- Possible Future Living Area
- Future Long Term Living Area
- Existing Rural Residential
- Existing CBD Area
- Existing Neighbourhood Centre
- Future Neighbourhood Centre
- Existing Local Centre
- Future Local Centre
- Existing Other Commercial
- Future Other Commercial
- Existing Industrial Land
- Future Industrial Land
- Existing School/TAFE
- Future School
- Exisiting University & TAFE Campus
- Existing Active Recreation
- Future Active Recreation
- Conservation & Riparian Area
- Future Active/Passive Open Space or Conservatio
- Future Advanced Screening
- Scenic Protection Areas
- Rural Area
- Future Western Bypass
- Bypass alignment in this location subject to further investigation as part of LEP
- Main Roads
- Local Road Network
- North Nowra Link Road Options
- South Coast Correctional Centre Site

Adopted by Council on 24th October 2006 and 25th September 2007.
Endorsed by the Department of Planning 28th February 2008.

## Structure Plan



Nowra Bomaderry Structure Plan

February 2008

Not To Scale

**LEGEND**

N

**NOTES**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global environmental solutions

Lot 30 in DP 1198692
George Evans Road, Mundamia

Proposed Residential Estate

# Flora & Fauna Assessment Report

Appendix A
Proposed Subdivision Layout

01 June 2015

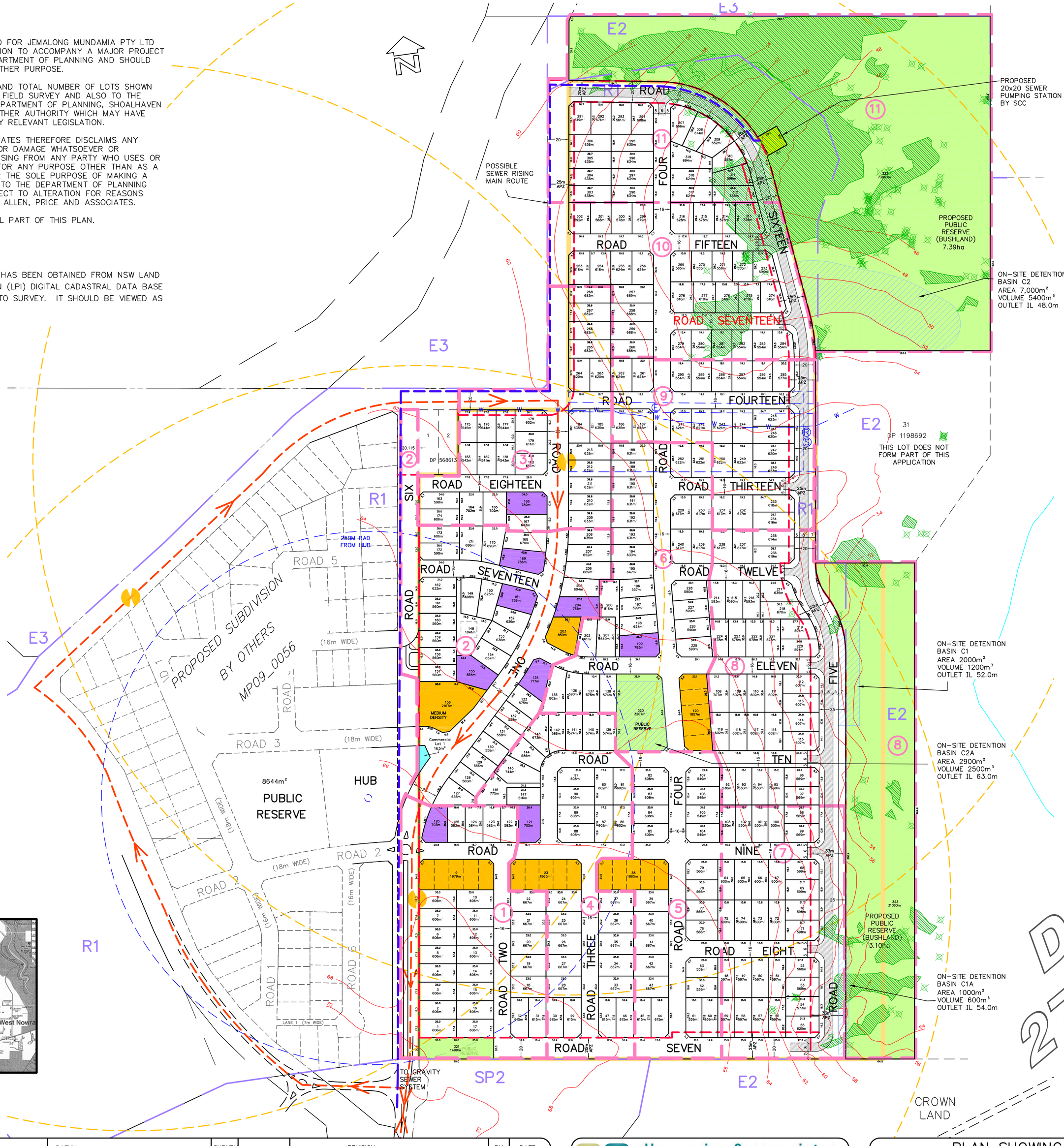
THIS PLAN WAS PREPARED FOR JEMALONG MUNDAMIA PTY LTD AS A PROPOSED SUBDIVISION TO ACCOMPANY A MAJOR PROJECT APPLICATION TO THE DEPARTMENT OF PLANNING AND SHOULD NOT BE USED FOR ANY OTHER PURPOSE.

THE DIMENSIONS, AREAS AND TOTAL NUMBER OF LOTS SHOWN HEREON ARE SUBJECT TO FIELD SURVEY AND ALSO TO THE REQUIREMENTS OF THE DEPARTMENT OF PLANNING, SHOALHAVEN CITY COUNCIL AND ANY OTHER AUTHORITY WHICH MAY HAVE REQUIREMENTS UNDER ANY RELEVANT LEGISLATION.

ALLEN, PRICE AND ASSOCIATES THEREFORE DISCLAIMS ANY LIABILITY FOR ANY LOSS OR DAMAGE WHATSOEVER OR HOWSOEVER INCURRED ARISING FROM ANY PARTY WHO USES OR RELIES UPON THIS PLAN FOR ANY PURPOSE OTHER THAN AS A DOCUMENT PREPARED FOR THE SOLE PURPOSE OF MAKING A SUBDIVISION APPLICATION TO THE DEPARTMENT OF PLANNING AND WHICH MAY BE SUBJECT TO ALTERATION FOR REASONS BEYOND THE CONTROL OF ALLEN, PRICE AND ASSOCIATES.

THIS NOTE IS AN INTEGRAL PART OF THIS PLAN.

NOTE:
CADASTRAL INFORMATION HAS BEEN OBTAINED FROM NSW LAND & PROPERTY INFORMATION (LPI) DIGITAL CADASTRAL DATA BASE (DCDB) AND IS SUBJECT TO SURVEY. IT SHOULD BE VIEWED AS APPROXIMATE ONLY.




- COMMERCIAL
- DUAL OCCUPANCY
- MULTI DWELLING HOUSING
- APZ LINE
- PROPOSED BUS ROUTE SHOWING DIRECTION OF TRAVEL
- PROPOSED BUS STOP
- 500m WALKING DISTANCE FROM PROPOSED BUS STOP
- R1 — ZONING LINE
- DENOTES LOCATION OF NOWRA HEATH MYRTLE BY SLR– FIG. 8
- DENOTES LOCATION OF NOWRA HEATH MYRTLE PATCHES BY SLR FIG. 8
- PROPOSED SEWER RISING MAIN ROUTE BY SCC
- (11) STAGING
- DEVELOPABLE AREA
- DENOTES EASEMENTS OF DP 1198692 TO BE PROGRESSIVELY EXPUNGED AS WORKS PROGRESS

EASEMENTS CREATED IN DP 1198692

- (W) DENOTES EASEMENT FOR WATER OVER EXISTING LINE OF PIPE (APPROX. POSITION) (DP 1198692)
- (R) RIGHT OF WAY 75 WIDE (DP 1198692)
- (S) EASEMENT FOR SUPPLY OF SERVICES 75 WIDE (DP 1198692)
- (E) EASEMENT FOR OVERHEAD POWERLINES 9 WIDE (DP 1198692)

## RESIDENTIAL STAGING

| | |
|---|---|
| 1 | 29 LOTS |
| 2 | 35 LOTS |
| 3 | 28 LOTS |
| 4 | 32 LOTS |
| 5 | 25 LOTS |
| 6 | 30 LOTS |
| 7 | 30 LOTS |
| 8 | 33 LOTS |
| 9 | 24 LOTS |
| 10 | 32 LOTS |
| 11 | 21 LOTS |
| TOTAL | 319 LOTS |

## LOT YIELD

| | | |
|---|---|---|
| RESIDENTIAL LOTS | 304 | |
| DUAL OCCUPANCY | 9 | (18 DWELLINGS) |
| MULTI DWELLING LOTS | 6 | (29 DWELLINGS) |
| TOTAL | 319 | (351 DWELLINGS) |
| PUBLIC RESERVE | 4 | |
| COMMERCIAL LOT | 1 | |

| | |
|---|---|
| OVERALL SITE AREA | 41.39 ha |
| OVERALL DEV. AREA | 31.57 ha |
| JEMALONG PUBLIC RESERVE | 4,607m² |
| SCC PUBLIC RESERVE | 8,644m² |
| TOTAL | 13,251m² |

RESERVE AREA REQUIRED
JEMALONG
351 DWELLINGS x 2.5 People x 12m² = 10,530m²

SCC
103 LOTS x 2.5 People x 12m² = 3,090m²

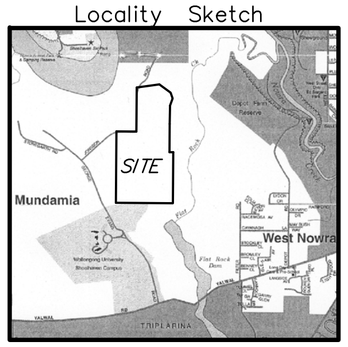
TOTAL 13,620m²

| | |
|---|---|
| PUBLIC RESERVE (BUSHLAND)–NTH | 7.39ha |
| PUBLIC RESERVE (BUSHLAND)–STH | 3.10ha |
| TOTAL | 10.49ha |

JEMALONG DEVELOPMENT AREA PER HECTARE
31.57ha/351 dwellings = 11.11 dwellings per hectare

DRAFT 27.04.2015

Locality Sketch




0 25 50 75 100
scale: – 1:2000

| | | | | | | |
|---|---|---|---|---|---|---|
| RATIO: 1:2000 AT A1, 1:4000 AT A3 | DATUM: | SURVEY | | REVISION | BY | DATE |
| | ORIGIN: | DESIGN | MJP | 1 MINOR AMENDMENTS TO LOT LAYOUT. ALLOCATED DP No .ADDED. | DS | 14.07.2014 |
| | | DRAWN | DS | 2 MINOR AMENDMENTS TO LOT LAYOUT. | DS | 15.07.2014 |
| | | CHECK'D | | 3 MINOR AMENDMENTS TO LOT LAYOUT, APZ AMENDED, NOTES RE ON SITE DETENTION ADDED. | DS | 12.08.2014 |
| | DATE OF PLAN: 25 FEB. 2014 | | | 4 APZ's, DETENTION BASINS & HEATH MYRTLE PATCHES AMENDED TO REFLECT CONSULTANTS STUDIES. | DS | 15.08.2014 |
| | | | | 5 APZ's AMENDED TO ADD RADII. BUFFER REMOVED. NOTE ADDED TO NORTHERN CONSERVATION AREA | DS | 15.08.2014 |
| | | | | 6 MINOR AMENDMENTS TO STAGES, LOT YIELD, COMMERCIAL LOT ADDED | DS | 27.10.2014 |
| | | | | 7 LOT LAYOUT AMENDED TO SUIT REVISED APZ ZONES | DS | 23.03.2015 |
| | | | | 8 KERB DETAIL ADDED ROAD 5. DET.BASINS C1 & C1A SHIFTED. | DS | 09.04.2015 |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land and development consultants
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consultants@allenprice.com.au www.allenprice.com.au


PLAN SHOWING PROPOSED SUBDIVISION
OF LOT 30 DP 1198692
(PREVIOUSLY LOT 3 DP 568613 & LOT 384 DP 755952)
AT MUNDAMIA GROWTH AREA
FOR JEMALONG MUNDAMIA PTY LTD

REF. No. 25489–11
SHEET 1 OF 1 SHEETS
REVISION 07

global environmental solutions

Lot 30 in DP 1198692
George Evans Road, Mundamia

Proposed Residential Estate

# Flora & Fauna Assessment Report

Appendix B
Survey Details

01 June 2015

# 1 INTRODUCTION

## 1.1 Survey Effort

Field surveys for flora and fauna were conducted within the subject land and study area at Mundamia during the following survey periods:

- 26th of February 2004 to 22nd of June 2004 by BES (Table 1); and
- 24th to the 26th of September 2008 by Environmental InSites (Table 2); and
- 7th to 9th April and 29th to 30th August 2014 by SLR Consulting (Table 3).

**Table 1** Field survey summary (BES 2004)

| Year | Dates | Technique | Location | Effort | Reference |
|---|---|---|---|---|---|
| 2004 | 26th February; 2nd, 18th March. | General vegetation surveys | Area 5 | 30.5 hours | BES 2004 |
| | 19th March; 27th April | Targeted grid searches for threatened and regionally significant flora species. | Area 5 | 67 hours | BES 2004 |
| | 22nd June | Targeted transects for *Genoplesium baueri* | Area 5 | 4 hours | BES 2004 |
| | 26th February | Diurnal habitat search | Area 5 | | BES 2004 |
| | 26th February | Nocturnal surveys including spotlighting, call playback and Ultrasonic detection | Area 5 | 10.25 hours | BES 2004 |
| | 26th – 29th February | Terrestrial Elliott Trapping | Area 5 | 250 trap nights | BES 2004 |
| | 26th – 29th February | Terrestrial cage trapping (small) | Area 5 | 100 trap nights | BES 2004 |
| | 26th – 29th February | Terrestrial cage trapping (large) | Area 5 | 16 trap nights | BES 2004 |
| | 26th February to 18th March | Arboreal hair funnels | Area 5 | 550 trap nights | BES 2004 |
| | 2nd March | Diurnal habitat search | Area 5 | 23.5 hours | BES 2004 |
| | 2nd March | Nocturnal surveys including spotlighting, call playback and Ultrasonic detection | Area 5 | 6.25 hours | BES 2004 |
| | 18th March | Diurnal habitat search | Area 5 | 4 hours | BES 2004 |
| | 18th March | Nocturnal surveys including spotlighting, call playback and Ultrasonic detection | Area 5 | 6.2 hours | BES 2004 |
| | 19th March | Diurnal habitat search | Area 5 | 52 hours | BES 2004 |
| | 10th & 22nd June | Nesting assessments | Area 5 | 11.5 hours | BES 2004 |

Appendix B Details of ecological surveys on the subject land

**Table 2 Field surveys undertaken by Environmental InSites (2008)**

| Year | Dates | Technique | Location | Effort | Reference |
|---|---|---|---|---|---|
| 2008 | 24th-26th September | Targeted surveys for the Nowra Heath Myrtle *Triplarina nowraensis* | Subject Site | 8 hours | Environmental InSites 2008 |
| | 24th-26th September | Flora surveys | Subject Site | 8 hours | Environmental InSites 2008 |
| | 24th-26th September | Diurnal Bird Surveys | Subject Site | 4 hours (dedicated) plus whole survey | Environmental InSites 2008 |
| | 24th-25th September | Spotlighting | Subject Site | 4 hours | Environmental InSites 2008 |
| | 24th-25th September | Call Playback | Subject Site | 2 hours | Environmental InSites 2008 |
| | 24th-25th September | Ultrasonic Bat detection - Mobile | Subject Site | 4 hours | Environmental InSites 2008 |
| | 24th-25th September | Ultrasonic Bat detection – fixed | Subject Site | 20 hours | Environmental InSites 2008 |
| | 24th-25th September | Nocturnal Amphibian surveys | Creekline and dams within subject site | 3 hours | Environmental InSites 2008 |
| | 24th-26th September | Hollow tree surveys | Subject Site | 8 hours | Environmental InSites 2008 |
| | 24th-26th September | Habitat search | Subject Site | 6 hours | Environmental InSites 2008 |

**Table 3 Field surveys undertaken by SLR Ecology**

| Year | Dates | Technique | Location | Effort | Reference |
|---|---|---|---|---|---|
| 2014 | 7th–9th April, 29th-30th August | Targeted surveys for the Nowra Heath Myrtle *Triplarina nowraensis* | Subject Land | 18.5 person-hours | SLR Consulting 2014 |
| | 7th–9th April, 29th-30th August | Hollow tree surveys | Subject Land | 17 person-hours | SLR Consulting 2014 |
| | 7th-9th April | Nocturnal surveys including spotlighting and call playback | Subject Land | 8 person-hours | SLR Consulting 2014 |
| | 29th-30th August | Diurnal fauna opportunistic surveys | Subject Land | 9 person-hours | SLR Consulting 2014 |
| | 29th-30th August | Diurnal Bird Survey | Subject Land | 1 person-hour | SLR Consulting 2014 |
| | 29th-30th August | Diurnal Amphibian Survey | Subject Land | 1 person-hour | SLR Consulting 2014 |
| | 29th-30th August | Nocturnal surveys including spotlighting, call playback | Subject Land | 4 person-hours | SLR Consulting 2014 |
| | 7th-9th April | Arboreal glider-tube traps | Subject Land | 18 trap nights | SLR Consulting 2014 |
| | 7th-9th April | Ultrasonic Bat detection – fixed | Subject Land | 48 hours | SLR Consulting 2014 |
| | 7th-9th April | Infra-red Camera | Subject Land | 72 hours | SLR Consulting 2014 |
| | 9th April-29th August | Terrestrial hair funnels | Subject Land | 560 trap nights | SLR Consulting 2014 |

### 1.2 Supplementary Investigations

In November and December 2009 and February 2010, BES (now Eco Logical Australia – ELA) conducted further flora and fauna surveys on Council land to the immediate west of the subject land at Mundamia. Those investigations included:

- dedicated transect surveys for threatened orchids known to occur in the locality;
- nesting assessments for the Gang Gang Cockatoo;
- stag watch surveys for nocturnal mammals and birds;
- nocturnal spotlighting, call playback and Anabat recording;
- 200 trap-nights for the Eastern Pygmy Possum and the White-footed Dunnart; and
- the use of remote cameras to survey for Rosenberg's Goanna and the Tiger Quoll.

Additional surveys and inspections of the subject land and nearby land have also been conducted in 2010 and 2011 by Environmental InSites and by Shoalhaven City Council (SCC) including:

- a supplementary inspection of the proposed road alignment for access into the Mundamia residential area, on the 4th of May 2010 (Environmental InSites);
- dedicated surveys for *Pterostylis vernalis*, both on the subject land and in the immediate vicinity, by SCC and Environmental InSites (dates); and
- two supplementary dedicated surveys of the subject land (dates) by Environmental InSites to refine vegetation mapping and to provide added information and detail regarding the distribution and densities of patches of the Nowra Heath Myrtle.

In addition SLR Ecology surveyed two small portions of the site during 2013, including:

- a dedicated 3 person-hour search for *Pterostylis vernalis* within areas mapped as Kunzea Heathland on the 3rd of December 2013; and
- a survey in the vicinity of the existing dwelling off Jonsson Road (now Lot 31) on the 3rd of September 2013 – involving a 4.5 person-hour search for the Nowra Heath Myrtle and a 4.5 person-hour search for hollow-bearing trees.

### 1.3 Survey Limitations

Snapshot surveys (such as those undertaken as part of the planning and assessment process) are generally always limited by time and budget constraints and therefore it is often likely that the species recorded during a given survey only represent a portion of those which would utilise the site. To alleviate this problem surveys should be replicated during different seasons to increase the chance of recording cryptic species or species which use the site (or are only active/detectible) seasonally and/or periodically. As indicated in Table 2, the subject land and surrounding land have been surveyed over different seasons and importantly, in different years.

Given the habitats present on the subject land and the fact that the vast majority of the proposed development would occupy cleared and highly disturbed farmland, it is considered that the level of survey effort is sufficient in this instance.

# 2 FLORA SURVEY METHODS

The locations of flora survey methods and results are depicted in Appendix 1 (attached).

## 2.1 Systematic Surveys

Botanical surveys were undertaken on the 23rd and 24th of September 2008. Surveys were completed in accordance with DEC (2004) draft guidelines. Systematic surveys consisted of five 20 x 20 metre plots sampling each vegetation community. Cover abundance for each species recorded within the survey plots and was allocated on the basis of a modified Braun-Blanquet scale. Flora transects of 100 metres length were associated with each community and plot survey.

The Random Meander methodology also was utilised to target threatened species, as described by Cropper (1993).

Botanical nomenclature was applied according to Harden (1990-1993) and cross-referenced against updated and accepted changes per www.plantnet.com.au or the National Herbarium of New South Wales.

Where *var.* or *subsp.* was not able to be accurately determined, specimens were listed at the base species level.

## 2.2 Targeted Surveys for Nowra Heath-myrtle

The Nowra Heath-myrtle *Triplarina nowraensis*, was specifically searched for during Random Meander surveys. All habitats considered suitable for this species were searched on a number of occasions. Recent 2014 mapping of the Nowra Heath Myrtle included mapping patches and individual specimens for the whole of the subject land - previous mapping was less detailed with polygons only in the northeastern portion of the subject land and points indicating the presence of large patches of the species and individual specimens.

# 3 FAUNA SURVEY METHODS

The locations of fauna surveys sites are shown in Appendix 2.

## 3.1 Spotlighting Surveys

Spotlighting surveys were conducted throughout the subject land to target nocturnal mammals, owls, amphibians and other nocturnal fauna. Fauna species were detected both visually and aurally.

## 3.2 Call Playback Surveys

Pre-recorded calls of the Squirrel Glider, Yellow-bellied Glider, Masked Owl, Sooty Owl, Powerful Owl, Barking Owl, Bush Stone-curlew and Giant Burrowing Frog were broadcast at numerous locations during the 1997 – 2008 and 2014 field surveys. Surveys commenced after dusk, with each call being broadcast for 5 minutes followed by a two minute listening period. Ten minutes were spent listening for calls prior to and after playback.

## 3.3 Microchiropteran Bat Surveys

Anabat II (BES 2004) and Anabat SD1 (InSites 2008; SLR 2014) recorders were employed to detect microchiropteran bats. Anabat recorders are useful in detecting high flying microchiropteran bats that are often under-sampled by bat (harp) trapping. Anabat surveys were conducted during the spotlight traverses and from dusk till dawn using the delay system. Call analysis for this survey was undertaken using the AnalookW software package (Corben 2006) with reference to Pennay *et al* (2004) and a library of bat calls. The 2014 Anabat data was analysed externally by LesryK Environmental Consultants.

## 3.4 Avifauna Surveys

Diurnal bird surveys involved the observation and identification of calls and were conducted from dawn on each survey day. In addition, bird species were recorded on an opportunistic basis during all surveys across the site. Targeted searches were undertaken for feeding signs of the Glossy Black Cockatoo and potential nesting sites for large forest owls.

