Appendix C

North Manyana Ecological Assessment

EMM
EMGA Mitchell McLennan

North Manyana Planning Proposal
Ecological Assessment

Prepared for Kylor Pty Ltd | 3 December 2014

Planning + Environment + Acoustics

North Manyana Rezoning proposal

Ecological Assessment

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North Manyana Rezoning proposal

Final report

Report J12075RP2 | Prepared for Kylor Pty Ltd | 1 December 2014

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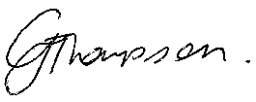
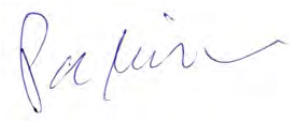
Signature		Signature	
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1 Introduction

This report has been prepared to accompany a planning proposal for rezoning of the "Kylor site" at North Manyana. It presents the findings of the ecological assessment undertaken for the Site. It details the methods and results of desktop investigations and field surveys of the Site and its surrounds. It also provides an indication of the likely impacts resulting from the rezoning when compared with the existing zoning, and an indication of likely offsetting requirements to compensate for any potential ecological impacts.

It is important to note that this study was based on a residential footprint of approximately 32 ha. However, the planning proposal has subsequently been updated to reduce the residential footprint by approximately 4.7 ha. As this study assesses the original larger residential footprint it provides a highly conservative assessment of the impacts of the proposal.

1.1 Objectives