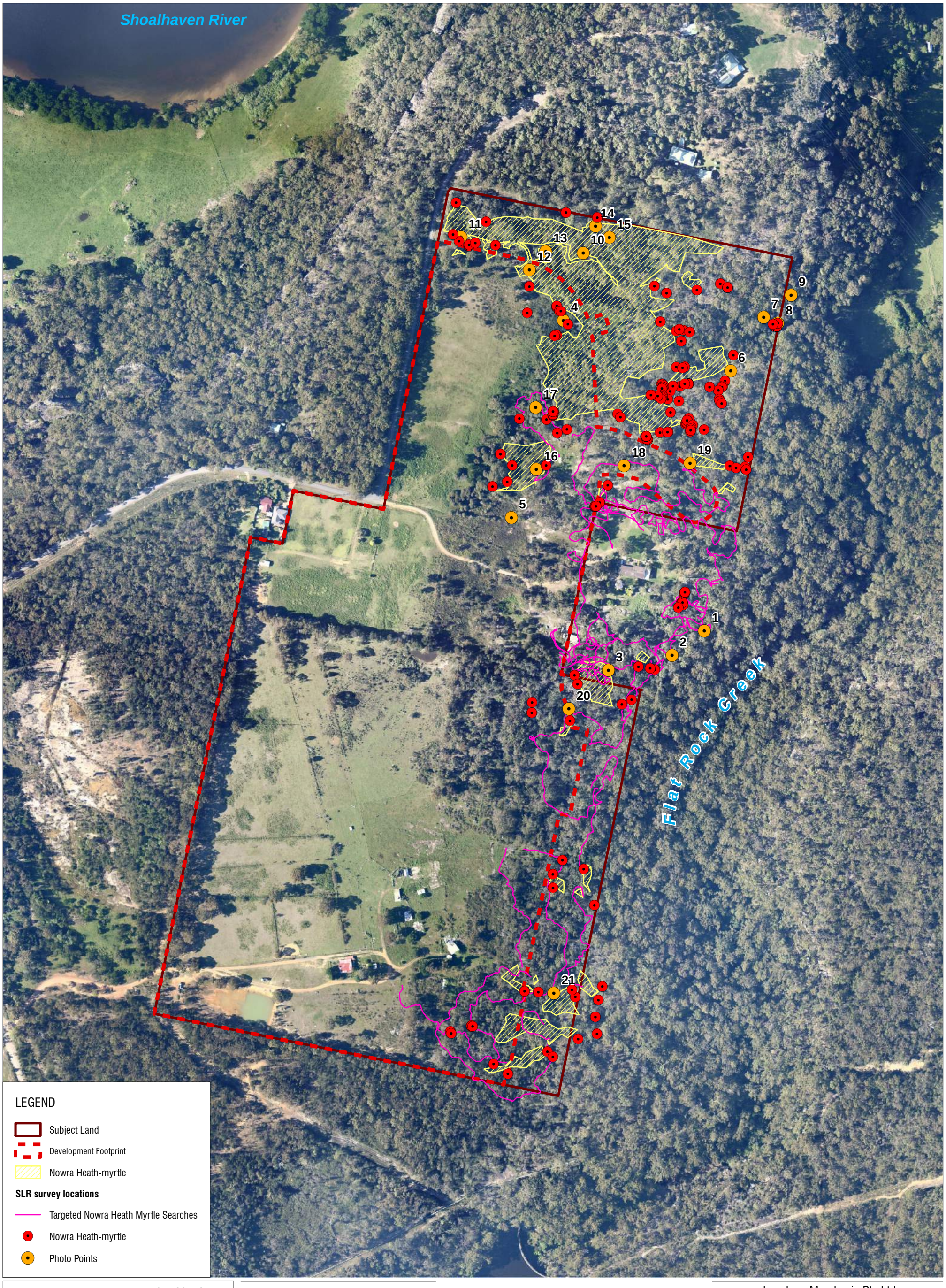
## 3.5 Habitat Searches

An opportunistic habitat search was conducted throughout the subject land during other surveys. This involved actively searching piles of vegetative litter, rock shelves and crevices and human refuse. All rocks, sticks, logs or refuse disturbed were returned to their original placement following completion of the search.

### 3.6 Hollow-Bearing Tree Survey

Hollow-bearing trees were re-mapped across the subject land as part of the 2014 surveys. Each hollow was located using GIS (iPhone Application 'GIS Roam') and mapped (with numbering). Each tree was also tagged with a silver metal tag nailed into the trunk and enscripted with a unique tree number and SLR identification. Data recorded for each of the hollows is found in Appendix K.
The information collected for each hollow-bearing tree includes:

- tree species; and
- the number and size of visible hollows;
  - Small <15 cm diameter and large enough for a small arboreal species (e.g. Sugar Glider);
  - Medium 15 – 25 cm diameter and large enough for a medium arboreal species (e.g. Squirrel Glider); and
  - Large > 25 cm diameter and large enough for a large arboreal species (e.g. forest owl).

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| | |
|---|---|
| Project No.: | 610.14258 |
| Date: | 21/05/2015 |
| Drawn by: | KC |
| Scale: | 1:4,000 |
| Sheet Size: | A4 |
| Projection: | GDA 1994 MGA Zone 55 |

N
W E
S
0 50 100 150 200 m

Jemalong Mundamia Pty Ltd

**Mundamia Residential Subdivision DA**

# Flora survey locations

APPENDIX 1

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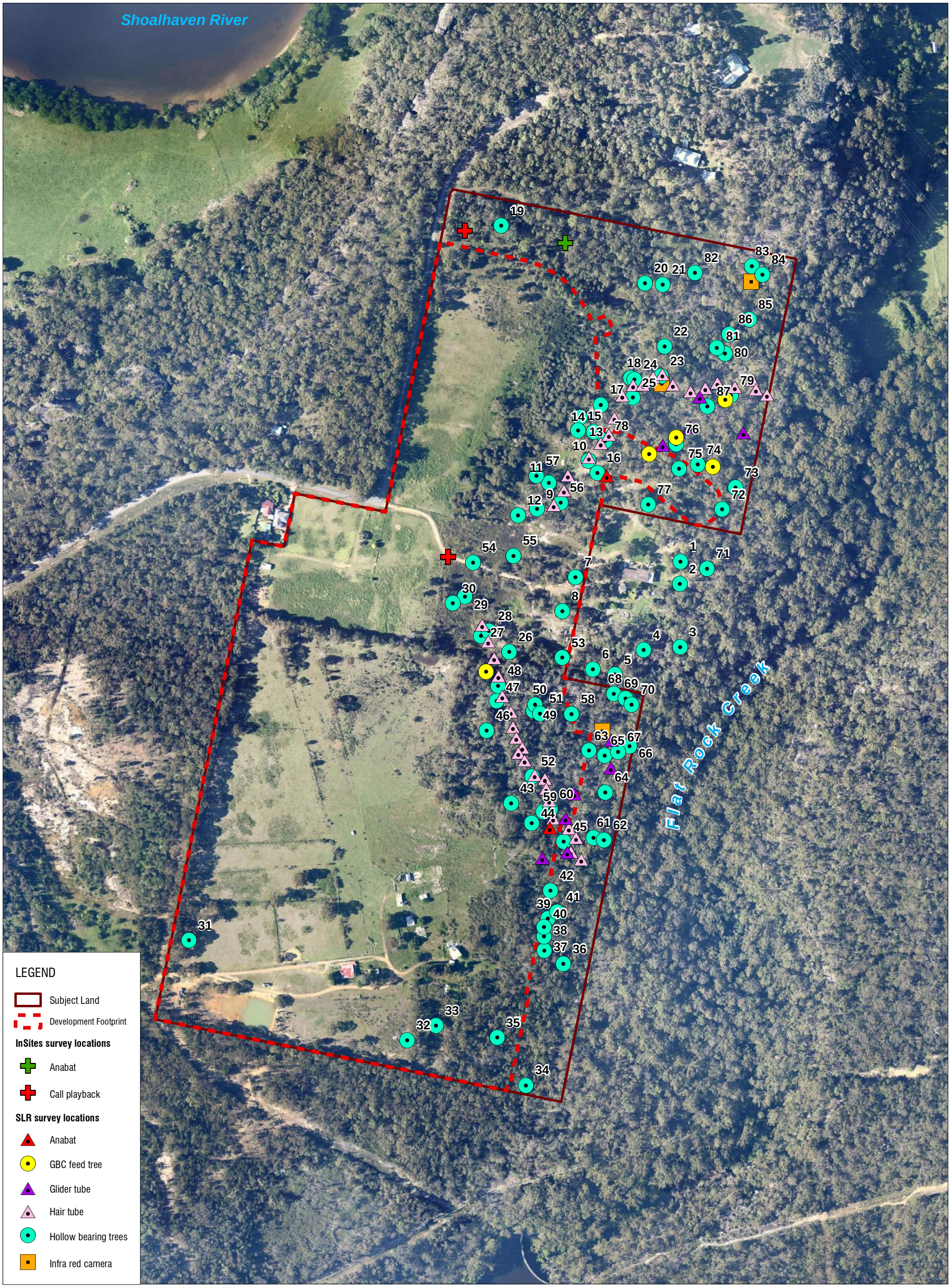


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| Project No.: | 610.14258 |
| Date: | 21/05/2015 |
| Drawn by: | KC |
| Scale: | 1:4,000 |
| Sheet Size: | A4 |
| Projection: | GDA 1994 MGA Zone 55 |

N
W
E
S

0 50 100 150 200 m

Jemalong Mundamia Pty Ltd

**Mundamia Residential Subdivision DA**

# Fauna survey locations

APPENDIX 2

global environmental solutions

Lot 30 in DP 1198692
George Evans Road, Mundamia

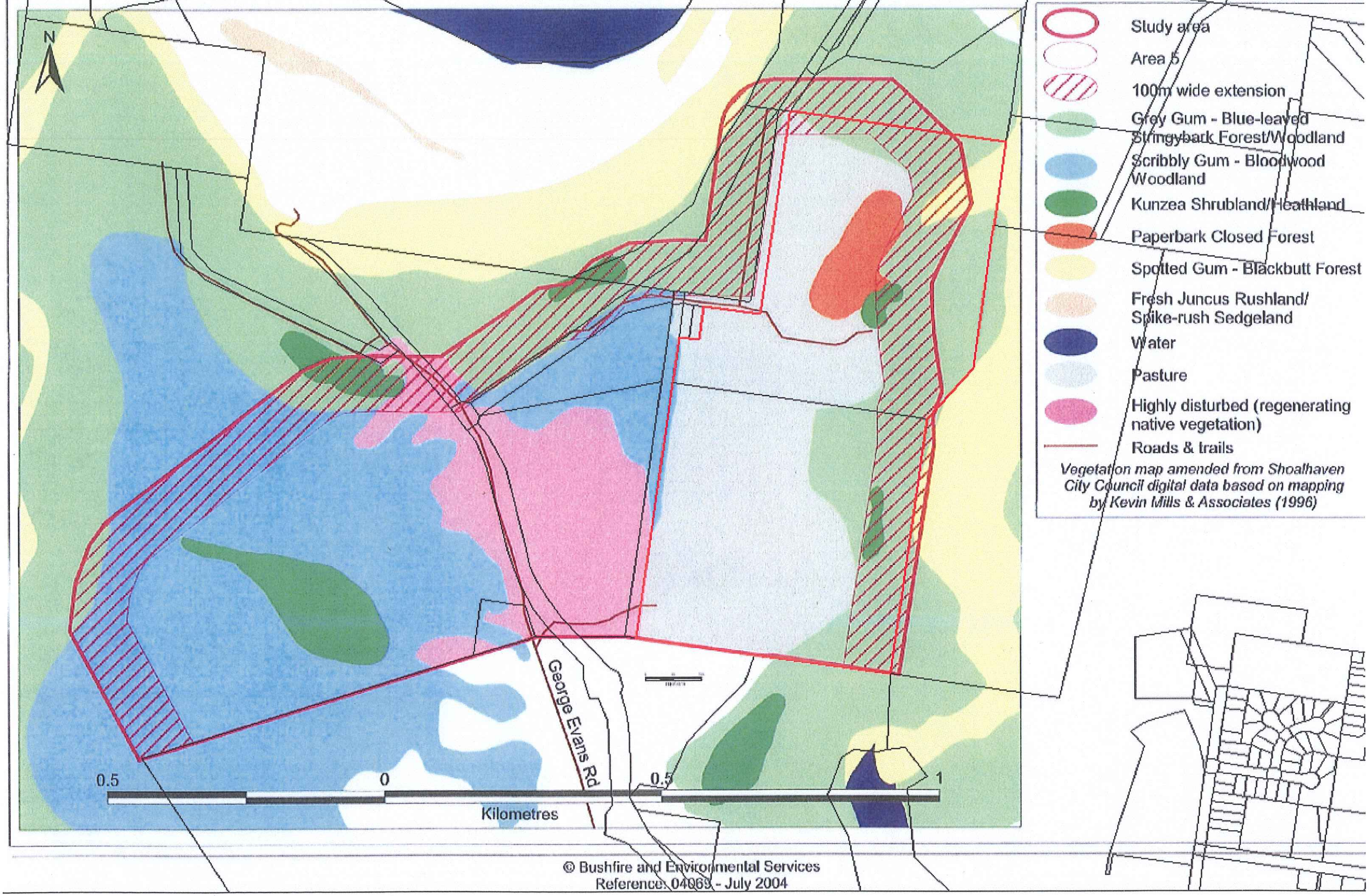
Proposed Residential Estate

# Flora & Fauna Assessment Report

Appendix C
BES Mapping

01 June 2015

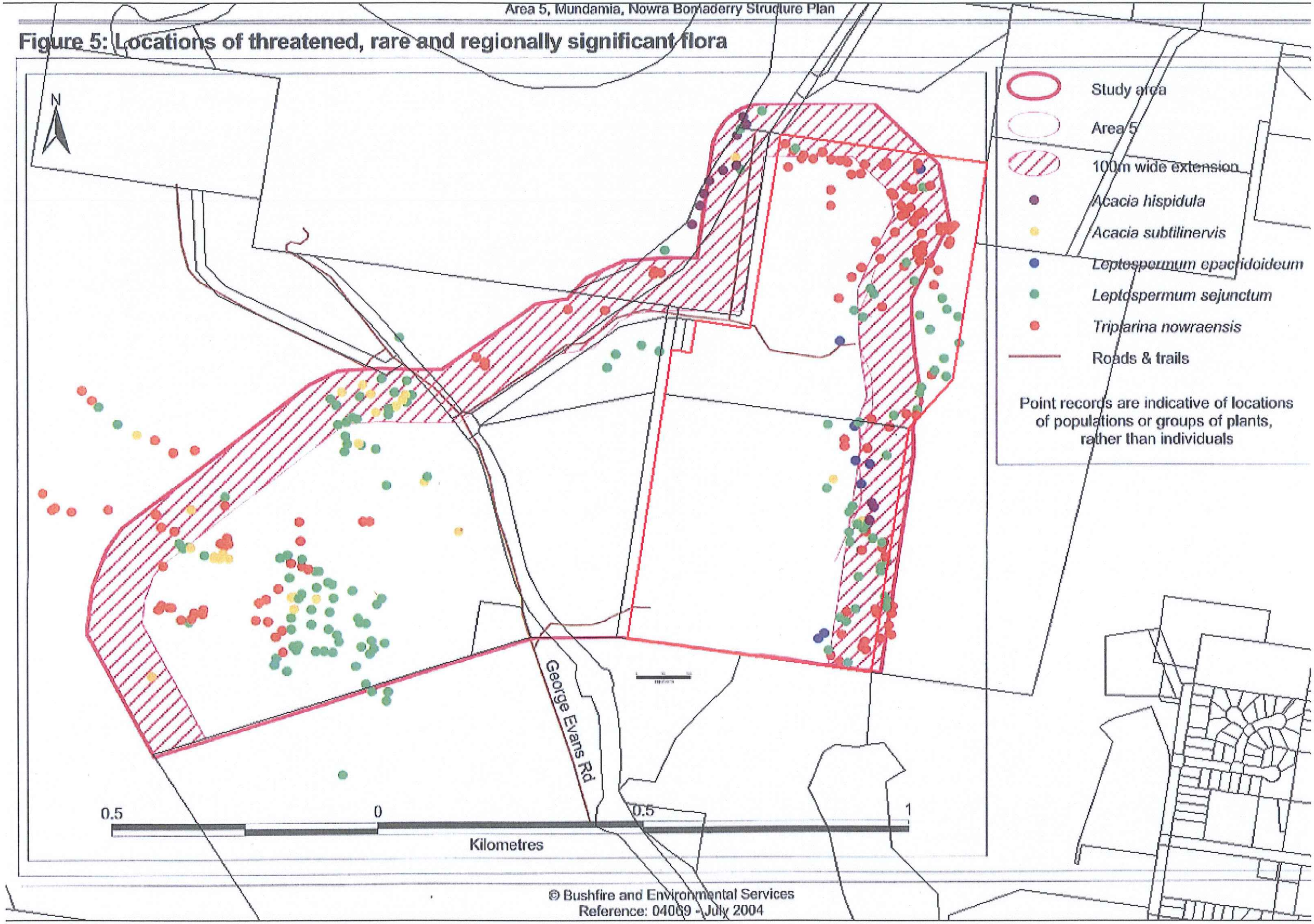
## Figure 4: Vegetation of the study area





Reference: 04069 - July 2004

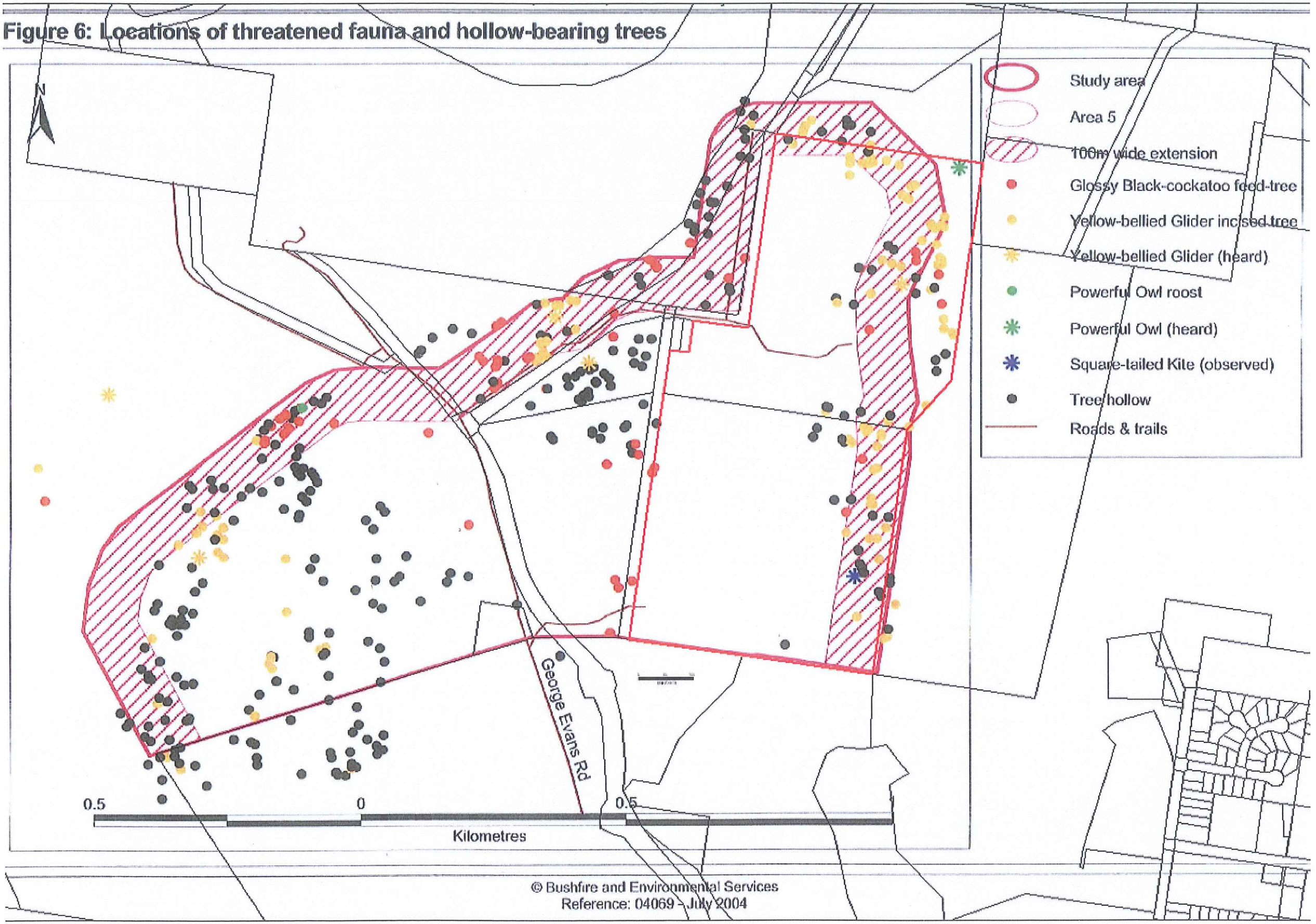
## Figure 5: Locations of threatened, rare and regionally significant flora





Reference: 04069 - July 2004

## Figure 6: Locations of threatened fauna and hollow-bearing trees





Reference: 04069 - July 2004

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# Flora & Fauna Assessment Report

Appendix D
Wildlife Atlas Search

01 June 2015

| **KEY** | |
|---|---|
| **Status** | The "*threatened species*" listing in the *Threatened Species Conservation Act 1995* |
| V | Species listed as "*vulnerable*" |
| E1 | Species listed as "*endangered*" |
| E2 | Species is part of an "*endangered population*" |
| E4A | Species listed as "*critically endangered*" |
| **Records** | The number of records of the relevant "*threatened species*" listed in the search area |
| **Relevance** | The potential relevance that the "*threatened species*" might have to the subject site. |
| H | Considered by SLR Ecology to have a "*high*" potential relevance to the subject site |
| M | Considered by SLR Ecology to have a "*moderate*" potential relevance to the site |
| L | Considered by SLR Ecology to have a "*low*" potential relevance to the subject site |
| N | Considered by SLR Ecology to have "*no*" relevance to the subject site |

**NOTES**

The table below is based on data obtained from the recently reformed *Atlas of NSW Wildlife* website http://www.bionet.nsw.gov.au/. The following notes accompany this database:

- Data from the BioNet Atlas of NSW Wildlife website, which holds records from a number of custodians. The data are only indicative and cannot be considered a comprehensive inventory, and may contain errors and omissions.
- Species listed under the Sensitive Species Data Policy may have their locations denatured (^rounded to 0.1Â°; ^^ rounded to 0.01Â°).
- Copyright - the State of NSW through the Office of Environment & Heritage.
- Search criteria: Licensed Report of all Valid Records of Threatened (listed on TSC Act 1995) Entities in selected area [North: -34.79 West: 150.46 East: 150.68 South: -34.97] returned a total of 2,114 records of 71 species.
- Report generated on 19/05/2015 6:39 PM.

| Status | Scientific Name | Common Name | Records | Relevance |
|---|---|---|---|---|
| | **PLANTS** | | | |
| | **Dilleniaceae** | | | |
| E1 | *Hibbertia puberula* | - | 1 | N |
| E1 | *Hibbertia stricta* subsp. *furcatula* | - | 20 | N |
| | **Fabaceae (Mimosoideae)** | | | |
| E1 | *Acacia bynoeana* | Bynoe's Wattle | 5 | N |
| V | *Acacia pubescens* | Downy Wattle | 1 | N |
| | **Myrtaceae** | | | |
| V | *Eucalyptus langleyi* | Albatross Mallee | 24 | N |
| E2 | *Eucalyptus langleyi* | Albatross Mallee population | 24 | N |
| V | *Eucalyptus sturgissiana* | Ettrema Mallee | 1 | N |
| V | *Melaleuca deanei* | Deane's Paperbark | 2 | N |
| E1 | *Syzygium paniculatum* | Magenta Lilly Pilly | 1 | N |
| E1 | *Triplarina nowraensis* | Nowra Heath Myrtle | 345 | H |
| | **Orchidaceae** | | | |
| V | ^*Cryptostylis hunteriana* | Leafless Tongue Orchid | 4 | N |
| V | ^*Genoplesium baueri* | Bauer's Midge Orchid | 17 | N |
| E1 | ^*Pterostylis gibbosa* | Illawarra Greenhood | 76 | N |
| E4A | ^^*Pterostylis ventricosa* | - | 1 | N |
| E4A | ^*Pterostylis vernalis* | - | 20 | N |
| | **Rubiaceae** | | | |
| E1 | *Galium australe* | Tangled Bedstraw | 2 | N |

Appendix D OEH Wildlife Atlas Search for "*threatened species*" within 10km of the subject land

| Status | Scientific Name | Common Name | Records | Relevance |
|---|---|---|---|---|
| | **Rutaceae** | | | |
| E1 | *Zieria baeuerlenii* | Bomaderry Zieria | 117 | N |
| V | *Zieria tuberculata* | Warty Zieria | 4 | N |
| | **Solanaceae** | | | |
| E1 | *Solanum celatum* | - | 8 | N |
| | **AMPHIBIANS** | | | |
| | **Myobatrachidae** | | | |
| V | *Heleioporus australiacus* | Giant Burrowing Frog | 6 | L/N |
| | **Hylidae** | | | |
| E1 | *Litoria aurea* | Green & Golden Bell Frog | 335 | L/N |
| V | *Litoria littlejohni* | Littlejohn's Tree Frog | 1 | L/N |
| | **REPTILES** | | | |
| | **Cheloniidae** | | | |
| V | *Chelonia mydas* | Green Turtle | 2 | N |
| | **Varinidae** | | | |
| V | *Varanus rosenbergi* | Rosenberg's Goanna | 1 | N |
| | **Elapidae** | | | |
| E1 | ^*Hoplocephalus bungaroides* | Broad-headed Snake | 9 | N |
| | **BIRDS** | | | |
| | **Anatidae** | | | |
| V | *Stictonetta naevosa* | Freckled Duck | 3 | N |
| | **Ardeidae** | | | |
| E1 | *Botaurus poiciloptilus* | Australasian Bittern | 6 | N |
| V | *Ixobrychus flavicollis* | Black Bittern | 4 | N |
| | **Accipitridae** | | | |
| V | *Circus assimilis* | Spotted Harrier | 2 | N |
| V | *Hieraaetus morphnoides* | Little Eagle | 2 | N |
| V | ^^*Lophoictinia isura* | Square-tailed Kite | 27 | L |
| V | *Pandion cristatus* | Eastern Osprey | 2 | N |
| | **Falconidae** | | | |
| V | *Falco subniger* | Black Falcon | 1 | N |
| | **Burhinidae** | | | |
| E1 | *Burhinus grallarius* | Bush Stone-curlew | 3 | L/N |
| | **Charadriidae** | | | |
| E4A | *Thinornis rubricollis* | Hooded Plover | 1 | N |
| | **Rostratulidae** | | | |
| E1 | *Rostratula australis* | Australian Painted Snipe | 1 | N |
| | **Scolopacidae** | | | |
| V | *Limosa limosa* | Black-tailed Godwit | 1 | N |
| | **Cacatuidae** | | | |
| V | ^^*Callocephalon fimbriatum* | Gang-gang Cockatoo | 34 | M |
| V | ^*Calyptorhynchus lathami* | Glossy Black-Cockatoo | 322 | H |
| | **Psittacidae** | | | |
| V | *Glossopsitta pusilla* | Little Lorikeet | 14 | L/N |
| V | ^^*Neophema pulchella* | Turquoise Parrot | 10 | L/N |
| | **Strigidae** | | | |
| V | ^^*Ninox connivens* | Barking Owl | 1 | L/N |
| V | ^^*Ninox strenua* | Powerful Owl | 35 | L |
| | **Tytonidae** | | | |
| V | ^^*Tyto novaehollandiae* | Masked Owl | 9 | L/N |
| V | ^^*Tyto tenebricosa* | Sooty Owl | 19 | N |

| Status | Scientific Name | Common Name | Records | Relevance |
|---|---|---|---|---|
| | **Acanthizidae** | | | |
| E1 | *Calamanthus fuliginosus* | Striated Fairy-wren | 1 | N |
| | **Meliphagidae** | | | |
| E4A | *Anthochaera phrygia* | Regent Honeyeater | 1 | L/N |
| V | *Epthianura albifrons* | White-fronted Chat | 3 | N |
| | **Neosittidae** | | | |
| V | *Daphoenositta chrysoptera* | Varied Sittella | 17 | N |
| | **Petroicidae** | | | |
| V | *Petroica boodang* | Scarlet Robin | 11 | L/N |
| V | *Petroica boodang* | Flame Robin | 1 | L/N |
| V | *Petroica rodinogaster* | Pink Robin | 1 | L/N |
| | **MAMMALS** | | | |
| | **Dasyuridae** | | | |
| V | *Dasyurus maculatus* | Tiger Quoll | 21 | N |
| V | *Sminthopsis leucopus* | White-footed Dunnart | 2 | N |
| | **Peramelidae** | | | |
| E1 | *Isoodon obesulus obesulus* | Southern Brown Bandicoot | 1 | N |
| | **Phascolarctidae** | | | |
| V | *Phascolarctos cinereus* | Koala | 4 | N |
| | **Burramyidae** | | | |
| V | *Cercartetus nanus* | Eastern Pygmy Possum | 8 | L/N |
| | **Petauridae** | | | |
| V | *Petaurus australis* | Yellow-bellied Glider | 370 | H |
| | **Potoroidae** | | | |
| V | *Potorous tridactylus* | Long-nosed Potoroo | 1 | N |
| | **Macropodidae** | | | |
| V | *Macropus parma* | Parma Wallaby | 1 | N |
| E1 | *Petrogale penicillata* | Brush-tailed Rock Wallaby | 8 | N |
| | **Pteropodidae** | | | |
| V | *Pteropus poliocephalus* | Grey-headed Flying Fox | 75 | L |
| | **Emballonuridae** | | | |
| V | *Saccolaimus flaviventris* | Yellow-bellied Sheath-tail Bat | 5 | M |
| | **Molossidae** | | | |
| V | *Mormopterus norfolkensis* | Eastern Free-tail Bat | 7 | M |
| | **Vespertilionidae** | | | |
| V | *Chalinolobus dwyeri* | Large-eared Pied Bat | 6 | M |
| V | *Falsistrellus tasmaniensis* | Eastern False Pipistrelle | 8 | M |
| V | *Kerivoula papuensis* | Golden-tipped Bat | 1 | L/N |
| V | *Miniopterus schreibersii oceanensis* | Eastern Bent-wing Bat | 21 | M |
| V | *Myotis macropus* | Southern Myotis | 3 | L/N |
| V | *Scoteanax rueppellii* | Greater Broad-nosed Bat | 12 | M |
| | **Otariidae** | | | |
| V | *Arctocephalus pusillus doriferus* | Australian Fur-seal | 1 | N |

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# Flora & Fauna Assessment Report

Appendix E
Protected Matters Search

01 June 2015

Australian Government
Department of the Environment

# EPBC Act Protected Matters Report

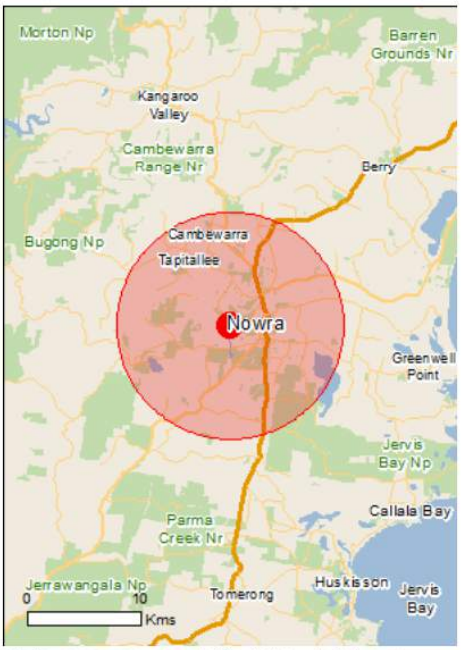
This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

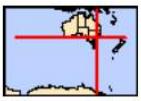
Report created: 19/05/15 19:37:04






This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

Coordinates
Buffer: 10.0Km



# Summary

## Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

| | |
|---|---|
| World Heritage Properties: | None |
| National Heritage Places: | None |
| Wetlands of International Importance: | None |
| Great Barrier Reef Marine Park: | None |
| Commonwealth Marine Area: | None |
| Listed Threatened Ecological Communities: | 1 |
| Listed Threatened Species: | 66 |
| Listed Migratory Species: | 57 |

## Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage/index.html

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

| | |
|---|---|
| Commonwealth Land: | 10 |
| Commonwealth Heritage Places: | None |
| Listed Marine Species: | 59 |
| Whales and Other Cetaceans: | None |
| Critical Habitats: | None |
| Commonwealth Reserves Terrestrial: | None |
| Commonwealth Reserves Marine: | None |

## Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

| | |
|---|---|
| State and Territory Reserves: | 11 |
| Regional Forest Agreements: | 1 |
| Invasive Species: | 48 |
| Nationally Important Wetlands: | 1 |
| Key Ecological Features (Marine) | None |

# Details

## Matters of National Environmental Significance

### Listed Threatened Ecological Communities [ Resource Information ]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

| Name | Status | Type of Presence |
|---|---|---|
| Upland Basalt Eucalypt Forests of the Sydney Basin Bioregion | Endangered | Community may occur within area |

### Listed Threatened Species [ Resource Information ]

| Name | Status | Type of Presence |
|---|---|---|
| **Birds** | | |
| Anthochaera phrygia<br>Regent Honeyeater [82338] | Endangered | Species or species habitat known to occur within area |
| Botaurus poiciloptilus<br>Australasian Bittern [1001] | Endangered | Species or species habitat known to occur within area |
| Dasyornis brachypterus<br>Eastern Bristlebird [533] | Endangered | Species or species habitat known to occur within area |
| Diomedea epomophora epomophora<br>Southern Royal Albatross [25996] | Vulnerable | Foraging, feeding or related behaviour likely to occur within area |
| Diomedea epomophora sanfordi<br>Northern Royal Albatross [82331] | Endangered | Foraging, feeding or related behaviour likely to occur within area |
| Diomedea exulans antipodensis<br>Antipodean Albatross [82269] | Vulnerable | Foraging, feeding or related behaviour likely to occur within area |
| Diomedea exulans exulans<br>Tristan Albatross [82337] | Endangered | Species or species habitat may occur within area |
| Diomedea exulans gibsoni<br>Gibson's Albatross [82271] | Vulnerable | Foraging, feeding or related behaviour likely to occur within area |
| Diomedea exulans (sensu lato)<br>Wandering Albatross [1073] | Vulnerable | Foraging, feeding or related behaviour likely to occur within area |
| Lathamus discolor<br>Swift Parrot [744] | Endangered | Species or species habitat likely to occur within area |
| Macronectes giganteus<br>Southern Giant-Petrel [1060] | Endangered | Species or species habitat may occur within |

| Name | Status | Type of Presence |
|---|---|---|
| | | area |
| Macronectes halli<br>Northern Giant-Petrel [1061] | Vulnerable | Species or species habitat may occur within area |
| Neophema chrysogaster<br>Orange-bellied Parrot [747] | Critically Endangered | Species or species habitat may occur within area |
| Rostratula australis<br>Australian Painted Snipe [77037] | Endangered | Species or species habitat may occur within area |
| Thalassarche bulleri<br>Buller's Albatross, Pacific Albatross [64460] | Vulnerable | Species or species habitat may occur within area |
| Thalassarche cauta cauta<br>Shy Albatross, Tasmanian Shy Albatross [82345] | Vulnerable | Foraging, feeding or related behaviour likely to occur within area |
| Thalassarche cauta salvini<br>Salvin's Albatross [82343] | Vulnerable | Foraging, feeding or related behaviour likely to occur within area |
| Thalassarche cauta steadi<br>White-capped Albatross [82344] | Vulnerable | Foraging, feeding or related behaviour likely to occur within area |
| Thalassarche eremita<br>Chatham Albatross [64457] | Endangered | Foraging, feeding or related behaviour likely to occur within area |
| Thalassarche melanophris<br>Black-browed Albatross [66472] | Vulnerable | Species or species habitat may occur within area |
| Thalassarche melanophris impavida<br>Campbell Albatross [82449] | Vulnerable | Species or species habitat may occur within area |
| Fish | | |
| Epinephelus daemelii<br>Black Rockcod, Black Cod, Saddled Rockcod [68449] | Vulnerable | Species or species habitat likely to occur within area |
| Macquaria australasica<br>Macquarie Perch [66632] | Endangered | Species or species habitat may occur within area |
| Prototroctes maraena<br>Australian Grayling [26179] | Vulnerable | Species or species habitat known to occur within area |
| Frogs | | |
| Heleioporus australiacus<br>Giant Burrowing Frog [1973] | Vulnerable | Species or species habitat likely to occur within area |
| Litoria aurea<br>Green and Golden Bell Frog [1870] | Vulnerable | Species or species habitat likely to occur within area |
| Litoria littlejohni<br>Littlejohn's Tree Frog, Heath Frog [64733] | Vulnerable | Species or species habitat may occur within area |
| Mixophyes balbus<br>Stuttering Frog, Southern Barred Frog (in Victoria) [1942] | Vulnerable | Species or species habitat likely to occur within area |
| Mammals | | |

| Name | Status | Type of Presence |
|---|---|---|
| Chalinolobus dwyeri | | |
| Large-eared Pied Bat, Large Pied Bat [183] | Vulnerable | Species or species habitat known to occur within area |
| Dasyurus maculatus maculatus (SE mainland population) | | |
| Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184] | Endangered | Species or species habitat known to occur within area |
| Isoodon obesulus obesulus | | |
| Southern Brown Bandicoot (Eastern) [68050] | Endangered | Species or species habitat known to occur within area |
| Petrogale penicillata | | |
| Brush-tailed Rock-wallaby [225] | Vulnerable | Species or species habitat known to occur within area |
| Phascolarctos cinereus (combined populations of Qld, NSW and the ACT) | | |
| Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104] | Vulnerable | Species or species habitat known to occur within area |
| Potorous tridactylus tridactylus | | |
| Long-nosed Potoroo (SE mainland) [66645] | Vulnerable | Species or species habitat known to occur within area |
| Pseudomys novaehollandiae | | |
| New Holland Mouse, Pookila [96] | Vulnerable | Species or species habitat likely to occur within area |
| Pteropus poliocephalus | | |
| Grey-headed Flying-fox [186] | Vulnerable | Foraging, feeding or related behaviour known to occur within area |
| Plants | | |
| Acacia bynoeana | | |
| Bynoe's Wattle, Tiny Wattle [8575] | Vulnerable | Species or species habitat likely to occur within area |
| Acacia pubescens | | |
| Downy Wattle, Hairy Stemmed Wattle [18800] | Vulnerable | Species or species habitat may occur within area |
| Asterolasia elegans | | |
| [56780] | Endangered | Species or species habitat may occur within area |
| Cryptostylis hunteriana | | |
| Leafless Tongue-orchid [19533] | Vulnerable | Species or species habitat known to occur within area |
| Cynanchum elegans | | |
| White-flowered Wax Plant [12533] | Endangered | Species or species habitat likely to occur within area |
| Eucalyptus langleyi | | |
| Albatross Mallee [56224] | Vulnerable | Species or species habitat likely to occur within area |
| Genoplesium baueri | | |
| Yellow Gnat-orchid [7528] | Endangered | Species or species habitat known to occur within area |
| Genoplesium vernale | | |
| East Lynne Midge-orchid [68379] | Vulnerable | Species or species habitat may occur within area |
| Grevillea parviflora subsp. parviflora | | |
| Small-flower Grevillea [64910] | Vulnerable | Species or species habitat known to occur within area |
| Haloragis exalata subsp. exalata | | |
| Wingless Raspwort, Square Raspwort [24636] | Vulnerable | Species or species habitat likely to occur within area |

| Name | Status | Type of Presence |
|---|---|---|
| Melaleuca biconvexa<br>Biconvex Paperbark [5583] | Vulnerable | Species or species habitat may occur within area |
| Melaleuca deanei<br>Deane's Melaleuca [5818] | Vulnerable | Species or species habitat likely to occur within area |
| Pimelea spicata<br>Spiked Rice-flower [20834] | Endangered | Species or species habitat may occur within area |
| Prasophyllum affine<br>Jervis Bay Leek Orchid, Culburra Leek-orchid, Kinghorn Point Leek-orchid [2210] | Endangered | Species or species habitat may occur within area |
| Pterostylis gibbosa<br>Illawarra Greenhood, Rufa Greenhood, Pouched Greenhood [4562] | Endangered | Species or species habitat known to occur within area |
| Pterostylis pulchella<br>Pretty Greenhood [6448] | Vulnerable | Species or species habitat likely to occur within area |
| Pterostylis vernalis<br>Halbury Rustyhood [84711] | Critically Endangered | Species or species habitat known to occur within area |
| Rhizanthella slateri<br>Eastern Underground Orchid [11768] | Endangered | Species or species habitat may occur within area |
| Streblus pendulinus<br>Siah's Backbone, Sia's Backbone, Isaac Wood [21618] | Endangered | Species or species habitat known to occur within area |
| Syzygium paniculatum<br>Magenta Lilly Pilly, Magenta Cherry, Pocket-less Brush Cherry, Scrub Cherry, Creek Lilly Pilly, Brush Cherry [20307] | Vulnerable | Species or species habitat likely to occur within area |
| Thelymitra kangaloonica<br>Kangaloon Sun Orchid [81861] | Critically Endangered | Species or species habitat may occur within area |
| Thesium australe<br>Austral Toadflax, Toadflax [15202] | Vulnerable | Species or species habitat likely to occur within area |
| Triplarina nowraensis<br>Nowra Heath-myrtle [64544] | Endangered | Species or species habitat known to occur within area |
| Zieria baeuerlenii<br>Bomaderry Zieria, Bomaderry Creek Zieria [56781] | Endangered | Species or species habitat likely to occur within area |
| Reptiles | | |
| Caretta caretta<br>Loggerhead Turtle [1763] | Endangered | Species or species habitat likely to occur within area |
| Chelonia mydas<br>Green Turtle [1765] | Vulnerable | Species or species habitat known to occur within area |
| Dermochelys coriacea<br>Leatherback Turtle, Leathery Turtle, Luth [1768] | Endangered | Species or species habitat known to occur within area |
| Eretmochelys imbricata<br>Hawksbill Turtle [1766] | Vulnerable | Species or species habitat known to occur within area |

| Name | Status | Type of Presence |
|---|---|---|
| Hoplocephalus bungaroides<br>Broad-headed Snake [1182] | Vulnerable | Species or species habitat likely to occur within area |
| Natator depressus<br>Flatback Turtle [59257] | Vulnerable | Species or species habitat known to occur within area |

Listed Migratory Species [ Resource Information ]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

| Name | Threatened | Type of Presence |
|---|---|---|
| Migratory Marine Birds | | |
| Apus pacificus<br>Fork-tailed Swift [678] | | Species or species habitat likely to occur within area |
| Diomedea antipodensis<br>Antipodean Albatross [64458] | Vulnerable* | Foraging, feeding or related behaviour likely to occur within area |
| Diomedea dabbenena<br>Tristan Albatross [66471] | Endangered* | Species or species habitat may occur within area |
| Diomedea epomophora (sensu stricto)<br>Southern Royal Albatross [1072] | Vulnerable* | Foraging, feeding or related behaviour likely to occur within area |
| Diomedea exulans (sensu lato)<br>Wandering Albatross [1073] | Vulnerable | Foraging, feeding or related behaviour likely to occur within area |
| Diomedea gibsoni<br>Gibson's Albatross [64466] | Vulnerable* | Foraging, feeding or related behaviour likely to occur within area |
| Diomedea sanfordi<br>Northern Royal Albatross [64456] | Endangered* | Foraging, feeding or related behaviour likely to occur within area |
| Macronectes giganteus<br>Southern Giant-Petrel [1060] | Endangered | Species or species habitat may occur within area |
| Macronectes halli<br>Northern Giant-Petrel [1061] | Vulnerable | Species or species habitat may occur within area |
| Thalassarche bulleri<br>Buller's Albatross, Pacific Albatross [64460] | Vulnerable | Species or species habitat may occur within area |
| Thalassarche cauta (sensu stricto)<br>Shy Albatross, Tasmanian Shy Albatross [64697] | Vulnerable* | Foraging, feeding or related behaviour likely to occur within area |
| Thalassarche eremita<br>Chatham Albatross [64457] | Endangered | Foraging, feeding or related behaviour likely to occur within area |
| Thalassarche impavida<br>Campbell Albatross [64459] | Vulnerable* | Species or species habitat may occur within area |
| Thalassarche melanophris<br>Black-browed Albatross [66472] | Vulnerable | Species or species habitat may occur within area |
| Thalassarche salvini<br>Salvin's Albatross [64463] | Vulnerable* | Foraging, feeding or related behaviour likely to occur within area |

| Name | Threatened | Type of Presence |
|---|---|---|
| Thalassarche steadi | | |
| White-capped Albatross [64462] | Vulnerable* | Foraging, feeding or related behaviour likely to occur within area |
| Migratory Marine Species | | |
| Caretta caretta | | |
| Loggerhead Turtle [1763] | Endangered | Species or species habitat likely to occur within area |
| Chelonia mydas | | |
| Green Turtle [1765] | Vulnerable | Species or species habitat known to occur within area |
| Dermochelys coriacea | | |
| Leatherback Turtle, Leathery Turtle, Luth [1768] | Endangered | Species or species habitat known to occur within area |
| Dugong dugon | | |
| Dugong [28] | | Species or species habitat may occur within area |
| Eretmochelys imbricata | | |
| Hawksbill Turtle [1766] | Vulnerable | Species or species habitat known to occur within area |
| Lamna nasus | | |
| Porbeagle, Mackerel Shark [83288] | | Species or species habitat likely to occur within area |
| Manta birostris | | |
| Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995] | | Species or species habitat may occur within area |
| Natator depressus | | |
| Flatback Turtle [59257] | Vulnerable | Species or species habitat known to occur within area |
| Migratory Terrestrial Species | | |
| Haliaeetus leucogaster | | |
| White-bellied Sea-Eagle [943] | | Species or species habitat known to occur within area |
| Hirundapus caudacutus | | |
| White-throated Needletail [682] | | Species or species habitat known to occur within area |
| Merops ornatus | | |
| Rainbow Bee-eater [670] | | Species or species habitat may occur within area |
| Monarcha melanopsis | | |
| Black-faced Monarch [609] | | Species or species habitat known to occur within area |
| Monarcha trivirgatus | | |
| Spectacled Monarch [610] | | Species or species habitat may occur within area |
| Myiagra cyanoleuca | | |
| Satin Flycatcher [612] | | Species or species habitat known to occur within area |
| Rhipidura rufifrons | | |
| Rufous Fantail [592] | | Species or species habitat known to occur within area |
| Migratory Wetlands Species | | |
| Ardea alba | | |
| Great Egret, White Egret [59541] | | Species or species habitat known to occur within area |
| Ardea ibis | | |
| Cattle Egret [59542] | | Species or species |

| Name | Threatened | Type of Presence |
|---|---|---|
| | | habitat may occur within area |
| Arenaria interpres<br>Ruddy Turnstone [872] | | Species or species habitat known to occur within area |
| Calidris acuminata<br>Sharp-tailed Sandpiper [874] | | Species or species habitat known to occur within area |
| Calidris alba<br>Sanderling [875] | | Species or species habitat known to occur within area |
| Calidris canutus<br>Red Knot, Knot [855] | | Species or species habitat known to occur within area |
| Calidris ferruginea<br>Curlew Sandpiper [856] | | Species or species habitat known to occur within area |
| Calidris melanotos<br>Pectoral Sandpiper [858] | | Species or species habitat known to occur within area |
| Calidris ruficollis<br>Red-necked Stint [860] | | Species or species habitat known to occur within area |
| Calidris tenuirostris<br>Great Knot [862] | | Species or species habitat known to occur within area |
| Charadrius bicinctus<br>Double-banded Plover [895] | | Species or species habitat known to occur within area |
| Charadrius leschenaultii<br>Greater Sand Plover, Large Sand Plover [877] | | Species or species habitat known to occur within area |
| Charadrius mongolus<br>Lesser Sand Plover, Mongolian Plover [879] | | Species or species habitat known to occur within area |
| Charadrius veredus<br>Oriental Plover, Oriental Dotterel [882] | | Species or species habitat known to occur within area |
| Gallinago hardwickii<br>Latham's Snipe, Japanese Snipe [863] | | Species or species habitat known to occur within area |
| Heteroscelus brevipes<br>Grey-tailed Tattler [59311] | | Species or species habitat known to occur within area |
| Limicola falcinellus<br>Broad-billed Sandpiper [842] | | Species or species habitat known to occur within area |
| Limosa lapponica<br>Bar-tailed Godwit [844] | | Species or species habitat known to occur within area |
| Limosa limosa<br>Black-tailed Godwit [845] | | Species or species habitat known to occur within area |
| Numenius madagascariensis<br>Eastern Curlew [847] | | Species or species habitat known to occur |

| Name | Threatened | Type of Presence within area |
|---|---|---|
| Numenius phaeopus | | |
| Whimbrel [849] | | Species or species habitat known to occur within area |
| Pandion cristatus | | |
| Eastern Osprey [82411] | | Species or species habitat known to occur within area |
| Pluvialis fulva | | |
| Pacific Golden Plover [25545] | | Species or species habitat known to occur within area |
| Rostratula benghalensis (sensu lato) | | |
| Painted Snipe [889] | Endangered* | Species or species habitat may occur within area |
| Tringa glareola | | |
| Wood Sandpiper [829] | | Species or species habitat known to occur within area |
| Tringa stagnatilis | | |
| Marsh Sandpiper, Little Greenshank [833] | | Species or species habitat known to occur within area |

## Other Matters Protected by the EPBC Act

**Commonwealth Land** [ Resource Information ]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

| Name |
|---|
| Commonwealth Land - |
| Commonwealth Land - Australian Postal Commission |
| Commonwealth Land - Australian Postal Corporation |
| Commonwealth Land - Australian Telecommunications Commission |
| Commonwealth Land - Defence Housing Authority |
| Commonwealth Land - Defence Service Homes Corporation |
| Defence - DCO NOWRA |
| Defence - HMAS ALBATROSS |
| Defence - Shop 3 |
| Defence - Suite 18, Holt Centre |

**Listed Marine Species** [ Resource Information ]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

| Name | Threatened | Type of Presence |
|---|---|---|
| Birds | | |
| Apus pacificus | | |
| Fork-tailed Swift [678] | | Species or species habitat likely to occur within area |
| Ardea alba | | |
| Great Egret, White Egret [59541] | | Species or species habitat known to occur within area |
| Ardea ibis | | |
| Cattle Egret [59542] | | Species or species habitat may occur within area |
| Arenaria interpres | | |
| Ruddy Turnstone [872] | | Species or species habitat known to occur within area |
| Calidris acuminata | | |
| Sharp-tailed Sandpiper [874] | | Species or species habitat known to occur |

| Name | Threatened | Type of Presence within area |
|---|---|---|
| Calidris alba<br>Sanderling [875] | | Species or species habitat known to occur within area |
| Calidris canutus<br>Red Knot, Knot [855] | | Species or species habitat known to occur within area |
| Calidris ferruginea<br>Curlew Sandpiper [856] | | Species or species habitat known to occur within area |
| Calidris melanotos<br>Pectoral Sandpiper [858] | | Species or species habitat known to occur within area |
| Calidris ruficollis<br>Red-necked Stint [860] | | Species or species habitat known to occur within area |
| Calidris tenuirostris<br>Great Knot [862] | | Species or species habitat known to occur within area |
| Charadrius bicinctus<br>Double-banded Plover [895] | | Species or species habitat known to occur within area |
| Charadrius leschenaultii<br>Greater Sand Plover, Large Sand Plover [877] | | Species or species habitat known to occur within area |
| Charadrius mongolus<br>Lesser Sand Plover, Mongolian Plover [879] | | Species or species habitat known to occur within area |
| Charadrius ruficapillus<br>Red-capped Plover [881] | | Species or species habitat known to occur within area |
| Charadrius veredus<br>Oriental Plover, Oriental Dotterel [882] | | Species or species habitat known to occur within area |
| Diomedea antipodensis<br>Antipodean Albatross [64458] | Vulnerable* | Foraging, feeding or related behaviour likely to occur within area |
| Diomedea dabbenena<br>Tristan Albatross [66471] | Endangered* | Species or species habitat may occur within area |
| Diomedea epomophora (sensu stricto)<br>Southern Royal Albatross [1072] | Vulnerable* | Foraging, feeding or related behaviour likely to occur within area |
| Diomedea exulans (sensu lato)<br>Wandering Albatross [1073] | Vulnerable | Foraging, feeding or related behaviour likely to occur within area |
| Diomedea gibsoni<br>Gibson's Albatross [64466] | Vulnerable* | Foraging, feeding or related behaviour likely to occur within area |
| Diomedea sanfordi<br>Northern Royal Albatross [64456] | Endangered* | Foraging, feeding or related behaviour likely to occur within area |
| Gallinago hardwickii<br>Latham's Snipe, Japanese Snipe [863] | | Species or species habitat known to occur within area |

| Name | Threatened | Type of Presence |
|---|---|---|
| Haliaeetus leucogaster<br>White-bellied Sea-Eagle [943] | | Species or species habitat known to occur within area |
| Heteroscelus brevipes<br>Grey-tailed Tattler [59311] | | Species or species habitat known to occur within area |
| Himantopus himantopus<br>Black-winged Stilt [870] | | Species or species habitat known to occur within area |
| Hirundapus caudacutus<br>White-throated Needletail [682] | | Species or species habitat known to occur within area |
| Lathamus discolor<br>Swift Parrot [744] | Endangered | Species or species habitat likely to occur within area |
| Limicola falcinellus<br>Broad-billed Sandpiper [842] | | Species or species habitat known to occur within area |
| Limosa lapponica<br>Bar-tailed Godwit [844] | | Species or species habitat known to occur within area |
| Limosa limosa<br>Black-tailed Godwit [845] | | Species or species habitat known to occur within area |
| Macronectes giganteus<br>Southern Giant-Petrel [1060] | Endangered | Species or species habitat may occur within area |
| Macronectes halli<br>Northern Giant-Petrel [1061] | Vulnerable | Species or species habitat may occur within area |
| Merops ornatus<br>Rainbow Bee-eater [670] | | Species or species habitat may occur within area |
| Monarcha melanopsis<br>Black-faced Monarch [609] | | Species or species habitat known to occur within area |
| Monarcha trivirgatus<br>Spectacled Monarch [610] | | Species or species habitat may occur within area |
| Myiagra cyanoleuca<br>Satin Flycatcher [612] | | Species or species habitat known to occur within area |
| Neophema chrysogaster<br>Orange-bellied Parrot [747] | Critically Endangered | Species or species habitat may occur within area |
| Numenius madagascariensis<br>Eastern Curlew [847] | | Species or species habitat known to occur within area |
| Numenius phaeopus<br>Whimbrel [849] | | Species or species habitat known to occur within area |
| Pandion haliaetus<br>Osprey [952] | | Species or species habitat known to occur within area |

| Name | Threatened | Type of Presence |
|---|---|---|
| Pluvialis fulva<br>Pacific Golden Plover [25545] | | Species or species habitat known to occur within area |
| Rhipidura rufifrons<br>Rufous Fantail [592] | | Species or species habitat known to occur within area |
| Rostratula benghalensis (sensu lato)<br>Painted Snipe [889] | Endangered* | Species or species habitat may occur within area |
| Thalassarche bulleri<br>Buller's Albatross, Pacific Albatross [64460] | Vulnerable | Species or species habitat may occur within area |
| Thalassarche cauta (sensu stricto)<br>Shy Albatross, Tasmanian Shy Albatross [64697] | Vulnerable* | Foraging, feeding or related behaviour likely to occur within area |
| Thalassarche eremita<br>Chatham Albatross [64457] | Endangered | Foraging, feeding or related behaviour likely to occur within area |
| Thalassarche impavida<br>Campbell Albatross [64459] | Vulnerable* | Species or species habitat may occur within area |
| Thalassarche melanophris<br>Black-browed Albatross [66472] | Vulnerable | Species or species habitat may occur within area |
| Thalassarche salvini<br>Salvin's Albatross [64463] | Vulnerable* | Foraging, feeding or related behaviour likely to occur within area |
| Thalassarche steadi<br>White-capped Albatross [64462] | Vulnerable* | Foraging, feeding or related behaviour likely to occur within area |
| Tringa glareola<br>Wood Sandpiper [829] | | Species or species habitat known to occur within area |
| Tringa stagnatilis<br>Marsh Sandpiper, Little Greenshank [833] | | Species or species habitat known to occur within area |
| Mammals | | |
| Dugong dugon<br>Dugong [28] | | Species or species habitat may occur within area |
| Reptiles | | |
| Caretta caretta<br>Loggerhead Turtle [1763] | Endangered | Species or species habitat likely to occur within area |
| Chelonia mydas<br>Green Turtle [1765] | Vulnerable | Species or species habitat known to occur within area |
| Dermochelys coriacea<br>Leatherback Turtle, Leathery Turtle, Luth [1768] | Endangered | Species or species habitat known to occur within area |
| Eretmochelys imbricata<br>Hawksbill Turtle [1766] | Vulnerable | Species or species habitat known to occur within area |
| Natator depressus<br>Flatback Turtle [59257] | Vulnerable | Species or species habitat known to occur |

| Name | Threatened | Type of Presence within area |
|---|---|---|

## Extra Information

### State and Territory Reserves [ Resource Information ]

| Name | State |
|---|---|
| Bamarang | NSW |
| Bomaderry Creek | NSW |
| Brundee Swamp | NSW |
| Cambewarra Range | NSW |
| Colymea | NSW |
| FMAs in NOWRA | NSW |
| South Coast Subregion of Southern Region | NSW |
| Tapitallee | NSW |
| Triplarina | NSW |
| Wogamia | NSW |
| Worrigee | NSW |

### Regional Forest Agreements [ Resource Information ]

Note that all areas with completed RFAs have been included.

| Name | State |
|---|---|
| Southern RFA | New South Wales |

### Invasive Species [ Resource Information ]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

| Name | Status | Type of Presence |
|---|---|---|
| Birds | | |
| Acridotheres tristis<br>Common Myna, Indian Myna [387] | | Species or species habitat likely to occur within area |
| Alauda arvensis<br>Skylark [656] | | Species or species habitat likely to occur within area |
| Anas platyrhynchos<br>Mallard [974] | | Species or species habitat likely to occur within area |
| Carduelis carduelis<br>European Goldfinch [403] | | Species or species habitat likely to occur within area |
| Columba livia<br>Rock Pigeon, Rock Dove, Domestic Pigeon [803] | | Species or species habitat likely to occur within area |
| Lonchura punctulata<br>Nutmeg Mannikin [399] | | Species or species habitat likely to occur within area |

| Name | Status | Type of Presence |
|---|---|---|
| Passer domesticus<br>House Sparrow [405] | | Species or species habitat likely to occur within area |
| Passer montanus<br>Eurasian Tree Sparrow [406] | | Species or species habitat likely to occur within area |
| Pycnonotus jocosus<br>Red-whiskered Bulbul [631] | | Species or species habitat likely to occur within area |
| Streptopelia chinensis<br>Spotted Turtle-Dove [780] | | Species or species habitat likely to occur within area |
| Sturnus vulgaris<br>Common Starling [389] | | Species or species habitat likely to occur within area |
| Turdus merula<br>Common Blackbird, Eurasian Blackbird [596] | | Species or species habitat likely to occur within area |
| Mammals | | |
| Bos taurus<br>Domestic Cattle [16] | | Species or species habitat likely to occur within area |
| Canis lupus familiaris<br>Domestic Dog [82654] | | Species or species habitat likely to occur within area |
| Capra hircus<br>Goat [2] | | Species or species habitat likely to occur within area |
| Felis catus<br>Cat, House Cat, Domestic Cat [19] | | Species or species habitat likely to occur within area |
| Feral deer<br>Feral deer species in Australia [85733] | | Species or species habitat likely to occur within area |
| Lepus capensis<br>Brown Hare [127] | | Species or species habitat likely to occur within area |
| Mus musculus<br>House Mouse [120] | | Species or species habitat likely to occur within area |
| Oryctolagus cuniculus<br>Rabbit, European Rabbit [128] | | Species or species habitat likely to occur within area |
| Rattus norvegicus<br>Brown Rat, Norway Rat [83] | | Species or species habitat likely to occur within area |
| Rattus rattus<br>Black Rat, Ship Rat [84] | | Species or species habitat likely to occur within area |
| Sus scrofa<br>Pig [6] | | Species or species habitat likely to occur within area |
| Vulpes vulpes<br>Red Fox, Fox [18] | | Species or species habitat likely to occur within area |

| Name | Status | Type of Presence |
|---|---|---|
| Plants | | |
| Alternanthera philoxeroides<br>Alligator Weed [11620] | | Species or species habitat likely to occur within area |
| Anredera cordifolia<br>Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643] | | Species or species habitat likely to occur within area |
| Asparagus aethiopicus<br>Asparagus Fern, Ground Asparagus, Basket Fern, Sprengi's Fern, Bushy Asparagus, Emerald Asparagus [62425] | | Species or species habitat likely to occur within area |
| Asparagus asparagoides<br>Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473] | | Species or species habitat likely to occur within area |
| Asparagus scandens<br>Asparagus Fern, Climbing Asparagus Fern [23255] | | Species or species habitat likely to occur within area |
| Cabomba caroliniana<br>Cabomba, Fanwort, Carolina Watershield, Fish Grass, Washington Grass, Watershield, Carolina Fanwort, Common Cabomba [5171] | | Species or species habitat likely to occur within area |
| Chrysanthemoides monilifera<br>Bitou Bush, Boneseed [18983] | | Species or species habitat may occur within area |
| Chrysanthemoides monilifera subsp. monilifera<br>Boneseed [16905] | | Species or species habitat likely to occur within area |
| Chrysanthemoides monilifera subsp. rotundata<br>Bitou Bush [16332] | | Species or species habitat likely to occur within area |
| Cytisus scoparius<br>Broom, English Broom, Scotch Broom, Common Broom, Scottish Broom, Spanish Broom [5934] | | Species or species habitat likely to occur within area |
| Eichhornia crassipes<br>Water Hyacinth, Water Orchid, Nile Lily [13466] | | Species or species habitat likely to occur within area |
| Genista sp. X Genista monspessulana<br>Broom [67538] | | Species or species habitat may occur within area |
| Lantana camara<br>Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892] | | Species or species habitat likely to occur within area |
| Lycium ferocissimum<br>African Boxthorn, Boxthorn [19235] | | Species or species habitat likely to occur within area |
| Nassella neesiana<br>Chilean Needle grass [67699] | | Species or species habitat likely to occur within area |
| Nassella trichotoma<br>Serrated Tussock, Yass River Tussock, Yass Tussock, Nassella Tussock (NZ) [18884] | | Species or species habitat likely to occur within area |
| Pinus radiata<br>Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780] | | Species or species habitat may occur within area |
| Protasparagus densiflorus<br>Asparagus Fern, Plume Asparagus [5015] | | Species or species habitat likely to occur |

| Name | Status | Type of Presence |
|---|---|---|
| | | within area |
| Rubus fruticosus aggregate<br>Blackberry, European Blackberry [68406] | | Species or species habitat likely to occur within area |
| Sagittaria platyphylla<br>Delta Arrowhead, Arrowhead, Slender Arrowhead [68483] | | Species or species habitat likely to occur within area |
| Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii<br>Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497] | | Species or species habitat likely to occur within area |
| Salvinia molesta<br>Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665] | | Species or species habitat likely to occur within area |
| Senecio madagascariensis<br>Fireweed, Madagascar Ragwort, Madagascar Groundsel [2624] | | Species or species habitat likely to occur within area |
| Ulex europaeus<br>Gorse, Furze [7693] | | Species or species habitat likely to occur within area |

| Nationally Important Wetlands | [ Resource Information ] |
|---|---|
| Name | State |
| Shoalhaven/Crookhaven Estuary | NSW |

# Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

# Coordinates

-34.87933 150.5759

# Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Department of Environment, Climate Change and Water, New South Wales
-Department of Sustainability and Environment, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment and Natural Resources, South Australia
-Parks and Wildlife Service NT, NT Dept of Natural Resources, Environment and the Arts
-Environmental and Resource Management, Queensland
-Department of Environment and Conservation, Western Australia
-Department of the Environment, Climate Change, Energy and Water
-Birds Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-SA Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Atherton and Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
-State Forests of NSW
-Geoscience Australia
-CSIRO
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.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global environmental solutions

Lot 30 in DP 1198692
George Evans Road, Mundamia

Proposed Residential Estate

# Flora & Fauna Assessment Report

Appendix F
Flora Species List

01 June 2015

**Table A1** Floristic data for the subject site at Mundamia

**KEY**

* Exotic species

E Endangered Species

3RCa ROTAP

2RC ROTAP

2K ROTAP

BES - (BES 2004) records

Q1-5 Systematic quadrat

Cover abundance

| Braun-Blanquet | Score |
|---|---|
| <5% uncommon | 1 |
| <5% common | 2 |
| 5-25% | 3 |
| 25-50% | 4 |
| 50-75% | 5 |
| 75-100% | 6 |

| Status | Scientific Name | Common Name | BES | Q1 | Q2 | Q3 | Q4 | Q5 |
|---|---|---|---|---|---|---|---|---|
| | **LYCOPSIDA** | | | | | | | |
| | **Lycopodiaceae** | | | | | | | |
| | *Lycopodium deuterodensum* | Bushy Clubmoss | x | | | | | |
| | **FILICOPSIDA** | | | | | | | |
| | **Adiantaceae** | | | | | | | |
| | *Adiantum aethiopicum* | Common Maidenhair | x | | | | | |
| | *Cheilanthes sieberi subsp. sieberi* | Mulga fern | x | | | | 1 | |
| | *Pellaea falcata var. falcata* | Sickle Fern | x | | | | | |
| | **Aspleniaceae** | | | | | | | |
| | *Asplenium flabellifolium* | Necklace Fern | x | | | | | |
| | **Cyatheaceae** | | | | | | | |
| | *Cyathea australis* | Rough Treefern | x | | | 1 | | |
| | **Davalliaceae** | | | | | | | |
| | *Davallia pyxidata* | Hare's Foot Fern | x | | | | | |
| | **Dennstaedtiaceae** | | | | | | | |
| | *Pteridium esculentum* | Bracken | x | 1 | 1 | 3 | 2 | |

| Status | Scientific Name | Common Name | BES | Q1 | Q2 | Q3 | Q4 | Q5 |
|---|---|---|---|---|---|---|---|---|
| | **Dicksoniaceae** | | | | | | | |
| | *Calochlaena dubia* | Dicksoniaceae | x | | | 2 | | |
| | **Gleicheniaceae** | | | | | | | |
| | *Gleichenia dicarpa* | Pouched Coral Fern | x | | | | | |
| | **Lindsaeaceae** | | | | | | | |
| | *Lindsaea linearis* | Screw Fern | x | | | | 1 | |
| | *Lindsaea microphylla* | Lacy Wedge Fern | x | | | | | |
| | **Polypodiaceae** | | | | | | | |
| | *Pyrrosia rupestris* | Rock Felt Fern | x | | | | | |
| | **CYCADOPSIDA** | | | | | | | |
| | **Zamiaceae** | | | | | | | |
| | *Macrozamia communis* | Burrawang | x | | | | | |
| | **CONIFEROPSIDA** | | | | | | | |
| | **Callitrichaceae** | | | | | | | |
| * | *Callitris sp.* | Cypress Pine | x | | | | | |
| | **MAGNOLIOPSIDA:DICOTYLEDONS** | | | | | | | |
| | **Acanthaceae** | | | | | | | |
| | *Brunoniella australis* | Blue Trumpet | x | | | | | |
| | *Brunoniella pumilio* | Dwarf Blue Trumpet | x | | 1 | | | |
| * | *Thunbergia alata* | Black-eyed Susan | x | | | | | |
| | **Amaranthaceae** | | | | | | | |
| * | *Amaranthus viridis* | Green Amaranth | x | | | | | |
| | **Apiaceae** | | | | | | | |
| | *Actinotus helianthi* | Flannel Flower | x | | | | | |
| | *Centella asiatica* | Pennywort | x | | 1 | 2 | | |
| | *Hydrocotyle peduncularis* | - | x | | | 2 | | |
| | *Platysace linearifolia* | Narrow-leafed Platysace | x | 1 | | | 2 | |
| | *Xanthosia tridentata* | Rock Xanthosia | x | | | | | |
| | **Apocynaceae** | | | | | | | |
| * | *Araujia sericifera* | Moth Vine | x | | | | | |
| | *Parsonsia straminea* | Common Silkpod | x | | | 2 | | |
| | **Asteraceae** | | | | | | | |
| * | *Ageratina adenophora* | Crofton Weed | x | | | 2 | | |
| * | *Bidens pilosa* | Cobbler's Pegs | x | | | | | |

| Status | Scientific Name | Common Name | BES | Q1 | Q2 | Q3 | Q4 | Q5 |
|---|---|---|---|---|---|---|---|---|
| | *Brachycome spathulata* | - | x | | | | | |
| * | *Cirsium vulgare* | Spear Thistle | x | | | | | |
| * | *Conyza sp.* | A Fleabane | x | | | | | |
| * | *Conyza sumatrensis* | Tall fleabane | | | 1 | 1 | | |
| | *Euchiton involucratus* | | x | | | | | |
| | *Helichrysum collinum* | A Paper-daisy | x | 1 | | | | |
| * | *Hypochaeris radicata* | Catsear | x | | | | | |
| | *Ozothamnus diosmifolius* | Everlasting | x | | | | | |
| | *Senecio hispidulus var. hispidulus* | A Groundsel | x | | | | | |
| | *Senecio linearifolius* | Fireweed Groundsel | x | | | 2 | | |
| * | *Senecio madagascariensis* | Fireweed | x | | 1 | | | |
| | *Sigesbeckia orientalis subsp. orientalis* | Indian Weed | x | | | | | |
| * | *Taraxacum officinale* | Dandelion | x | 1 | | | | |
| | **Baueraceae** | | | | | | | |
| | *Bauera rubioides* | Dog Rose | x | 1 | | | | |
| | **Campanulaceae** | | | | | | | |
| | *Wahlenbergia gracilis* | Sprawling or Australian Bluebell | x | | 1 | | | |
| | **Casuarinaceae** | | | | | | | |
| | *Allocasuarina distyla* | - | x | | | | | |
| | *Allocasuarina littoralis* | Black Sheoak | x | 3 | 2 | | 3 | 1 |
| | **Chenopodiaceae** | | | | | | | |
| * | *Chenopodium album* | Fat Hen | x | | | | | |
| | **Clusiaceae** | | | | | | | |
| | *Hypericum gramineum* | Small St John's Wort | x | 1 | | | | 1 |
| | **Convolvulaceae** | | | | | | | |
| | *Dichondra repens* | Kidney Weed | x | | | 1 | | |
| | **Crassulaceae** | | | | | | | |
| * | *Crassula multicava* | A Stonecrop | x | | | | | |
| | *Crassula sieberiana* | Austral Stonecrop | x | | | | | |
| | **Cunoniaceae** | | | | | | | |
| | *Ceratopetalum gummiferum* | NSW Christmas Bush | x | | | | | |
| | **Dilleniaceae** | | | | | | | |
| | *Hibbertia monogyna* | - | x | | | | | |
| | *Hibbertia obtusifolia* | - | x | | | | | |
| | *Hibbertia scandens* | Climbing Guinea Flower | | | | 2 | | |

| Status | Scientific Name | Common Name | BES | Q1 | Q2 | Q3 | Q4 | Q5 |
|---|---|---|---|---|---|---|---|---|
| | *Hibbertia sp.* aff. *riparia* | A Guinea-flower | x | | | | | |
| | **Droseraceae** | | | | | | | |
| | *Drosera peltata* | Pygmy Sundew | x | 1 | | | | 2 |
| | **Elaeocarpaceae** | | | | | | | |
| | *Elaeocarpus reticulatus* | Blueberry Ash | x | | | | | |
| | **Epacridaceae** | | | | | | | |
| | *Epacris microphylla* | - | x | | | 1 | | 2 |
| | *Epacris pulchella* | NSW Coral Heath | x | | | | | |
| | *Leucopogon ericoides* | - | x | | | | 2 | |
| | *Leucopogon juniperinus* | Prickly Beard-heath | x | 1 | | | | |
| | *Leucopogon lanceolatus* | Lance Beard-heath | x | | | | | |
| | *Leucopogon lanceolatus var. lanceolatus* | Lance Beard-heath | | 2 | | | | 2 |
| | *Leucopogon microphyllus* | - | x | | | | | 1 |
| | *Leucopogon virgatus* | A Beard-heath | x | | | | | |
| | *Lissanthe strigosa subsp. strigosa* | Peach Heath | x | | | | | |
| | *Monotoca scoparia* | - | x | | | | 1 | |
| | **Euphorbiaceae** | | | | | | | |
| | *Glochidion ferdinandi var. ferdinandi* | Cheese Tree | x | | | 1 | | |
| | *Homalanthus populifolius* | Bleeding Heart | | | | 1 | | |
| | *Phyllanthus hirtellus* | - | x | 2 | 1 | | 2 | |
| | *Ricinocarpos pinifolius* | Wedding Bush | | | | | 1 | |
| | **Fabaceae (Caesalpinioideae)** | | | | | | | |
| | *Senna odorata* | Southern Cassia | x | | | | | |
| | **Fabaceae (Faboideae)** | | | | | | | |
| | *Aotus ericoides* | Aotus | x | | | | | 1 |
| | *Bossiaea ensata* | - | x | | | | | |
| | *Bossiaea heterophylla* | Variable Bossiaea | x | | | | | |
| | *Bossiaea obcordata* | Spiny Bossiaea | x | | | | 2 | |
| | *Bossiaea scolopendria* | - | x | | | | 2 | |
| | *Daviesia ulicifolia* | Gorse Bitter Pea | x | | 1 | | 1 | |
| | *Dillwynia ramosissima* | Bushy Parrot-pea | x | 1 | | | | 2 |
| | *Dillwynia retorta ssp. retorta* | Eggs and Bacon | x | 1 | | | | 2 |
| | *Dillwynia rudis* | Eggs and Bacon | x | | | | | |
| | *Dillwynia sp. 'trichopoda'* | Eggs and Bacon | x | | | | | |
| | *Glycine clandestina* | - | x | 2 | 2 | | | |
| | *Glycine tabacina* | - | | 2 | | | | |
| | *Gompholobium grandiflorum* | Large Wedge Pea | x | | | | 1 | |
| | *Gompholobium pinnatum* | Pinnate Wedge Pea | x | | | | | |

| Status | Scientific Name | Common Name | BES | Q1 | Q2 | Q3 | Q4 | Q5 |
|---|---|---|---|---|---|---|---|---|
| | *Hardenbergia violacea* | False Sarsaparilla | x | | | | 1 | |
| | *Hovea linearis* | Narrow-leaved Hovea | x | | | | 1 | |
| | *Mirbelia rubiifolia* | - | x | | | | | 2 |
| | *Phyllota phylicoides* | Heath Phyllota | x | | | | | |
| | *Platylobium formosum* | Handsome Flat-pea | x | 1 | | | 2 | |
| | *Pultenaea daphnoides* | Large-leaf Bush-pea | x | 1 | 1 | | | |
| | *Pultenaea elliptica* | - | x | | | | | |
| | *Pultenaea retusa* | - | x | | | | | |
| | *Viminaria juncea* | Native Broom | x | | | | | 1 |
| | **Fabaceae (Mimosoideae)** | | | | | | | |
| | *Acacia baileyana* | Cootamundra Wattle | x | | | | | |
| | *Acacia binervata* | Two-veined Hickory | x | | | | | |
| | *Acacia elongata* | Swamp Wattle | x | | | | | |
| | *Acacia falcata* | - | x | | | | | |
| | *Acacia hispidula* | - | x | | | | | |
| | *Acacia implexa* | Hickory Wattle | x | | | | 1 | |
| | *Acacia irrorata subsp. irrorata* | Green Wattle | x | | | | | |
| | *Acacia longifolia subsp. longifolia* | Sydney Golden Wattle | x | 1 | 1 | 2 | | |
| | *Acacia mearnsii* | Black Wattle | x | | | | | |
| | *Acacia myrtifolia* | Red-stemmed Wattle | x | | | | | |
| | *Acacia obtusifolia* | - | x | | | | | |
| | *Acacia parramattensis* | Parramatta Wattle | x | | | | | |
| | *Acacia stricta* | Straight Wattle | x | | | | | |
| | *Acacia suaveolens* | Sweet Wattle | x | | | | | |
| 3RCa | *Acacia subtilinervis* | - | x | | | | | 1 |
| | *Acacia terminalis* | Sunshine Wattle | x | | | | 1 | |
| | *Acacia ulicifolia* | Prickly Moses | x | 1 | 1 | | 2 | |
| | **Gentianaceae** | | | | | | | |
| * | *Centaurium tenuiflorum* | - | x | | | | | |
| | **Goodeniaceae** | | | | | | | |
| | *Goodenia hederacea subsp. hederacea* | Ivy Goodenia | x | | | | 1 | |
| | *Goodenia heterophylla subsp. eglandulosa* | Variable-leaved Goodenia | x | 1 | | | | |
| | *Goodenia paniculata* | - | x | | | 1 | | |
| | *Scaevola ramosissima* | Purple Fan-flower | x | | | | | |
| | **Haloragaceae** | | | | | | | |
| | *Gonocarpus micranthus subsp. ramosissimus* | - | | | 3 | 2 | | |
| | *Gonocarpus tetragynus* | - | x | | | | | |
| | *Gonocarpus teucrioides* | Raspwort | x | 2 | | | | 2 |

| Status | Scientific Name | Common Name | BES | Q1 | Q2 | Q3 | Q4 | Q5 |
|---|---|---|---|---|---|---|---|---|
| | **Lamiaceae** | | | | | | | |
| | *Chloanthes stoechadis* | Common Chloanthes | x | | | | | |
| | *Plectranthus graveolens* | Netted Cockspur Flower | x | | | | | |
| | *Prostanthera incana* | Velvet Mint-bush | x | | | | | |
| | **Lauraceae** | | | | | | | |
| | *Cassytha glabella* | Slender Devil's Twine | x | | | | | |
| | *Cassytha pubescens* | Common Devil's Twine | x | 2 | | | | |
| * | *Cinnamomum camphora* | Camphor Laurel | x | | | | | |
| | **Lobeliaceae** | | | | | | | |
| | *Lobelia alata* | Angled Lobelia | x | | | | | |
| | *Pratia purpurascens* | Whiteroot | x | | | | | |
| | **Loganiaceae** | | | | | | | |
| | *Mitrasacme polymorpha* | - | x | | | | | |
| | **Meliaceae** | | | | | | | |
| | *Melia azedarach* | Meliaceae | x | | | | | |
| | *Synoum glandulosum subsp. glandulosum* | Scentless Rosewood | | | | 1 | | |
| | **Moraceae** | | | | | | | |
| | *Ficus rubiginosa* | Port Jackson Fig | x | | | | | |
| | **Myrsinaceae** | | | | | | | |
| * | *Anagallis arvensis* | Scarlet/Blue Pimpernel | x | | | | | |
| | **Myrtaceae** | | | | | | | |
| | *Angophora hispida* | Dwarf Apple | x | | | | | |
| | *Backhousia myrtifolia* | Grey Myrtle | x | | | | | |
| | *Baeckea brevifolia* | Heath-myrtle | x | | | | | 1 |
| | *Baeckea diosmifolia* | - | x | | | | | |
| | *Callistemon rigidus* | Stiff Bottlebrush | x | | | | | 3 |
| | *Calytrix tetragona* | Fringe Myrtle | x | | | | | 1 |
| | *Corymbia gummifera* | Red Bloodwood | x | 2 | | | 3 | |
| | *Corymbia maculata* | Spotted Gum | x | | 5 | | | |
| | *Eucalyptus agglomerata* | Blue-leaved Stringybark | x | 3 | | | 4 | |
| | *Eucalyptus globoidea* | White Stringybark | x | | | | | |
| | *Eucalyptus imitans* | A Stringybark | x | | | | | |
| | *Eucalyptus pilularis* | Blackbutt | x | | | | 3 | |
| | *Eucalyptus punctata* | Grey Gum | x | 4 | 3 | | 3 | 3 |
| | *Eucalyptus sclerophylla* | Hard-leaved Scribbly Gum | x | | | | | |
| | *Eucalyptus sieberi* | Silvertop Ash | x | | | | | |
| | *Kunzea ambigua* | Tick Bush | x | 4 | 1 | | 2 | 5 |

| Status | Scientific Name | Common Name | BES | Q1 | Q2 | Q3 | Q4 | Q5 |
|---|---|---|---|---|---|---|---|---|
| | *Leptospermum continentale* | Prickly Teatree | x | | | 3 | | |
| 2RC- | *Leptospermum epacridoideum* | Jervis Bay Tea Tree | x | | | | | 2 |
| | *Leptospermum morrisonii* | Morrison's Tea-tree | x | | | 1 | | |
| | *Leptospermum parvifolium* | Slender Tea-tree | x | | | | | |
| | *Leptospermum polygalifolium* | Lemon-scented Tea Tree | x | | | 1 | | |
| | *Leptospermum rotundifolium* | Round-leaf Tea-tree | x | | | | | |
| 2K | *Leptospermum sejunctum* | Nowra Tea-tree | x | | | | | 2 |
| | *Leptospermum trinervium* | Slender Tea-tree | x | | | | 2 | 1 |
| | *Melaleuca hypericifolia* | Hillock bush | x | | | | | |
| | *Melaleuca linariifolia* | Snow-in-Summer | x | | 1 | 5 | | |
| | *Melaleuca thymifolia* | - | x | | | | | 2 |
| | *Micromyrtus ciliata* | Fringed Heath-myrtle | x | | | | | |
| | *Syncarpia glomulifera* | Turpentine | x | | | | | |
| E | *Triplarina nowraensis* | Nowra Heath Myrtle | x | 3 | 4 | 2 | | 1 |
| | **Oleaceae** | | | | | | | |
| | *Notelaea longifolia* | Large Mock-olive | | | | 1 | | |
| | *Notelaea venosa* | Mock Olive | x | | 1 | | | |
| | **Passifloraceae** | | | | | | | |
| | *Passiflora herbertiana subsp. herbertiana* | - | x | | | | | |
| | **Phormiaceae** | | | | | | | |
| | *Dianella caerulea* | Blue Flax lily | x | | | | | |
| | *Dianella caerulea var. producta* | Blue Flax lily | x | | 1 | | | |
| | Phytolaccaceae | | | | | | | |
| * | *Phytolacca octandra* | Inkweed | x | | | | | |
| | **Pittosporaceae** | | | | | | | |
| | *Billardiera scandens* | Appleberry | x | 1 | | 1 | | |
| | *Bursaria spinosa var. spinosa* | Native Blackthorn | x | | | | | |
| | *Pittosporum revolutum* | Rough Fruit Pittosporum | x | | | | | |
| | *Pittosporum undulatum* | Sweet Pittosporum | x | | 1 | | | |
| | **Plantaginaceae** | | | | | | | |
| * | *Plantago lanceolata* | Lamb's Tongues | x | | | | | |
| | **Polygalaceae** | | | | | | | |
| | *Comesperma ericinum* | Matchheads | x | | | | 1 | |
| | *Comesperma volubile* | - | x | | | | | |
| | **Proteaceae** | | | | | | | |
| | *Banksia paludosa* | - | x | | | | | |

| Status | Scientific Name | Common Name | BES | Q1 | Q2 | Q3 | Q4 | Q5 |
|---|---|---|---|---|---|---|---|---|
| | *Banksia serrata* | Old-man Banksia | x | | | | 3 | |
| | *Banksia spinulosa* | Hairpin Banksia | x | 3 | 1 | | 2 | 2 |
| | *Conospermum longifolium subsp. longifolium* | - | x | | | | | |
| | *Hakea dactyloides* | Broad-leaved Hakea | x | | | | | 1 |
| | *Hakea salicifolia* | Willow-leaved Hakea | x | | | | | |
| | *Hakea sericea* | Needlebush | x | 1 | | | | 2 |
| | *Hakea teretifolia* | Dagger Hakea | x | | | | | 2 |
| | *Isopogon anemonifolius* | Broad-leaf Drumsticks | x | | | | | |
| | *Isopogon anethifolius* | - | x | | | | | |
| | *Lambertia formosa* | Mountain Devil | x | | | | 1 | |
| | *Lomatia ilicifolia* | Holly-leaved Lomatia | x | | | | | |
| | *Persoonia levis* | Broad-leaved Geebung | x | | | | 1 | 1 |
| | *Persoonia linearis* | Narrow-leaved Geebung | x | 2 | 2 | | 3 | 2 |
| | *Persoonia mollis* | | x | 2 | | | 2 | |
| | *Petrophile pedunculata* | - | x | | | | | |
| | *Petrophile pulchella* | Conesticks | x | | | | 3 | |
| | *Telopea speciosissima* | Waratah | x | 2 | | | 2 | |
| | **Ranunculaceae** | | | | | | | |
| | *Clematis aristata* | Old Man's Beard | x | | | | | |
| | **Rhamnaceae** | | | | | | | |
| | *Pomaderris discolor* | - | x | | | | | |
| | *Pomaderris intermedia* | - | x | | 1 | | | |
| | **Rubiaceae** | | | | | | | |
| | *Morinda jasminoides* | Sweet Morinda | x | | | 2 | | |
| | *Opercularia aspera* | Coarse Stinkweed | x | | | | | |
| | *Pomax umbellata* | Pomax | x | 2 | 2 | | 2 | |
| | **Rutaceae** | | | | | | | |
| | *Correa reflexa var. reflexa* | Native Fuchsia | x | | | | | |
| | *Crowea exalata* | - | x | | | | | |
| | *Philotheca scabra subsp. scabra* | A wax-flower | x | | | | | |
| | *Zieria laevigata var. laxiflora* | A Zieria | x | | | | | |
| | *Zieria pilosa* | Hairy Zieria | x | | | | | |
| | *Zieria smithii* | Sandfly Zieria | x | | | | | |
| | **Santalaceae** | | | | | | | |
| | *Exocarpos strictus* | Dwarf Cherry | x | | | | | |
| | *Leptomeria acida* | Sour Currant Bush | x | | | | 2 | 1 |
| | **Sapindaceae** | | | | | | | |
| | *Dodonaea triquetra* | Large-leaf Hop-bush | x | 1 | | | | |

| Status | Scientific Name | Common Name | BES | Q1 | Q2 | Q3 | Q4 | Q5 |
|---|---|---|---|---|---|---|---|---|
| | **Scrophulariaceae** | | | | | | | |
| | *Veronica plebeia* | Trailing Speedwell | x | | 1 | | 1 | |
| | **Selaginellaceae** | | | | | | | |
| | *Selaginella uliginosa* | Swamp Selaginella | x | | | 1 | | |
| | **Solanaceae** | | | | | | | |
| * | *Solanum nigrum* | Black-berry Nightshade | x | | | | | |
| | *Solanum pungetium* | Eastern Nightshade | x | | | | | |
| | **Sterculiaceae** | | | | | | | |
| | *Lasiopetalum ferrugineum var. ferrugineum* | Rusty Petals | x | 1 | | | | |
| | **Stylidiaceae** | | | | | | | |
| | *Stylidium graminifolium* | Grass Triggerplant | x | | 1 | | 1 | |
| | *Stylidium laricifolium* | Giant Triggerplant | x | | | | 1 | |
| | **Thymelaeaceae** | | | | | | | |
| | *Pimelea linifolia* | Slender Rice-flower | x | 2 | 2 | | | 1 |
| | **Verbenaceae** | | | | | | | |
| * | *Lantana camara* | Lantana | x | | | 2 | | |
| * | *Verbena sp.* | A Purpletop | x | | | | | |
| | **Violaceae** | | | | | | | |
| | *Viola hederacea* | Ivy-leaved Violet | | | | 2 | | |
| | **MAGNOLIOPSIDA: MONOCOTYLEDONS** | | | | | | | |
| | **Anthericaceae** | | | | | | | |
| | *Caesia parviflora var. parviflora* | - | x | | | | | |
| * | *Chlorophytum comosum* | Spider Plant | x | | | | | |
| | *Laxmannia gracilis* | Slender Wire Lily | x | 1 | | | | |
| | *Thysanotus tuberosus* | Common Fringe-lily | x | | | | | |
| | **Commelinaceae** | | | | | | | |
| | *Commelina cyanea* | Native Wandering Jew | x | | 1 | 1 | | |
| | **Cyperaceae** | | | | | | | |
| | *Caustis flexuosa* | Curly Wig | x | | | | | |
| | *Cyperus polystachyos* | A Sedge | x | | | | | |
| | *Eleocharis sp.* | - | x | | | | | |
| | *Fimbristylis dichotoma* | Common Fringe-sedge | x | | | | | |
| | *Gahnia aspera* | Rough Saw-sedge | x | | 1 | | | |

| Status | Scientific Name | Common Name | BES | Q1 | Q2 | Q3 | Q4 | Q5 |
|---|---|---|---|---|---|---|---|---|
| | *Gahnia clarkei* | Tall Saw-sedge | x | | | 4 | | |
| | *Gahnia radula* | A Saw-sedge | x | | | | | |
| | *Lepidosperma concavum* | A sword-sedge | x | | | | | |
| | *Lepidosperma laterale* | Variable Sword-sedge | x | 2 | 2 | | 2 | |
| | *Lepidosperma sp.* | - | x | | | | | |
| | *Ptilothrix deusta* | - | x | | 2 | | | 1 |
| | *Schoenus apogon* | Fluke Bogrush | | | 4 | 2 | | 2 |
| | *Schoenus imberbis* | Beardless Bog-rush | x | | | | | 1 |
| | **Haemodoraceae** | | | | | | | |
| | *Haemodorum corymbosum* | Blood Root | x | | | | | |
| | **Hypoxidaceae** | | | | | | | |
| | *Hypoxis hygrometrica* | Golden Weather-grass | x | | | | | |
| | **Iridaceae** | | | | | | | |
| | *Patersonia glabrata* | Leafy Purple-flag | x | | | | | |
| | *Patersonia sericea* | Silky Purple-Flag | x | 2 | 1 | | 2 | |
| | **Lomandraceae** | | | | | | | |
| | *Lomandra confertifolia subsp. rubiginosa* | A mat-rush | x | 2 | 2 | | | |
| | *Lomandra glauca subsp. glauca* | Pale Mat-rush | x | | | | 2 | 2 |
| | *Lomandra gracilis* | - | | | | | 1 | |
| | *Lomandra longifolia* | Spiny-headed Mat-rush | x | 3 | 3 | 1 | | |
| | *Lomandra multiflora* | Many-flowered Mat-rush | x | 2 | | | 2 | 2 |
| | *Lomandra obliqua* | Fish Bones | x | | | | 2 | |
| | **Luzuriagaceae** | | | | | | | |
| | *Eustrephus latifolius* | Wombat Berry | x | | | | | |
| | **Orchidaceae** | | | | | | | |
| | *Caladenia alata* | - | | 1 | | | | |
| | *Cryptostylis* Sp. (Leaf only) | A Tongue Orchid | | | 1 | | | |
| | *Cryptostylis subulata* | Large Tongue Orchid | x | | | | | |
| | *Cymbidium suave* | Snake Orchid | x | | | | | |
| | *Dendrobium speciosum* | Rock Lily | x | | | | | |
| | *Diuris sulphurea* | Hornet Orchid | | 1 | 1 | | | |
| | *Spiranthes australis* | Austral Ladies Tresses | x | | | | | |
| | **Poaceae** | | | | | | | |
| * | *Andropogon virginicus* | Whisky Grass | | | | | 1 | |
| | *Anisopogon avenaceus* | Oat Speargrass | x | | | | | 1 |
| | *Aristida* sp. | A Three-awn Speargrass | x | | | | | |
| | *Aristida vagans* | Threeawn Speargrass | x | 2 | | | 2 | 2 |

| Status | Scientific Name | Common Name | BES | Q1 | Q2 | Q3 | Q4 | Q5 |
|---|---|---|---|---|---|---|---|---|
| | *Austrodanthonia tenuior* | - | x | | | | 1 | |
| | *Austrostipa pubescens* | Tall Speargrass | | | | | 2 | |
| * | *Briza maxima* | Quaking Grass | x | | | | | |
| * | *Bromus catharticus* | Prairie Grass | x | | | | | |
| * | *Cortaderia selloana* | Pampas Grass | x | | | | | |
| | *Cymbopogon refractus* | Barbed Wire Grass | x | | | | | |
| | *Cynodon dactylon* | Common Couch | | | | 3 | | |
| | *Deyeuxia quadriseta* | Reed Bent Grass | x | | | | | |
| | *Digitaria parviflora* | Small-flowered Finger Grass | | 1 | | 1 | 1 | |
| | *Digitaria sp.* | A Fingergrass | x | | | | | |
| | *Echinopogon caespitosus var. caespitosus* | Tufted Hedgehog Grass | x | 2 | | | | |
| * | *Ehrharta erecta* | Panic Veldtgrass | x | | | | | |
| | *Entolasia marginata* | Bordered Panic | x | 1 | 2 | 2 | | |
| | *Entolasia stricta* | Wiry Panic | x | 3 | 2 | 2 | 2 | 2 |
| | *Eragrostis benthamii* | - | | | | | 1 | |
| | *Eragrostis brownii* | Brown's Lovegrass | x | 1 | | | 2 | 2 |
| | *Eragrostis leptostachya* | Paddock Lovegrass | | 2 | | | | |
| | *Imperata cylindrica var. major* | Blady Grass | x | 2 | 2 | 2 | | |
| | *Microlaena stipoides var. stipoides* | - | x | 2 | 2 | | | |
| | *Oplismenus aemulus* | - | x | | | 3 | | |
| | *Panicum simile* | Two-colour Panic | | 2 | 1 | | 2 | |
| | *Panicum sp.* | - | x | | | | | |
| * | *Paspalum dilatatum* | Paspalum | x | | | | | |
| * | *Paspalum urvillei* | Vasey Grass | x | | | | | |
| * | *Pennisetum clandestinum* | Kikuyu Grass | x | | | | | |
| * | *Setaria geniculata* | Slender Pigeon Grass | x | | | | | |
| | *Themeda australis* | Kangaroo Grass | x | 2 | | | 1 | |
| | **Restionaceae** | | | | | | | |
| | *Leptocarpus tenax* | - | x | | | | | |
| | *Lepyrodia scariosa* | Scale Rush | x | | | | | 3 |
| | **Smilacaceae** | | | | | | | |
| | *Smilax glyciphylla* | Sweet Sarsaparilla | x | | | | | |
| | **Xanthorrhoeaceae** | | | | | | | |
| | *Xanthorrhoea resinosa subsp. resinosa* | A Grasstree | x | | | | 2 | |

global environmental solutions

Lot 30 in DP 1198692
George Evans Road, Mundamia

Proposed Residential Estate

# Flora & Fauna Assessment Report

Appendix G
Fauna Species List

01 June 2015

Appendix G Fauna Species List

**Key:**
Legal Status:
TSC Act = NSW *Threatened Species Conservation Act, 1995*
EPBC Act = Commonwealth *Environmental Protection and Biodiversity Conservation Act, 1999*
V = Vulnerable; M = Migratory
Taxonomy:
Non-flying Mammals – Ronald Strahan (1995) "*Mammals of Australia*"
Bats – Sue Churchill (1998) "*Australian Bats*"
Amphibians – Martin Robinson (1998) "*A Field Guide to Frogs*"
Birds – Les Christidis and Walter Boles (2008) "*Systematics and Taxonomy of Australian Birds*"

| Family | Scientific Name | Common Name | Legal Status | | | Survey | | |
|---|---|---|---|---|---|---|---|---|
| | | | Introduced | TSC Act | EPBC Act | BES 2004 | InSites 2008 | SLR 2014 |
| **Amphibians** | | | | | | | | |
| Hylidae | *Litoria dentata* | Bleating Tree Frog | | | | X | | |
| | *Litoria peronii* | Peron's Tree Frog | | | | X | X | |
| | *Litoria verreauxii* | Verreaux's Tree Frog | | | | X | X | X |
| Myobatrachidae | *Crinia signifera* | Common Eastern Froglet | | | | X | X | X |
| | *Paracrinia haswelli* | Haswell's Froglet | | | | X | X | |
| | *Limnodynastes peronii* | Striped Marsh Frog | | | | | X | |
| | *Uperoleia tyleri* | Tyler's Toadlet | | | | X | X | |
| **Reptiles** | | | | | | | | |
| Agamidae | *Amphibolurus muricatus* | Jacky Lizard | | | | X | X | |
| Elapidae | *Pseudonaja textilis* | Common Brown Snake | | | | | X | |
| | *Pseudechis porphyriacus* | Red-bellied Black Snake | | | | X | | |
| Scincidae | *Ctenotus taeniolatus* | Copper-tailed Skink | | | | X | | X |
| | *Lampropholis delicata* | Garden Skink | | | | X | X | X |
| | *Lampropholis guichenoti* | Grass Skink | | | | X | | |
| | *Tiliqua scincoides* | Blue-tongue Lizard | | | | | | X |
| Varanidae | *Varanus varius* | Lace Monitor | | | | X | | X |

Appendix G Fauna Species List

| Family | Scientific Name | Common Name | Legal Status | | | Survey | | |
|---|---|---|---|---|---|---|---|---|
| | | | Introduced | TSC Act | EPBC Act | BES 2004 | InSites 2008 | SLR 2014 |
| **Avifauna** | | | | | | | | |
| Acanthizidae | *Gerygone mouki* | Brown Gerygone | | | | | X | |
| | *Acanthiza nana* | Yellow Thornbill | | | | | | X |
| | *Acanthiza pusilla* | Brown Thornbill | | | | X | X | |
| | *Origma solitaria* | Rock Warbler | | | | X | X | X |
| | *Acanthiza lineata* | Striated Thornbill | | | | X | X | |
| | *Sericornis frontalis* | White-browed Scrubwren | | | | | X | X |
| | *Gerygone olivacea* | White-throated Gerygone | | | | | X | |
| Accipitridae | *Lophoictinia isura* | Square-tailed Kite | | V | M | X | | |
| | *Haliaeetus leucogaster* | White-bellied Sea Eagle | | | M | | X | X |
| Aegothelidae | *Aegotheles cristatus* | Australian Owlet-nightjar | | | | X | X | |
| Alcedinidae | *Alcedo azurea* | Azure Kingfisher | | | | | X | |
| Anatidae | *Chenonetta jubata* | Australian Wood Duck | | | M | X | X | |
| Artamidae | *Gymnorhina tibicen* | Australian Magpie | | | | X | X | X |
| | *Artamus cyanopterus* | Dusky Woodswallow | | | | X | | |
| | *Cracticus torquatus* | Grey Butcherbird | | | | X | X | X |
| | *Strepera graculina* | Pied Currawong | | | | | X | X |
| Cacatuidae | *Cacatua roseicapilla* | Galah | | | | X | X | X |
| | *Callocephalon fimbriatum* | Gang-gang Cockatoo | | V | | X | | |
| | *Calyptorhynchus lathami* | Glossy Black Cockatoo | | V | | X | X | X |
| | *Cacatua galerita* | Sulphur-crested Cockatoo | | | | X | X | |
| | *Calyptorhynchus funereus* | Yellow-tailed Black Cockatoo | | | | X | X | X |
| Campephagidae | *Coracina novaehollandiae* | Black-faced Cuckoo-shrike | | | | X | X | X |
| Caprimulgidae | *Eurostopodus mystacalis* | White-throated Nightjar | | | | X | | |
| Charadriidae | *Vanellus miles* | Masked Lapwing | | | M | X | X | |
| Cinclosomatidae | *Psophodes olivaceus* | Eastern Whipbird | | | | X | X | X |

Appendix G Fauna Species List

| Family | Scientific Name | Common Name | Legal Status | | | Survey | | |
|---|---|---|---|---|---|---|---|---|
| | | | Introduced | TSC Act | EPBC Act | BES 2004 | InSites 2008 | SLR 2014 |
| Climacteridae | *Cormobates leucophaeus* | White-throated Tree-creeper | | | | X | | X |
| Columbidae | *Macropygia amboinensis* | Brown Cuckoo-Dove | | | | | X | |
| | *Phaps chalcoptera* | Common Bronze-wing | | | | X | X | |
| | *Geopelia striata* | Peaceful Dove | | | | X | | X |
| Coraciidae | *Eurystomus orientalis* | Dollarbird | | | | X | | |
| Corvidae | *Corvus coronoides* | Australian Raven | | | | X | X | X |
| Cuculidae | *Chalcites basalis* | Horsfield's Bronze-Cuckoo | | | | | | X |
| | *Eudynamys scolopacea* | Common Koel | | | | | X | |
| | *Scythrops novaehollandiae* | Channel-billed Cuckoo | | | | | X | |
| Dicaeidae | *Dicaeum hirundinaceum* | Mistletoebird | | | | | X | |
| Dicruridae | *Rhipidura albiscapa* | Grey Fantail | | | | X | X | X |
| | *Myiagra rubecula* | Leaden Flycatcher | | | | X | | |
| | *Grallina cyanoleuca* | Magpie-lark | | | | X | X | X |
| | *Rhipidura rufifrons* | Rufous Fantail | | | | X | | |
| | *Rhipidura leucophrys* | Willie Wagtail | | | | X | | X |
| Halcyonidae | *Dacelo novaeguineae* | Kookaburra | | | | X | X | X |
| | *Todirhamphus sanctus* | Sacred Kingfisher | | | | X | | |
| Hirundinidae | *Hirundo nigricans* | Tree Martin | | | | X | | X |
| | *Hirundo neoxena* | Welcome Swallow | | | | | X | |
| Maluridae | *Malurus cyaneus* | Superb Fairy-wren | | | | X | X | X |
| | *Malurus lamberti* | Variegated Fairy-wren | | | | X | X | |
| Meliphagidae | *Acanthorhynchus tenuirostris* | Eastern Spinebill | | | | X | X | X |
| | *Meliphaga lewinii* | Lewin's Honeyeater | | | | X | X | X |
| | *Phylidonyris novaehollandiae* | New Holland Honeyeater | | | | X | | X |
| | *Philemon corniculatus* | Noisy Friarbird | | | | X | X | |
| | *Anthochaera carunculata* | Red Wattlebird | | | | X | X | |

| Family | Scientific Name | Common Name | Legal Status | | | Survey | | |
|---|---|---|---|---|---|---|---|---|
| | | | Introduced | TSC Act | EPBC Act | BES 2004 | InSites 2008 | SLR 2014 |
| | *Myzomela sanguinolenta* | Scarlet Honeyeater | | | | X | | |
| | *Lichenostomus leucotis* | White-eared Honeyeater | | | | X | | |
| | *Melithreptus lunatus* | White-naped Honeyeater | | | | X | | |
| | *Lichenostomus chrysops* | Yellow-faced Honeyeater | | | | X | X | |
| | *Lichenostomus melanops* | Yellow-tufted Honeyeater | | | | X | X | X |
| Menuridae | *Menura novaehollandiae* | Superb Lyrebird | | | | X | | X |
| Oriolidae | *Oriolus sagittatus* | Olive-backed Oriole | | | | | X | |
| Pachycephalidae | *Pachycephala pectoralis* | Golden Whistler | | | | | X | X |
| | *Colluricincla harmonica* | Grey Shrike-thrush | | | | X | X | X |
| | *Pachycephala rufiventris* | Rufous Whistler | | | | X | X | |
| Pardalotidae | *Pardalotus punctatus* | Spotted Pardalote | | | | X | X | X |
| | *Pardalotus striatus* | Striated Pardalote | | | | X | X | |
| Passeridae | *Taeniopygia bichenovii* | Double-barred Finch | | | | X | | |
| | *Neochmia temporalis* | Red-browed Finch | | | | X | | X |
| Petroicidae | *Eopsaltria australis* | Eastern Yellow Robin | | | | | X | X |
| | *Microeca fascinans* | Jacky Winter | | | | | X | |
| | *Petroica rosea* | Rose Robin | | | | | | X |
| Psittacidae | *Platycercus elegans* | Crimson Rosella | | | | X | X | X |
| | *Platycercus eximius* | Eastern Rosella | | | | X | X | X |
| | *Glossopsitta pusilla* | Little Lorikeet | | | | X | | |
| | *Glossopsitta concinna* | Musk Lorikeet | | | | X | | |
| | *Trichoglossus haematodus* | Rainbow Lorikeet | | | | X | | X |
| Ptilonorhynchidae | *Ptilonorhynchus violaceus* | Satin Bowerbird | | | | X | X | X |
| Strigidae | *Ninox strenua* | Powerful Owl | | V | | X | | X |
| | *Ninox novaeseelandiae* | Southern Boobook | | | | X | | |
| Turdidae | *Zoothera lunulata* | Bassian Thrush | | | | | | X |

| Family | Scientific Name | Common Name | Legal Status | | | Survey | | |
|---|---|---|---|---|---|---|---|---|
| | | | Introduced | TSC Act | EPBC Act | BES 2004 | InSites 2008 | SLR 2014 |
| Zosteropidae | *Zosterops lateralis* | Silvereye | | | | | X | |
| **Mammals** | | | | | | | | |
| Bovidae | *Bos taurus* | European Cattle | Domestic | | | X | | |
| | *Ovis aries* | Sheep | Domestic | | | | X | |
| Canidae | *Canis familiaris* | Dog | Domestic | | | X | X | X |
| | *Vulpes vulpes* | Fox | X | | | X | X | |
| Dasyuridae | *Antechinus agilis* | Agile Antechinus | | | | X | | X |
| Equidae | *Equus caballus* | Horse | Domestic | | | X | | |
| Felidae | *Felis catus* | Cat | Domestic | | | X | | |
| Leporidae | *Lepus capensis* | Brown Hare | X | | | X | | |
| | *Oryctolagus cuniculus* | Rabbit | X | | | X | X | X |
| Macropodidae | *Macropus giganteus giganteus* | Eastern Grey Kangaroo | | | | X | X | X |
| | *Wallabia bicolor* | Swamp Wallaby | | | | X | | X |
| Molossidae | *Mormopterus norfolkensis* | East-coast Free-tail Bat | | V | | | X | |
| | *Tadarida australis* | White-striped Free-tail Bat | | | | X | X | |
| Muridae | *Rattus lutreolus* | Swamp Rat | | | | X | | |
| | *Rattus fuscipes* | European Rat | X | | | | | |
| Peramelidae | *Perameles nasuta nasuta* | Long-nosed Bandicoot | | | | X | | |
| Petauridae | *Petaurus breviceps breviceps* | Sugar Glider | | | | X | X | X |
| | *Petaurus australis australis* | Yellow-bellied Glider | | V | | X | X | X |
| Phalangeridae | *Trichosurus vulpecula vulpecula* | Common Brushtail Possum | | | | X | | |
| Pseudocheiridae | *Pseudocheirus peregrinus peregrinus* | Common Ringtail Possum | | | | X | X | X |
| Pteropodidae | *Pteropus poliocephalus* | Grey-headed Flying Fox | | V | V | X | | |
| Rhinolophidae | *Rhinolophus megaphyllus* | Eastern Horseshoe Bat | | | | X | X | X |
| Vespertilionidae | *Miniopterus schreibersii oceanensis* | Common Bent-wing Bat | | V | | X | X | |
| | *Chalinolobus morio* | Chocolate Wattled Bat | | | | X | X | X |

| Family | Scientific Name | Common Name | Legal Status | | | Survey | | |
|---|---|---|---|---|---|---|---|---|
| | | | Introduced | TSC Act | EPBC Act | BES 2004 | InSites 2008 | SLR 2014 |
| | *Scotorepens orion* | Eastern Broad-nosed Bat | | | | X | | |
| | *Chalinolobus gouldii* | Gould's Wattled Bat | | | | X | X | X |
| | *Vespadelus darlingtoni* | Large Forest Bat | | | | X | X | X |
| | *Vespadelus vulturnus* | Little Forest Bat | | | | X | X | X |
| | *Vespadelus regulus* | Southern Forest Bat | | | | | X | |
| | *Nyctophilus gouldi* | Gould's Long-eared Bat | | | | | X | |
| | *Nyctophilus geoffroyi* | Lesser Long-eared Bat | | | | | X | |
| | *Nyctophilus sp.* | Long-eared Bat | | | | X | | |
| Vombatidae | *Wombatus ursinus ursinus* | Common Wombat | | | | | X | X |

global environmental solutions

Lot 30 in DP 1198692
George Evans Road, Mundamia

Proposed Residential Estate

# Flora & Fauna Assessment Report

Appendix H
EPBC Referral Decision

01 June 2015

Australian Government
Department of Sustainability, Environment, Water, Population and Communities

Mr Francis Dominic Fanning
Technical Director – Ecology
SLR Consulting Australasia Pty Ltd
PO Box 176
LANE COVE NSW 1595

Date: 26 April 2012
EPBC Ref: 2012/6327
EPBC contact: Mark Jenkins
(02) 6274 1558
mark.jenkins@environment.gov.au

Dear Mr Fanning

**Decision on referral**
**Residential development - Lot 3 and Lot 384 George Evans Road Mundamia, NSW**

This is to advise you of my decision, under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), about the proposed action to develop a residential subdivision at Lot 3 and Lot 384 George Evans Road, Mundamia, New South Wales.

**As a delegate of the Minister for Sustainability, Environment, Water, Population and Communities, I have decided that the proposed action is not a controlled action. This means that the proposed action does not require further assessment and approval under the EPBC Act before it can proceed.**

A copy of the document recording this decision is enclosed. This document will be published on the department's website.

Please note that this decision relates only to the specific matters protected under Chapter 2 of the EPBC Act.

This decision does not affect any requirement for separate state or local government environment assessment and approvals of the proposed action.

The department has an active audit program for proposals that have been referred under the EPBC Act. The audit program aims to ensure that proposals are implemented as planned. You should be aware that the project may be selected for audit by the department at any time and all related records and documents may be subject to scrutiny. Information about the department's compliance monitoring and auditing program is enclosed.

I have also written to Mr Richard Ash, Project Manager, Twynam Mundamia Pty Ltd and Mr John Ross, Project Manager, NSW Department of Planning and Infrastructure advising them of this decision.

If you have any questions about the referral process or this decision, please contact the EPBC project manager and quote the EPBC reference number shown at the beginning of this letter.

Yours sincerely

Charmayne Murray
Assistant Secretary (acting)
Environment Assessment Branch

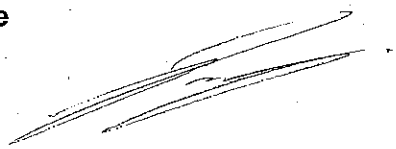
# Notification of REFERRAL DECISION – not controlled action

## Residential development - Lot 3 and Lot 384 George Evans Road Mundamia, NSW (EPBC 2012/6327)

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

| **Proposed action** | |
|---|---|
| **person named in the referral** | Twynam Mundamia Pty Ltd (ABN 68 147 695 994) |
| **proposed action** | The proposed action is the development of a residential subdivision at Lot 3 and Lot 384 George Evans Road, Mundamia, New South Wales, as described in the referral documentation received on 26 March 2012 (see EPBC Act referral 2012/6327). |

| **Referral decision: Not a controlled action** | |
|---|---|
| **status of proposed action** | The proposed action is not a controlled action. |

| **Person authorised to make decision** | |
|---|---|
| **Name and position** | Charmayne Murray<br>Assistant Secretary (acting)<br>Environment Assessment Branch |
| **signature** |  |
| **date of decision** | 26/4/2012 |

global environmental solutions

Lot 30 in DP 1198692
George Evans Road, Mundamia

Proposed Residential Estate

# Flora & Fauna Assessment Report

Appendix I
Vegetation Management Principles Plan

22 May 2015

**LOT 30 in DP 1198692**
**GEORGE EVANS ROAD, MUNDAMIA**
**PROPOSED RESIDENTIAL ESTATE**

**FLORA & FAUNA ASSESSMENT REPORT**

**VEGETATION MANAGEMENT PRINCIPLES PLAN**

## 1 INTRODUCTION

- The proposed residential development of the subject site at Mundamia involves the retention of 9.49 hectares of vegetation for conservation purposes running along the northern and eastern boundaries of the proposed sub-division (Figure 1).
- The *Conservation Area* is proposed to be zoned *2E – Environmental Conservation* as part of the rezoning of the site.
- A variable width *Asset Protection Zone* (APZ), to be managed as an *Inner Protection Area* (IPA) is required along the western boundary of the *Conservation Area*.
- The remainder of the vegetation within the *Conservation Area* will be retained and managed for biodiversity conservation purposes.
- This *Vegetation Management Principles Plan* (VMPP) outlines the structure and general principles of the final *Vegetation Management Plan* (VMP) which will be produced following approval of the Part 3A *Project Application*.
- One threatened flora species Nowra Heath Myrtle *Triplarina nowraensis* is present within the proposed *Conservation Area* (Figure 2), some of which are located within the proposed *Asset Protection Zone* (APZ).
- All individuals of this species within the *Conservation Area* are to be retained and the VMP would provide detailed recommendations on the management of this species, the aim being to protect, conserve and expand the local population.
- Eight threatened fauna species have been recorded within and adjacent to the subject site, and the proposed *Conservation Area* provides the highest quality habitat for these species (the East Coast Free-tail Bat, Common Bent-wing Bat, Grey-headed Flying Fox, Yellow-bellied Glider, Square-tailed Kite, Powerful Owl, Gang Gang Cockatoo and Glossy Black Cockatoo).
- The area of vegetation to be retained within the *Conservation Area* will involve 3 different management regimes:
  - the active management of the APZ within the *Conservation Area*;
  - the active management of the water quality features at the interface between the development footprint and the *Conservation Area*; and
  - management of the remainder of vegetation within the *Conservation Area*.
- The aims of this VMPP are to provide the basic principles to guide the preparation of a detailed VMP with respect to:
  - the management and maintenance of the APZ;
  - management of the population of and habitat for the Nowra Heath Myrtle;
  - the management and maintenance of the water quality features;
  - the implementation of appropriate enhancement measures within areas of retained native vegetation;
  - the maintenance and enhancement of habitat for native fauna; and
  - monitoring of the *Conservation Area*, APZs, constructed swales and detention areas.

## 2 GENERAL PROTECTION MEASURES

- Erection of appropriate protection barriers and signage, including temporary fencing and sediment fencing (pursuant to a *Fencing Protocol*).
- Identification by the Project Ecologist of all trees to be removed within the APZ for bushfire protection purposes, avoiding hollow-bearing trees (unless absolutely necessary).
- The identification of individuals of the Nowra Heath Myrtle to ensure their protection during any management activities.
- The provision of sediment fences around all earthworks to protect areas of retained vegetation and/or habitats downslope and downstream.
- The conduct of an environmental induction program for site workers, and the provision of relevant signage around the site.
- Monitoring of works and the provision of a mechanism for the remedy of any disturbance or damage.

## 3 VEGETATION WITHIN the CONSERVATION AREA

- The overwhelming majority of the *Conservation Area* will be managed to maintain the current biodiversity values.
- Specific activities to be undertaken in this area will include:
  - a dedicated and ongoing weed removal and monitoring program;
  - the removal of debris and rubbish;
  - the identification of areas requiring supplementary plantings, and the implementation of a planting regime if necessary;
  - the implementation of a monitoring program during and immediately post-construction to identify any problems which may arise and to monitor the ongoing condition of vegetation in this area; and,
  - monitoring of the Nowra Heath Myrtle population.
- Given the relatively good condition of most the vegetation communities in the *Conservation Area*, it is considered that any weed management will be minor.
- It is likely that supplementary plantings will not be required throughout the majority of the *Conservation Area*. The only areas where supplementary plantings may be required is potentially along roads and other areas of disturbance.

## 4 ASSET PROTECTION ZONES

- Management of the *Asset Protection Zones* (APZs) within the *Conservation Area* along the eastern side of the residential subdivision will be undertaken in an environmentally sensitive manner, designed to achieve the requirements of the RFS without compromising the integrity of the vegetation communities or threatened species habitats.
- Any removal of vegetation within the APZs will be the minimum required by the RFS to achieve acceptable bushfire protection outcomes.
- All removal or modification of vegetation within the APZs will be supervised by the Project Ecologist to ensure threatened species habitat is maintained.
- Hollow-bearing trees and Yellow-bellied Glider feed trees will be retained preferentially throughout the APZs under the supervision of the Project Ecologist.
- All removal or thinning of mid-storey and understorey vegetation will be conducted by hand and/or hand tools to limit potential impacts.
- Vegetation removed from APZs will be re-used in other parts of the site.
- The APZs will be monitored and managed to ensure that no weed infestations occur and that the threatened species are not being affected.
- Unless absolutely essential, subject to approval by the Project Ecologist, no hollow-bearing trees will be removed from within the APZ.

## 5 STORMWATER MANAGEMENT FEATURES

- The landscaping of the bioretention swales and detention basins will be undertaken in consultation with the Project Ecologist to ensure that these structures function both as water management features and as fauna habitat.
- Any changes to the planting schedule must be approved by the Project Ecologist.
- Monitoring of the bioretention swales and detention basins will include:
  - ongoing review of the extent, distribution and composition of weed and native plant species;
  - monitoring of native fauna species utilising the wetlands; and
  - identification of any issues, problems or additional opportunities, and implementation of approved improvements.

## 6 MAINTENANCE REGIME

- The *Conservation Area* will be subject to an ongoing regime of:
  - monitoring (see below); and
  - 3-monthly management of weeds during construction works.
- The *Asset Protection Zones* will be managed by:
  - the annual hand removal of excess forest debris (<6mm in diameter) and/or lower stratum vegetation to achieve the fuel loads required by the RFS;
  - monitoring (see below);
  - 3-monthly management of weeds during construction works; and
  - annual weed removal as deemed necessary by the monitoring program.

## 7 MONITORING PROGRAM

- Establishment of photo-monitoring points and fixed survey quadrats (where possible) in the *Conservation Area* and APZ.
- Monitoring of the Nowra Heath Myrtle population.
- Monitoring of construction activities and protection fencing.
- Monitoring of the *Conservation Area* in respect of:
  - native plant species diversity, percentage cover and abundance;
  - weed species diversity, percentage cover and abundance;
  - vertebrate fauna diversity and abundance; and
  - disturbance.
- Monitoring of APZs and stormwater management features (3-monthly during construction), annually thereafter for the life of development activities.
- *Monitoring Reports* (annually).

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Lot 30 in DP 1198692
George Evans Road, Mundamia

Proposed Residential Estate

# Flora & Fauna Assessment Report

Appendix J
Site Photos

01 June 2015

Appendix J Photographs taken of the subject land at Mundamia during 2013 and 2014

Photo Point 1 The steep rocky vegetated nature of the eastern boundary of the subject site.

Photo Point 2 Facing southwest along the eastern boundary of the subject land, showing the steep cliff-face.

Photo Point 3 Evidence of Glossy Black Cockatoo feeding.

Photo Point 4 Along development area boundary - regrowth Tick Bush with scattered shrubs and Nowra Heath Myrtle - to 10m tall

Photo Point 5 Facing south showing the pasture with regrowth Scribbly Gum Bloodwood Heath, with wet rocky areas providing good frog habitat.

Photo Point 6 Facing north showing a waterfall drop-off into mesic riparian vegetation. The drainage line loses dense Nowra Heath Myrtle to the east.

Photo Point 7 Facing northwest at a drainage line junction with some minor Lantana infestation.

Photo Point 8 Facing east showing the dense mesic vegetation along the drainage line flowing toward to clearing outside the eastern boundary.

Photo Point 9 Facing east showing the slope offsite with tall mesic Blackbutt and Spotted Gum vegetation.

Photo Point 10 Facing northwest showing dense regrowth Nowra Heath Myrtle in the Grey Gum Stringybark vegetation.

Photo Point 11 Facing northeast into the patch of tall dense Tick Bush and Nowra Heath Myrtle.

Photo Point 12 Facing southeast showing the dense regrowth understorey of Nowra Heath Myrtle with regrowth Grey Gum Stringybark Forest.

Photo Point 13 Facing east along the boundary of the Nowra Heath Myrtle patch.

Photo Point 14 Facing west showing the small scattered Nowra Heath Myrtle patch at this location.

Photo Point 15 Facing east into the fairly open forest with scattered Nowra Heath Myrtle.

Photo Point 16 Facing northeast showing the dense regrowth Nowra Heath Myrtle – which becomes more mature and scattered in the drainage line to the west.

Photo Point 17 Facing east showing Paperbark habitat which lacks Nowra Heath Myrtle. Generally these areas contain dense wattle, sedge and heath vegetation.

Photo Point 18 Facing north showing the dry sclerophyll forest.

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Photo Point 19 Facing east showing the scattered Nowra Heath Myrtle along the shallow upper drainage lines.

Photo Point 20 Facing west showing dry rocky areas with dense Tick Bush - some scattered Nowra Heath Myrtle occurs in these areas.

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Photo Point 21 Facing southeast showing the dense Nowra Heath Myrtle along the tops of the moderately steep drainage lines in the southeastern corner of the site.

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Lot 30 in DP 1198692
George Evans Road, Mundamia

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# Flora & Fauna Assessment Report

Appendix K
Hollow-bearing Trees

01 June 2015

Appendix K Hollow-bearing Trees on the subject land at Mundamia

**KEY**

Hollow size category

Small = <15 cm diameter; large enough for a small arboreal species (eg Sugar Glider)
Medium = 15 – 25 cm diameter; large enough for a medium arboreal species (eg Squirrel Glider)
Large = > 25 cm diameter; large enough for a large arboreal species (eg Owl)

**Table 1 Hollow-bearing Tree Data**

| HBT No. | Sml | Med | Lrg | Common Name | Tree Species |
|---|---|---|---|---|---|
| 1 | 0 | 1 | 0 | Stag | - |
| 2 | 4 | 4 | 2 | Stag | - |
| 3 | 1 | 1 | 0 | Blue-leaved Stringybark | *Eucalyptus agglomerata* |
| 4 | 2 | 0 | 0 | Grey Gum | *Eucalyptus punctata* |
| 5 | 1 | 3 | 1 | Stag | - |
| 6 | 0 | 2 | 1 | Stag | - |
| 7 | 0 | 2 | 0 | Hard-leaved Scribbly Gum | *Eucalyptus sclerophylla* |
| 8 | 0 | 1 | 0 | Hard-leaved Scribbly Gum | *Eucalyptus sclerophylla* |
| 9 | 0 | 0 | 1 | Hard-leaved Scribbly Gum | *Eucalyptus sclerophylla* |
| 10 | 3 | 0 | 0 | Hard-leaved Scribbly Gum | *Eucalyptus sclerophylla* |
| 11 | 2 | 0 | 0 | Stag | - |
| 12 | 2 | 0 | 0 | Grey Gum | *Eucalyptus punctata* |
| 13 | 2 | 2 | 0 | Hard-leaved Scribbly Gum | *Eucalyptus sclerophylla* |
| 14 | 2 | 3 | 0 | Hard-leaved Scribbly Gum | *Eucalyptus sclerophylla* |
| 15 | 3 | 0 | 0 | Stag | - |
| 16 | 0 | 1 | 0 | Grey Gum | *Eucalyptus punctata* |
| 17 | 3 | 0 | 0 | Stag | - |
| 18 | 1 | 0 | 2 | Stag | - |
| 19 | 2 | 0 | 0 | Blue-leaved Stringybark | *Eucalyptus agglomerata* |
| 20 | 0 | 1 | 2 | Stag | - |
| 21 | 2 | 0 | 0 | Grey Gum | *Eucalyptus punctata* |
| 22 | 1 | 1 | 0 | Red Bloodwood | *Corymbia gummifera* |
| 23 | 2 | 3 | 0 | Grey Gum | *Eucalyptus punctata* |
| 24 | 0 | 1 | 0 | Stag | - |
| 25 | 2 | 0 | 0 | Blackbutt | *Eucalyptus pilularis* |
| 26 | 2 | 1 | 0 | Hard-leaved Scribbly Gum | *Eucalyptus sclerophylla* |
| 27 | 1 | 1 | 0 | Stag | - |
| 28 | 2 | 3 | 0 | Stag | - |
| 29 | 2 | 0 | 1 | Grey Gum | *Eucalyptus punctata* |
| 30 | 0 | 1 | 0 | Blue-leaved Stringybark | *Eucalyptus agglomerata* |
| 31 | 2 | 0 | 0 | Hard-leaved Scribbly Gum | *Eucalyptus sclerophylla* |
| 32 | 4 | 2 | 1 | Blue-leaved Stringybark | *Eucalyptus agglomerata* |
| 33 | 0 | 0 | 2 | Blue-leaved Stringybark | *Eucalyptus agglomerata* |
| 34 | 2 | 1 | 0 | Grey Gum | *Eucalyptus punctata* |
| 35 | 2 | 0 | 0 | Grey Gum | *Eucalyptus punctata* |
| 36 | 1 | 2 | 1 | Red Bloodwood | *Corymbia gummifera* |
| 37 | 2 | 0 | 1 | Hard-leaved Scribbly Gum | *Eucalyptus sclerophylla* |
| 38 | 0 | 1 | 1 | Hard-leaved Scribbly Gum | *Eucalyptus sclerophylla* |
| 39 | 0 | 2 | 0 | Grey Gum | *Eucalyptus punctata* |
| 40 | 4 | 0 | 0 | Blue-leaved Stringybark | *Eucalyptus agglomerata* |
| 41 | 0 | 0 | 1 | Spotted Gum | *Corymbia maculata* |
| 42 | 2 | 2 | 0 | Grey Gum | *Eucalyptus punctata* |
| 43 | 1 | 1 | 1 | Stag | - |

| HBT No. | Sml | Med | Lrg | Common Name | Tree Species |
|---|---|---|---|---|---|
| 44 | 2 | 1 | 0 | Grey Gum | *Eucalyptus punctata* |
| 45 | 3 | 0 | 0 | Hard-leaved Scribbly Gum | *Eucalyptus sclerophylla* |
| 46 | 1 | 0 | 0 | Hard-leaved Scribbly Gum | *Eucalyptus sclerophylla* |
| 47 | 0 | 0 | 1 | Hard-leaved Scribbly Gum | *Eucalyptus sclerophylla* |
| 48 | 0 | 1 | 0 | Grey Gum | *Eucalyptus punctata* |
| 49 | 0 | 1 | 0 | Grey Gum | *Eucalyptus punctata* |
| 50 | 0 | 1 | 0 | Grey Gum | *Eucalyptus punctata* |
| 51 | 3 | 0 | 0 | Grey Gum | *Eucalyptus punctata* |
| 52 | 2 | 0 | 0 | Grey Gum | *Eucalyptus punctata* |
| 53 | 0 | 1 | 2 | Grey Gum | *Eucalyptus punctata* |
| 54 | 1 | 0 | 0 | Grey Gum | *Eucalyptus punctata* |
| 55 | 1 | 0 | 0 | Red Bloodwood | *Corymbia gummifera* |
| 56 | 2 | 0 | 0 | Grey Gum | *Eucalyptus punctata* |
| 57 | 2 | 0 | 0 | Grey Gum | *Eucalyptus punctata* |
| 58 | 1 | 0 | 0 | Grey Gum | *Eucalyptus punctata* |
| 59 | 2 | 1 | 0 | Grey Gum | *Eucalyptus punctata* |
| 60 | 2 | 0 | 0 | Grey Gum | *Eucalyptus punctata* |
| 61 | 3 | 0 | 0 | Blackbutt | *Eucalyptus pilularis* |
| 62 | 2 | 2 | 0 | Blackbutt | *Eucalyptus pilularis* |
| 63 | 1 | 1 | 1 | Grey Gum | *Eucalyptus punctata* |
| 64 | 3 | 1 | 0 | Stag | - |
| 65 | 0 | 1 | 0 | Stag | - |
| 66 | 0 | 1 | 1 | Blackbutt | *Eucalyptus pilularis* |
| 67 | 2 | 0 | 0 | Grey Gum | *Eucalyptus punctata* |
| 68 | 0 | 1 | 0 | Stag | - |
| 69 | 1 | 0 | 1 | Grey Gum | *Eucalyptus punctata* |
| 70 | 1 | 0 | 1 | Red Bloodwood | *Corymbia gummifera* |
| 71 | 3 | 0 | 0 | Red Bloodwood | *Corymbia gummifera* |
| 72 | 2 | 2 | 0 | Stag | - |
| 73 | 3 | 0 | 0 | Blackbutt | *Eucalyptus pilularis* |
| 74 | 3 | 0 | 0 | Red Bloodwood | *Corymbia gummifera* |
| 75 | 3 | 1 | 0 | Red Bloodwood | *Corymbia gummifera* |
| 76 | 3 | 3 | 0 | Stag | - |
| 77 | 3 | 0 | 0 | Grey Gum | *Eucalyptus punctata* |
| 78 | 2 | 0 | 0 | Red Bloodwood | *Corymbia gummifera* |
| 79 | 0 | 1 | 0 | Red Bloodwood | *Corymbia gummifera* |
| 80 | 2 | 0 | 0 | Stag | - |
| 81 | 0 | 0 | 1 | Red Bloodwood | *Corymbia gummifera* |
| 82 | 0 | 0 | 1 | Grey Gum | *Eucalyptus punctata* |
| 83 | 3 | 0 | 1 | Stag | - |
| 84 | 2 | 0 | 0 | Spotted Gum | *Corymbia maculata* |
| 85 | 0 | 0 | 1 | Stag | - |
| 86 | 2 | 1 | 0 | Stag | - |
| 87 | 1 | 0 | 0 | Blue-leaved Stringybark | *Eucalyptus agglomerata* |
| **TOTALS** | **129** | **64** | **29** | | ***222*** |

**Table 2 Hollow-bearing Tree Photos**

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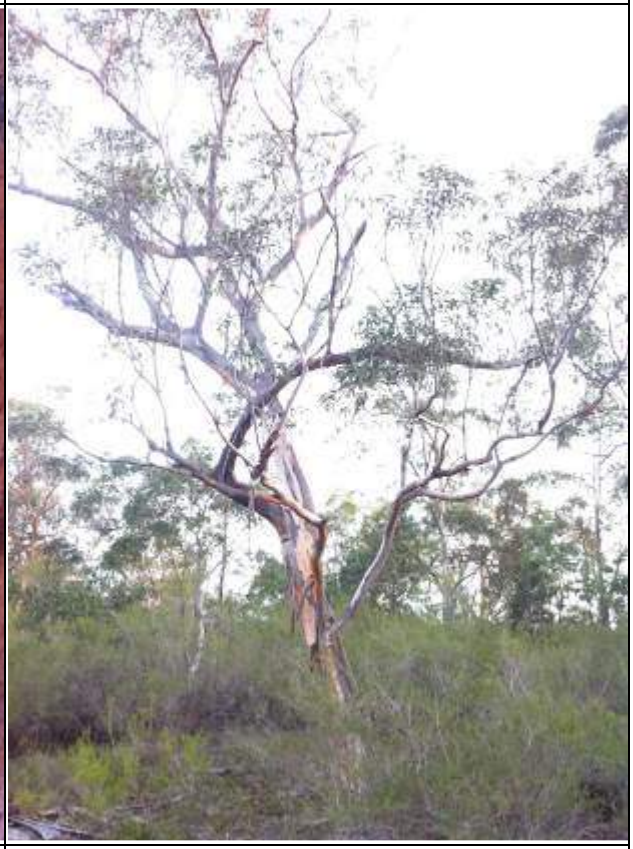
|  |  |
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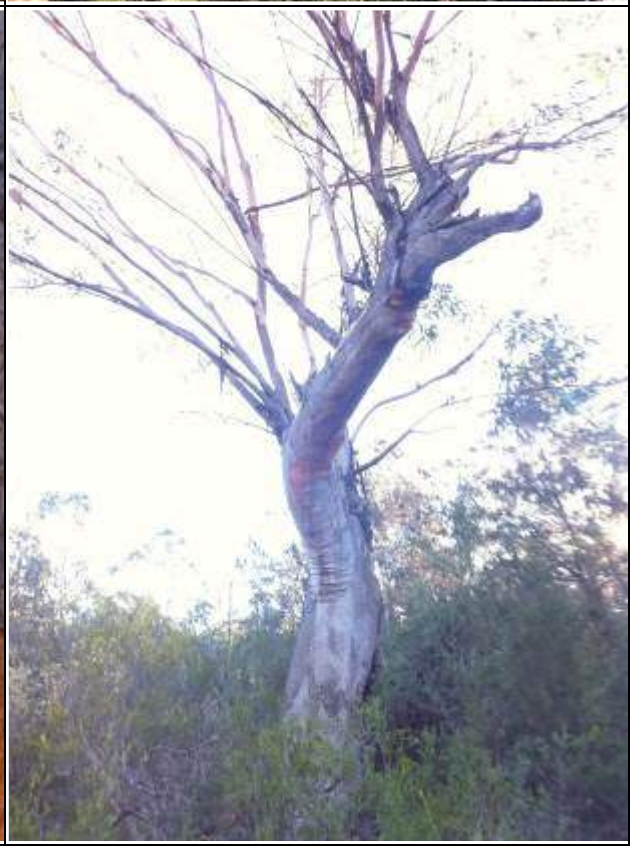
|  |  |

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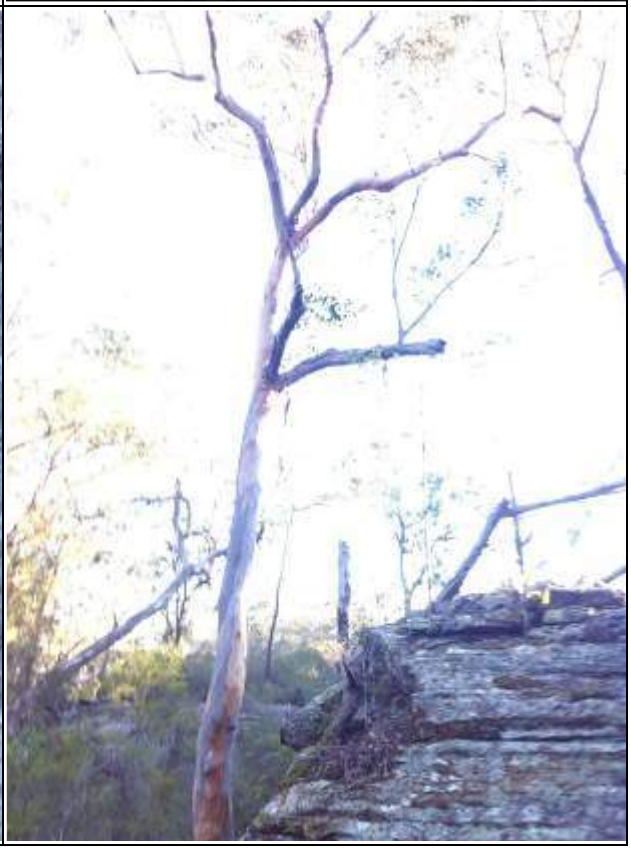
|  |  |

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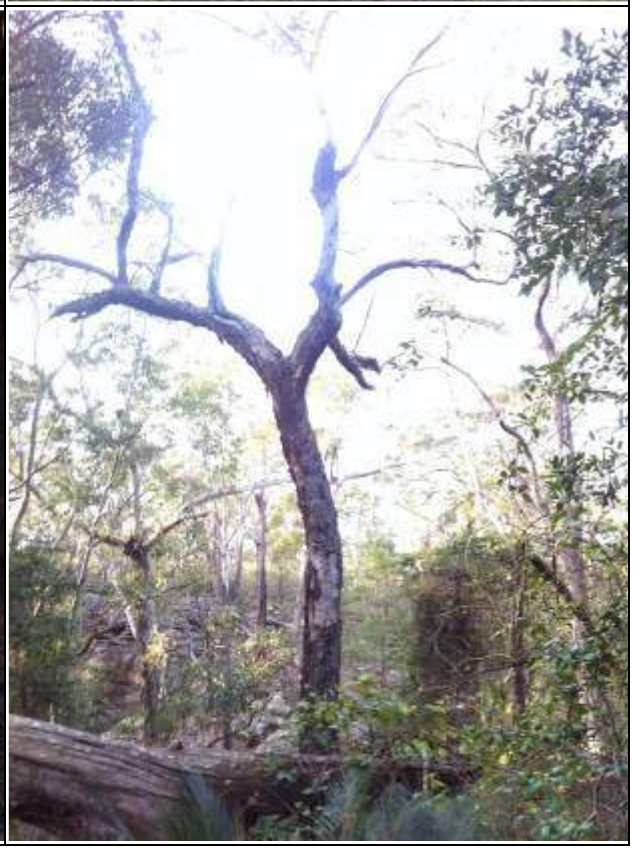
|  |  |

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George Evans Road, Mundamia

Proposed Residential Estate

# Flora & Fauna Assessment Report

Appendix L
Section 5A Assessments of Significance

01 June 2015

**LOT 30 in DP 1198692**
**GEORGE EVANS ROAD, MUNDAMIA**

**PROPOSED RESIDENTIAL ESTATE**

**FLORA & FAUNA ASSESSMENT REPORT**

**SECTION 5A ASSESSMENTS of SIGNIFICANCE**

# 1 INTRODUCTION

The *Environmental Planning & Assessment Act 1979* (EP&A Act) includes a requirement to determine "*whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats*". Section 5A (2) identifies seven factors which "*must be taken into account*" by a consent or determining authority in administering Sections 78A, 79B, 79C, 111 and 112 of the EP&A Act, as relevant in the circumstances.

The factors contained within Section 5A (2) of the EP&A Act which "*must be taken into account*" in determining "*whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats*" were amended in 2005, after proclamation of the *Threatened Species Amendment Act 2002* (TSAA Act). This *Report* addresses the amended version of Section 5A and the relevant factors contained therein.

In addition to the seven factors which "*must be taken into account*" (where relevant) pursuant to Section 5A(2) of the EP&A Act (see below), Section 5A(1)(b) of the EP&A Act requires that "*any* [relevant] *assessment guidelines*" promulgated by the relevant authorities (particularly in this instance the OEH) also "*must be taken into account in deciding whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats*".

The *Section 5A Assessment of Significance* contained herein, and the generic *Section 5A Assessment of Significance* contained in the main *Report*, have been prepared in cognisance of the *Threatened Species Assessment Guidelines – The Assessment of Significance* prepared by the then Department of Environment & Climate Change (dated August 2007).

## 2 FACTORS for CONSIDERATION

The factors which "*must be taken into account*" pursuant to Section 5A of the EP&A Act (as amended in 2005) are:

(a) in the case of threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such as that a viable local population of the species is likely to 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.

(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.

(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.

(e) whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

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

# 3 ASSESSMENTS of SIGNIFICANCE

## 3.1 Relevant Biota

As discussed in detail in the *Flora & Fauna Assessment Report* to which this Appendix is attached, the following species have been recorded on the site or adjacent land:

- Nowra Heath-myrtle – recorded in the east of the site, predominately within the proposed *Public Reserve*.
- Powerful Owl – the Powerful Owl was recorded in the vicinity of the subject land by BES in 2004 and again by SLR in 2013-2014 surveys. The Powerful Owl was recorded in the northeastern part of the subject land, in the *Public Reserve*.
- Yellow-bellied Glider – individuals and feed trees recorded on the subject land, with records indicating the species prefers the areas of old growth eucalypts found on the eastern and northern areas – predominantly below the escarpments and within the proposed *Public Reserve*.
- Glossy Black Cockatoo – individuals and feed trees recorded during several surveys by separate consultants over a number of years, with the majority of ideal habitat retained in the *Public Reserve*.
- Grey-headed Flying Fox – recorded flying over the subject land by BES (2004).
- Microchiropteran bats ('Micro-bats') - the Little Bent-wing and Eastern Bentwing Bat were recorded in flight over the site (using Anabat detectors).

The habitat for these species is considered in detail in this *Section 5A Assessment of Significance*.

## 3.2 Other Threatened Biota

Individuals of a number of additional threatened fauna species could potentially or theoretically occur on the subject site at Mundamia. These species, however, have not been recorded on the subject site and are addressed pursuant to Section 5A of the EP&A Act within the main report. Given the circumstances of the subject site, the locality and the proposed development, it is not "*likely*" that a "*significant effect*" would be imposed upon any such threatened species, even if present.

## 3.3 Nowra Heath-myrtle *Triplarina nowraensis*

### Factor (a) Threatened Species and the Risk of Extinction

The Nowra Heath-myrtle *Triplarina nowraensis* is an erect shrub to 5 metres tall with small paired leaves that are blunt-tipped and typical white-cream tea-tree flowers which are in pairs. The species occurs on poorly drained, gently sloping sandstone shelves or along creek lines underlain by Nowra Sandstone. The sites are often either treeless or have a very open tree canopy due to the impeded drainage (OEH 2015).

Detailed mapping of the population of Nowra Heath-myrtle confirms that the species is present in large numbers along the northern and eastern parts of the subject land which are largely set-aside for conservation. The greatest density of the Nowra Heath-myrtle on the subject land is located in the northern part of the property, in particularly within the northern *Public Reserve*. There are also a series of dense stands associated with drainage lines in the southern *Public Reserve*, particularly in the southeastern corner.

A total of 4.16 ha of patches of Nowra Heath Myrtle have been mapped within the subject land, with an additional 198 individuals also scattered across the northeastern and eastern parts of the site. The current proposed layout will require the removal of 1.06ha (25.48%) of patches and 46 (23.23%) individual specimens of the Nowra Heath-myrtle (Figure 6).

Whilst the proposed development will require the removal of individuals of and habitat for the Nowra Heath-myrtle, the proposed *Public Reserve* encompasses the overwhelming majority of the population. Further, the riparian corridor to Flat Rock Creek (to the east) is likely to contain many (as yet unmapped) additional specimens, which would form part of the population on the subject land (particularly to the southeast).

Whilst there will be some loss of specimens of the Nowra Heath-myrtle as a result of the proposed development on the subject land at Mundamia, that loss is offset by:

- the careful management of stormwater to mimic current conditions (Chapter 7.4);
- the retention of the majority of the population and most of the suitable habitat for the species within the *Public Reserve* on the subject land;
- the proposal to implement a dedicated *Vegetation Management Plan* within the *Public Reserve*, designed specifically *inter alia* to protect and enhance populations of the Nowra Heath-myrtle; and
- a commitment within the *Statement of Commitments* to monitor the population of the Nowra Heath-myrtle within the *Public Reserve*, and to provide data and information to Council and/or the OEH until the *Public Reserve* is dedicated to Council or the OEH for biodiversity conservation purposes.

The proposal is not likely to affect the life cycle of the Nowra Heath-myrtle - other than to a limited extent within the development footprint (which is just a small proportion of the total population present).

The majority of the population of and habitat for this species is being conserved with the proposed *Public Reserve*. On the basis of the above considerations, it is not "*likely*" that a "*viable local population*" of the Nowra Heath-myrtle would be "*placed at risk of extinction*" as a consequence of the development.

**Factor (b) Endangered Populations and the Risk of Extinction**

There is no "*endangered population*" of the Nowra Heath-myrtle.

**Factor (c) Endangered Ecological Communities and the Risk of Extinction**

The Nowra Heath-myrtle is not an "*endangered ecological community*".

**Factor (d) Habitat Removal, Modification, Fragmentation, Isolation and Importance**

As mentioned previously the proposed development will involve the removal of 25.48% of the total area of Nowra Heath-myrtle patches on the site, as well as an additional 46 individual specimens. The overwhelming majority of the population on the subject land will be retained and appropriately managed for conservation purposes.

In addition, suitable habitat for the Nowra Heath-myrtle is widespread in the immediate vicinity and general locality, including in locally occurring conservation reserves and state forests. Further, significant resources for this species will be retained within the subject site, as well as on other lands in the immediate vicinity.

With respect to the relevant matters in Factor (d) of Section 5A:

- only a relatively small proportion of the "*habitat*" for the Nowra Heath-myrtle is "*to be removed or modified as a result of the action proposed*" – Factor (d)(i);
- the proposal will not result in "*an area of habitat*" for this species becoming "*fragmented or isolated from other areas of habitat*" – Factor (d)(ii); and
- the habitat and/or resources to be removed from the subject site are not considered of "*importance ..to the long-term survival*" of the Nowra Heath-myrtle – given the extent of other resources in the immediate vicinity and general locality, the reduction of impacts as proposed and the mitigation measure proposed – Factor (d)(iii).

**Factor (e) Critical Habitat – Direct and Indirect Effects**

No "*critical habitat*" for the Nowra Heath-myrtle has been declared or is listed on the Critical Habitat Register (OEH 2015).

**Factor (f) Recovery Plans and Threat Abatement Plans**

The proposal is unlikely to have any adverse implications for the *National Recovery Plan for the Nowra Heath-myrtle Triplarina nowraensis* (OEH 2011).

Whilst the proposed development will require the removal of individuals of and habitat for the Nowra Heath Myrtle, the proposed *Public Reserve* encompasses the overwhelming majority of the population. Further, the riparian corridor to Flat Rock Creek (to the east) is likely to contain many (as yet unmapped) additional specimens, which would form part of the population on the subject land (particularly to the southeast).

The key threatening processes associated with the development (see below) have been carefully considered and minimised, as outlined in the *Recovery Plan*.

There is no relevant "*Threat Abatement Plan*" prepared pursuant to the requirements of the TSC Act.

**Factor (g) Key Threatening Processes**

The proposed development is not likely to result in the imposition or exacerbation of any *"key threatening processes"* for the Nowra Heath-myrtle.

The relevant key threatening processes associated with this species include the threat of clearing for development, as well as impacts of water run-off and weeds associated with development in the upper catchment. These processes have been carefully considered and minimised, as outlined in the Recovery Plan. Actions include reducing the development footprint, preparation for the long-term management of the vegetation in the *Public Reserve* (including weed control and regeneration of native vegetation) and the careful design of stormwater features.

Given those circumstances the imposition or exacerbation of those key threatening processes is not regarded as of significance with respect to the survival of the local population of this species.

**CONCLUSIONS**

Based on the consideration of the relevant factors under section 5A of the EP&A Act discussed above, the proposed development is not "*likely*" to impose "*a significant effect*" on the Nowra Heath-myrtle. Consequently, there is no requirement for the preparation of a species impact statement for the Nowra Heath-myrtle.

There is no requirement or justification for the preparation of a species impact statement (SIS) for the Nowra Heath-myrtle.

## 3.4 Powerful Owl *Ninox strenua*

### Factor (a) Threatened Species and the Risk of Extinction

The Powerful Owl is a large grey-brown and white flecked owl with large yellow eyes and a distinctive low double hoot call (OEH 2015). The Powerful Owl inhabits moist eucalypt forests and both wet and dry sclerophyll forests along the ranges and east coast of NSW. Optimal habitat for the Powerful Owl consists of tall moist forest communities with abundant tree-hollows (especially very large hollows for nesting) and populations of arboreal marsupials. The species requires large tree hollows (at least 0.5 metres deep) for nesting and a dense canopy or mid-canopy layer for roosting (OEH 2015).

The Powerful Owl was recorded in the vicinity of the subject land by BES in 2004 and again by SLR in 2013-2014 surveys. The Powerful Owl was recorded in the northeastern part of the subject land, in the area proposed for the *Public Reserve*. The owl has a large home-range (between 400-4,000 hectares) feeding on small mammals (such as possums, gliders, rodents and bats) (OEH 2015). The area to be cleared on the subject site represents only a minute proportion of the home range of even an individual of this species, and therefore cannot be regarded as of particular significance for any population or even an individual of this species.

The proposal will remove a small area of habitat within which the Powerful Owl could potentially forage on arboreal mammals. However, there are no hollow trees with suitable features for breeding by the Powerful Owl. Given the size of the home range of the Powerful Owl, the small area of the subject site and the context of the subject site in terms of surrounding vegetation, the site is likely to be of low significance for the maintenance of a local population of the Powerful Owl. .

Given those considerations, there is no possibility of the action proposed having an adverse effect on the "*life cycle*" of the Powerful Owl such that a "*viable local population*" of this species is likely to be "*placed at risk of extinction*" by the proposed development. It is not likely that the life cycle of the Powerful Owl would be "*disrupted*" by the proposed development at Mundamia to any relevant extent.

### Factor (b) Endangered Populations and the Risk of Extinction

There is no relevant "*endangered population*" of the Powerful Owl, as defined under the TSC Act, on the subject site or in the locality.

### Factor (c) Endangered Ecological Communities and the Risk of Extinction

The Powerful Owl is not an "*endangered ecological community*".

**Factor (d) Habitat Removal, Modification, Fragmentation, Isolation and Importance**

With respect to the relevant matters raised in Factor (d) of Section 5A of the EP&A Act "*in relation to the habitat*" of the Powerful Owl:

- the "*action proposed*" on the subject site at Mundamia will involve the removal of some native vegetation. However, the vegetation to be removed does not support suitable nesting sites for the Powerful Owl and represents only a small proportion of the home range of any local populations of the species;
- the proposed development will not result in the fragmentation of any nesting/roosting sites or foraging habitat from the subject site given the location of the proposed development and of the land itself. The subject site will not become isolated or fragmented from adjoining habitat for the Powerful Owl; and
- the area of the vegetation to be removed is only a small proportion of the total home range of the Powerful Owl, and therefore the "*action proposed*" cannot possibly have a "*significant effect*" on any populations or individuals if in fact they do utilise the subject site at all, considering the context of the locality.

Given these circumstances, the "*action proposed"* on the subject site at Mundamia:

- does not involve a relevant or significant area of "*habitat*" for the Powerful Owl being "*removed or modified*";
- does not involve "an area of habitat" for the species becoming "*fragmented or isolated from other areas of habitat*" given the context of the site, the extent of surrounding suitable habitat and the high mobility of the Powerful Owl and its ability to utilise urbanised environments; and
- is of no "*importance…to the long-term survival*" of the Powerful Owl "*in the locality*".

**Factor (e) Critical Habitat – Direct and Indirect Effects**

At the time of this Report, no "*critical habitat*" for the Powerful Owl had been declared by the Director-General of DECC.

**Factor (f) Recovery Plans and Threat Abatement Plans**

The Powerful Owl is a subject species of the *Recovery Plan for Large Forest Owls* (DECC 2006), which sets out objectives for their recovery. Consideration of the relevant "s*pecific recovery objectives, actions and performance criteria*" identified within the Recovery Plan includes:

- assessment of the potential "*impacts on large forest owls and their habitats*" has been undertaken in this Report as part of the "*planning and environmental assessment process*" (Objective 4); and
- the proposed development achieves the minimisation of "*further loss and fragmentation of habitat by protection and more informed management of significant owl habitat (including protection of individual nest sites)*" (emphasis added). The subject site is not regarded as "*significant Powerful Owl habitat*", given its small size, shape and local

context. The development as currently proposed does not involve any significant "*loss and fragmentation of habitat*" for this species (Objective 5).

The proposed development does not contravene the relevant objectives identified in the *Approved Recovery Plan for Large Forest Owls* (DECC 2006).

The *Recovery Plan for the Large Forest Owls* (DECC 2006) states that loss of native vegetation, hollow-bearing trees and removal of dead wood and dead trees are the major key threatening processes affecting such species.

The majority of these features on the subject land are located within the *Public Reserve* and will not be removed by the proposed development. Furthermore, there are no hollows suitable for nesting by the Powerful Owl on the site, and there are substantial areas of suitable foraging habitat for this species in the immediate vicinity and general area – including in substantial conservation reserves in the locality.

None of the current *Threat Abatement Plans* are of particular relevance for the Powerful Owl or its habitat.

**Factor (g) Key Threatening Processes**

The relevant key threatening processes for the proposed development are:

- Clearing of native vegetation; and
- Loss of hollow bearing trees.

Whilst the proposed development does involve the clearing of native vegetation as defined in the TSC Act, that removal will not involve the loss of significant areas of suitable foraging habitat for the Powerful Owl.

Whilst suitable foraging habitat for this species is present on the subject site, it constitutes only a small proportion of the area required by the species. Further, given the context of the site, the removal of or modification to vegetation is unlikely to increase the impact of this key threatening process on the Powerful Owl.

The proposed development may include the loss of hollow bearing trees as defined in the TSC Act. However, no hollow-bearing trees suitable for the Powerful Owl are located in the area to be affected by the proposal.

**CONCLUSIONS**

The seven factors which are required to be considered pursuant to Section 5A of the EP&A Act in the determination of "*whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats*" are discussed above with regard to the Powerful Owl.

On the basis of the assessment provided above, the proposed development on the subject site at Mundamia is not likely to involve the imposition of a significant effect on the Powerful Owl, because:

- the area of potential foraging habitat to be removed is insignificant considering the extent of forest vegetation in the locality;
- no roosting habitat for the species will be removed for the proposal; and
- the Powerful Owl is a highly mobile and wide-ranging species which would not be reliant on the subject site for its survival in the locality.

There is no requirement or justification for the preparation of a species impact statement (SIS) for the Powerful Owl.

## 3.5 Yellow-bellied Glider *Petaurus australis*

### Factor (a) Threatened Species and the Risk of Extinction

The Yellow-bellied Glider *Petaurus australis* is a large vocal glider moving about in small groups (OEH 2014). The species is found along the east coast of Australia from southeast Queensland to Victoria, from the coast to the western ranges of the Great Dividing Range. The species typically occur in tall mature eucalypt forest in areas of high rainfall and nutrient rich soil (OEH 2014). The glider incises the trunks and branches of favoured food trees (such as the Red Bloodwood), leaving a distinctive V-shaped scar. It nests in hollow-bearing trees in mature eucalypt forest, and feeds on tree sap, pollen, nectar and insects.

A population of the Yellow-bellied Glider occurs in the vicinity of the subject site. Recent and previous records of this species on the subject land (Figure 7) indicate that individuals prefer the areas of old growth eucalypts found on the eastern and northern areas of the subject land – predominantly below the escarpments and within the proposed *Public Reserve*.

The majority of suitable habitat for the Yellow-bellied Glider is contained within the proposed *Public Reserve* in the northern and eastern parts of the subject site, particularly in the northeast. The species is also likely to inhabit the lower escarpment along Flat Rock Creek to the east. It is not likely that individuals of that species would be adversely affected by the proposed development of the land such that the "*long-term viability*" of that species would be adversely affected and/or the "*local population*" of the species.would be "*placed at risk of extinction*".

### Factor (b) Endangered Populations and the Risk of Extinction

There is no relevant "*endangered population*" of the Yellow-bellied Glider.

### Factor (c) Endangered Ecological Communities and the Risk of Extinction

The Yellow-bellied Glider is not an "*endangered ecological community*".

### Factor (d) Habitat Removal, Modification, Fragmentation, Isolation and Importance

With respect to the relevant matters raised in Factor (d) of Section 5A of the EP&A Act "*in relation to the habitat*" of the Yellow-bellied Glider:

- the habitat within the subject site which could possibly be "*removed or modified as a result of the action proposed*" is only a minute proportion of the habitat in the locality – Factor (d)(i);
- the proposal will not result in habitat for the Yellow-bellied Glider becoming "*fragmented or isolated*" such that it would affect the "*long-term survival of the species .. in the locality*" – Factor (d)(ii); and

- the area of vegetation which might be affected by the proposal could not conceivably be regarded as of "*importance .. to the long-term survival of the species .. in the locality*" – Factor (d)(iii).

**Factor (e) Critical Habitat – Direct and Indirect Effects**

At the time of this *Report*, no "*critical habitat*" for the Yellow-bellied Glider had been declared by the Director-General of the OEH.

**Factor (f) Recovery Plans and Threat Abatement Plans**

A *Recovery Plan* for the Yellow-bellied Glider was prepared by the NPWS (OEH) in 2003. The *Recovery Plan* highlights native vegetation clearing, habitat fragmentation and loss of mature eucalypt forest as the major key threatening processes of this species. As discussed above, the development footprint is situated predominantly on the upper areas of the subject land, which is largely cleared and where eucalypts are generally small and lacking large hollows.

Recent and previous records of this species on the subject land (Figure 7) indicate that individuals prefer the areas of old growth eucalypts found on the eastern and northern areas of the subject land – predominantly below the escarpments and within the proposed *Public Reserve*. Much of the upper areas of the subject land is cleared and disturbed, and already acts as a barrier for the movement of this species. Consequently, construction of the proposed development will not exacerbate this east-west barrier. For these reasons, the proposal does not contravene the aims and objectives of the *Recovery Plan* for this species.

Given the relatively small area of potential habitat that would be affected by the proposal, and the retention of substantial areas of habitat in the vicinity, the proposal is not inconsistent with the objectives of the *Recovery Plan* for the Yellow-bellied Glider.

None of the current *Threat Abatement Plans* are of particular relevance for the Yellow-bellied Glider or its habitat.

**Factor (g) Key Threatening Processes**

Whilst the proposal does involve some minor clearing of "*native vegetation*", that removal will not involve the loss of significant (or indeed any) areas of habitat for the Yellow-bellied Glider. Substantial areas of suitable habitat will be retained in the remainder of the subject site and within the extensive reserves in the vicinity.

The proposed development of the subject site at Mundamia will involve "*clearing of native vegetation*". When viewed in the local context, however, the area of vegetation to be removed is small compared to the substantial areas of forest vegetation to be retained within the subject site and in the locality or 'home range' for the species.

Notwithstanding the imposition of those "*key threatening processes*" on the subject site at Mundamia, no significant impact on the "*viable local population*" of the Yellow-bellied Glider is anticipated.

**CONCLUSIONS**

The relevant factors of Section 5A of the EP&A Act required to be considered in determining "*whether there is likely to be a significant effect on threatened species, populations or ecological communities*, *or their habitats*" are discussed in detail above with regard to the Yellow-bellied Glider.

On the basis of the above considerations, the proposed development is not considered "*likely*" to impose "*a significant effect*" on the Yellow-bellied Glider.

There is no requirement or justification for the preparation of a species impact statement (SIS) for the Yellow-bellied Glider.

## 3.6 Glossy Black Cockatoo *Calyptorhynchus lathami*

### Factor (a) Threatened Species and the Risk of Extinction

The Glossy Black Cockatoo is a small brown-black cockatoo with red, yellow or orange tail or face markings (OEH 2015). The species inhabits open forests and woodland feeding exclusively on the fruits of *Allocasuarina* species and *Casuarina* species. The species is known to feed quietly in small groups for several hours, and as such dense piles of 'chew-cones' beneath feed tree species is often an indicator of the species.

The Glossy Black Cockatoo has been recorded at various locations on the subject land, as well as in other surrounding vegetated lands in the immediate vicinity. Glossy Black Cockatoos are relatively wide-ranging and highly mobile, and would utilise home ranges of several kilometres radius. Results of the OEH atlas search (Appendix D) and general observations of SLR ecologists indicate that this species is frequently and widely recorded throughout the xeric forest types in the Shoalhaven LGA, and is relatively abundant and widespread in this general region. The vegetation present on the subject site, therefore, represents a small proportion of the home range for any such species.

The subject site and surrounding lands clearly provide relevant resources and habitats for the Glossy Black Cockatoo, and the subject land (in conjunction with surrounding vegetated and forested lands) likely provides habitat for a *"viable local population"* of this species. It is not likely, however, that the subject site *per se* would support a viable local population of the Glossy Black Cockatoo in isolation.

It is not likely that a viable local population of the Glossy Black Cockatoo would be "*placed at risk of extinction*" as a consequence of the proposed development, given:

- the proposed retention of Glossy Black Cockatoo feed trees (*Allocasuarina littoralis*) within the *Public Reserve*;
- the lack of any evidence of breeding on the site by the Glossy Black Cockatoo;
- the extent of suitable habitat and resources to be retained on the subject land; and
- the extent of such resources which are already protected in the vicinity and locality.

### Factor (b) Endangered Populations and the Risk of Extinction

There is no relevant "*endangered population*" of the Glossy Black Cockatoo.

### Factor (c) Endangered Ecological Communities and the Risk of Extinction

The Glossy Black Cockatoo is not an "*endangered ecological community*".

**Factor (d) Habitat Removal, Modification, Fragmentation, Isolation and Importance**

The subject land contains a number of *Allocasuarina littoralis*, which provide potential foraging habitat for the Glossy Black Cockatoo. Evidence of feeding has been recorded within the subject land. Only very small areas of potential foraging habitat and resources for the Glossy Black Cockatoo will be removed for the proposed development of the subject land. Very few potential nest trees for the Glossy Black Cockatoo will be removed (one or two), noting also that there is no evidence for any breeding by Glossy Black Cockatoos on the subject land.

In this regard, there are substantial nesting and foraging resources within the *Public Reserve* on the subject land and on adjoining lands, and the Glossy Black Cockatoo (in any case) is highly mobile and wide-ranging, and is abundant in the Shoalhaven LGA.

With respect to the relevant considerations contained in Factor (d) of Section 5A:

- only an very limited amount of potential or known habitat for the Glossy Black Cockatoo "*is likely to be removed or modified as a result of the action proposed*" – given the retention of the majority of resources and habitat elements for the Glossy Black Cockatoo in the *Public Reserve*, and the extent of relevant resources and the habitat in the vicinity – Factor (d)(i);
- there is no likelihood of any "*area of habitat*" for the Glossy Black Cockatoo becoming "*fragmented or isolated from other areas of habitat as a result of the proposed action*" – given the retention of resources within the east of the subject land, and the substantial extent of resources and habitat features available in forest vegetation in the immediate vicinity and general locality. In addition, given the high mobility of the Glossy Black Cockatoo, there is no likelihood of the proposal resulting in any relevant fragmentation or isolation of habitat for that species – Factor (d)(ii); and
- given the extent of habitat and resources which will be retained on the subject land, and which are present both on the subject land and on adjoining lands in the immediate vicinity, and given the extent of those resources in the general locality, the minimal areas of habitat and resources which are to be *"removed, modified, fragmented or isolated"* as a result of the *"action proposed"* on the subject site, are not of particular *"importance .. to the long-term survival"* of the Glossy Black Cockatoo in the *"locality*".

**Factor (e) Critical Habitat – Direct and Indirect Effects**

There is no relevant "*critical habitat*" for the Glossy Black Cockatoo.

**Factor (f) Recovery Plans and Threat Abatement Plans**

There is currently no *Recovery Plan* for the Glossy Black Cockatoo.

None of the current *Threat Abatement Plans* are of particular relevance for the Glossy Black Cockatoo or its habitat.

**Factor (g) Key Threatening Processes**

The proposed development will, or may, result in the imposition or exacerbation of three relevant *"key threatening processes"* for the Glossy Black Cockatoo:

- the *"clearing of native vegetation";*
- the *"loss of hollow-bearing trees";*
- the *"loss of dead wood and dead trees"*.

As indicated above, the proposed development has been designed to retain the majority of the forest and woodland within a Public Reserve in the east of the site. This subsequently retains the majority of important habitat features for the Glossy Black Cockatoo, including foraging resources and hollow-bearing trees.

The proposed development will involve the "*clearing of native vegetation*" – including approximately nine hectares of open forest and woodland. Although some habitat of the Glossy Black Cockatoo will be affected, efforts have been made to retain areas of dense foraging habitat and hollow-bearing trees for this species. Most of the vegetation to be cleared is not of particular relevance for the Glossy Black Cockatoo.

The proposed development will not result in the imposition or exacerbation of any *"key threatening process"* to the extent that the proposal would threaten the survival of a *"viable population"* of the Glossy Black Cockatoo, or impose a "*significant effect"* on this species.

**CONCLUSIONS**

The relevant factors of Section 5A of the EP&A Act required to be considered in determining "*whether there is likely to be a significant effect on threatened species, populations or ecological communities*, *or their habitats*" are discussed in detail above with regard to the Glossy Black Cockatoo.

On the basis of the above considerations, the proposed development is not considered "*likely*" to impose "*a significant effect*" on the Glossy Black Cockatoo.

There is no requirement or justification for the preparation of a species impact statement (SIS) for the Glossy Black Cockatoo.

## 3.7 Grey-headed Flying Fox *Pteropus poliocephalus*

### Factor (a) Threatened Species and the Risk of Extinction

The Grey-headed Flying-fox is a large grey/black bat with an orange neck collar (OEH 2015). The species roosts in large camps near food resources, commonly in gullies, close to water and with a dense canopy (OEH 2015). Foraging is over very large areas feeding on the nectar and pollen of native trees (in particular *Eucalyptus*, *Melaleuca* and *Banksia*) or fruits of rainforest plants (OEH 2015).

The extent of occurrence of the species along the east coast of Australia is considered one interbreeding population with genetic exchange occurring across its distributional range. The Grey-headed Flying-fox is relatively wide-ranging and highly mobile, and would utilise home ranges of several kilometres radius in an evening. The vegetation present on the subject site and adjoining lands represents only a small proportion of the home range for any such species.

The Grey-headed Flying Fox was recorded flying over the subject land by BES (2004). There are, however, no known roosting sites or camps in the immediate vicinity of the site. Whilst individual Flying Foxes could visit the site on a temporary and seasonal basis while eucalypts are in flower, they are not likely to roost or visit the site on any permanent basis.

The proposed development on the subject site will remove only a minute proportion of the potential foraging resources for the Grey-headed Flying Fox in the locality.

Given the extent of occurrence of the Australian population of this species, it is not "*likely*" that a "*viable local population*" of the Grey-headed Flying Fox would be dependent upon those resources to be removed from the subject site *per se* for the proposal. There is, consequently, no "*likelihood*" that any such "*population*" of Grey-headed Flying Fox in this locality would be "*placed at risk of extinction*" as a consequence of the development.

### Factor (b) Endangered Populations and the Risk of Extinction

There is no "*endangered population*" of the Grey-headed Flying Fox.

### Factor (c) Endangered Ecological Communities and the Risk of Extinction

The Grey-headed Flying Fox is not an "*endangered ecological community*".

### Factor (d) Habitat Removal, Modification, Fragmentation, Isolation and Importance

With respect to the presence of habitat for the Grey-headed Flying Fox on the subject land:

- the scattered canopy trees (when in flower) within the subject site would constitute potential foraging resources for individuals of this species. However, these trees represent only a minute fraction of the foraging resources seasonally available for the Flying Fox in the locality;

- the adjoining tracts of forest and woodland to the east and elsewhere in the locality would represent substantially greater and more ecologically important foraging resources; and
- there is no camp or colony of the Flying Fox on the subject site, and hence no breeding activities would occur on the site.

Suitable habitat for the Grey-headed Flying Fox is widespread in the immediate vicinity and general locality, and includes the extensive conservation reserves and state forests nearby. Further, significant resources for the Grey-headed Flying Fox will be retained within the proposed *Public Reserve* in the north and east of the site, as well as on other lands in the immediate vicinity.

With respect to the relevant matters in Factor (d) of Section 5A:

- only a relatively small area of "*habitat*" for the Grey-headed Flying Fox is "*to be removed or modified as a result of the action proposed*" – as the development retains a substantial area of open space and forest vegetation, and there are substantial such resources in the locality and vicinity – Factor (d)(i);
- given the extent of open space and forest, including potential foraging trees, to be retained on the subject land and present elsewhere in the locality, and given the high mobility of these species, it is not likely that "*an area of habitat*" for these species would become "*fragmented or isolated from other areas of habitat as a result of the proposed action*" – Factor (d)(ii); and
- the habitat and/or resources present on the subject land are not considered of "*importance…to the long-term survival of the* [Grey-headed Flying Fox] *species... in the locality*" – given the extent of other resources in the immediate vicinity and general locality, and the mobility of the Flying Fox – Factor (d)(iii).

**Factor (e) Critical Habitat – Direct and Indirect Effects**

No "*critical habitat*" for the Grey-headed Flying Fox has been declared by the Director-General of the OEH.

**Factor (f) Recovery Plans and Threat Abatement Plans**

A "*Recovery Plan*" has not been prepared for the Grey-headed Flying Fox.

There is no relevant "*Threat Abatement Plan*" prepared pursuant to the requirements of the TSC Act.

**Factor (g) Key Threatening Processes**

The proposed project will result in the imposition of one potentially relevant *"key threatening processes"* for the Grey-headed Flying Fox, that being the *"clearing of native vegetation"*. The extent of "*native vegetation*" which would provide foraging resources to the Grey-headed Flying Fox to be removed from the subject land is small compared to the extensive tracts of such habitat in the vicinity and locality – much of which is already conserved, and in comparison to the home range of individuals

of this species and the geographic extent of the national population (being the "*viable local population"*) of this species.

Given those circumstances, and given the considerable extent of suitable foraging and roosting habitat in the proposed *Public Reserve* and immediate vicinity and general locality, including extensive conservation reserves, the imposition or exacerbation of that "*key threatening process*" is not regarded as of significance with respect to the survival of the Grey-headed Flying Fox.

It is not likely the imposition or exacerbation of those processes will significantly affect any "*viable local population*" of the Grey-headed Flying Fox. There is no possibility of any "*key threatening processes*" which will or may arise as a consequence of the proposed development placing "*a viable local population*" of any such species "*at risk of extinction*", nor will it impose a "*significant effect*" on the Grey-headed Flying-fox.

**CONCLUSIONS**

The relevant factors which are required to be considered pursuant to section 5A of the EP&A Act in the determination of "*whether there is likely to be a significant effect on threatened species, populations or ecological communities*, *or their habitats*" are discussed in detail above with regard to the Grey-headed Flying Fox.

The proposed development is not considered "*likely*" to impose "*a significant effect*" on the Grey-headed Flying Fox.

There is no requirement or justification for the preparation of a species impact statement (SIS) for the Grey-headed Flying Fox.

## 3.8 Microchiropteran Bats

### Factor (a) Threatened Species and the Risk of Extinction

Two threatened microchiropteran bat species, the Eastern Free-tail Bat *Mormopterus norfolkensis* and the Common (Eastern) Bent-wing Bat *Miniopterus schreibersii oceanensis* were recorded on the subject land, although there is only a low level of certainty in respect of the Common Bent-wing Bat, due to the poor quality of the call sequences (recorded via Anabat devices). The Eastern Free-tail Bat and Common (Eastern) Bent-wing bat are small microchiropteran bat species which forage for insects in forests and woodlands.

The Eastern Free-tail Bat roosts in hollows, under bark and in man-made structures, whilst the Common (Eastern) Bent-wing Bat requires predominately caves for roosting and breeding. The subject site contains dry sclerophyll woodland habitat and some tree hollows and therefore provides potential foraging habitat for both species of bat, and possibly some roosting habitat for the Eastern Free-tail Bat.

In any case, little or no potential roosting habitat for this species would be disturbed as a result of the proposed development. Extensive foraging habitat for this and other microchiropteran bat species will be retained in the proposed *Public Reserve* on the periphery of the land, and in the substantial other forested lands in the vicinity.

It is not "*likely*" that a "*viable local population*" of any threatened microchiropteran bat species would be dependent upon those resources to be removed from the subject site *per se* for the proposal. There is, consequently, no "*likelihood*" that any such "*population*" of any threatened microchiropteran bats in this locality would be "*placed at risk of extinction*" as a consequence of the development.

### Factor (b) Endangered Populations and the Risk of Extinction

There is no "*endangered population*" of any potentially relevant threatened microchiropteran bats.

### Factor (c) Endangered Ecological Communities and the Risk of Extinction

No threatened microchiropteran bat is an "*endangered ecological community*".

### Factor (d) Habitat Removal, Modification, Fragmentation, Isolation and Importance

Suitable habitat for all of the relevant threatened microchiropteran bats is widespread in the locality, including in the extensive conservation reserves and state forests present. Further, significant resources for microchiropteran bats will be retained within and on the subject land, as well as on other lands in the immediate vicinity.

With respect to the relevant matters in Factor (d) of Section 5A:

- only a relatively small area of "*habitat*" for any threatened microchiropteran bat species is "*to be removed or modified as a result of the action proposed*" – being the removal of potential foraging and roosting habitat. However, there are substantial tracts of similar resources in the locality – Factor (d)(i);
- given the extent of woodland, including hollow-bearing trees, to be retained in the east of the subject land and present elsewhere in the locality, and given the high mobility of these species, it is not likely that "*an area of habitat*" for these species would become "*fragmented or isolated from other areas of habitat as a result of the proposed action*" – Factor (d)(ii); and
- the habitat and/or resources present on the subject site at Mundamia are not considered of "*importance .. to the long-term survival of the* [any microchiropteran bat] *species .. in the locality*" – given the extent of other resources in the immediate vicinity and general locality, and the mobility of microchiropteran bats – Factor (d)(iii).

**Factor (e) Critical Habitat – Direct and Indirect Effects**

No "*critical habitat*" for any threatened microchiropteran bat has been declared by the Director-General of the OEH.

**Factor (f) Recovery Plans and Threat Abatement Plans**

A "*Recovery Plan*" has not been prepared for any threatened microchiropteran bat.

There is no relevant "*Threat Abatement Plan*" prepared pursuant to the requirements of the TSC Act.

**Factor (g) Key Threatening Processes**

The proposed development will or may result in the imposition or exacerbation of three potentially relevant *"key threatening processes"* for microchiropteran bats:

- the *"clearing of native vegetation";*
- the *"loss of hollow-bearing trees";*
- the *"loss of dead wood and dead trees"*.

As indicated above, the proposed development has been designed to retain the majority of the forest and woodland within a Public Reserve in the east of the site. This subsequently retains the majority of important habitat features for threatened microchiropteran bats, including foraging resources and hollow-bearing trees.

Whilst there may also be some limited *"loss of dead wood and dead trees"*, there is no evidence that threatened micro-bats are utilising these resources and any such resources that cannot be retained *in situ* during construction are to be salvaged and re-used in areas of retained vegetation on the site.

Given those circumstances, and given the considerable extent of suitable foraging and roosting habitat for threatened microchiropteran bats in the locality, the imposition or exacerbation of those "*key threatening processes*" is not regarded as of significance with respect to the survival of any threatened microchiropteran bats species.

**CONCLUSIONS**

The relevant factors which are required to be considered pursuant to section 5A of the EP&A Act in the determination of "*whether there is likely to be a significant effect on threatened species, populations or ecological communities*, *or their habitats*" are discussed in detail above with regard to threatened microchiropteran bats.

The proposed development is not considered "*likely*" to impose "*a significant effect*" on any threatened microchiropteran bats.

There is no requirement or justification for the preparation of an SIS for any microchiropteran bat species.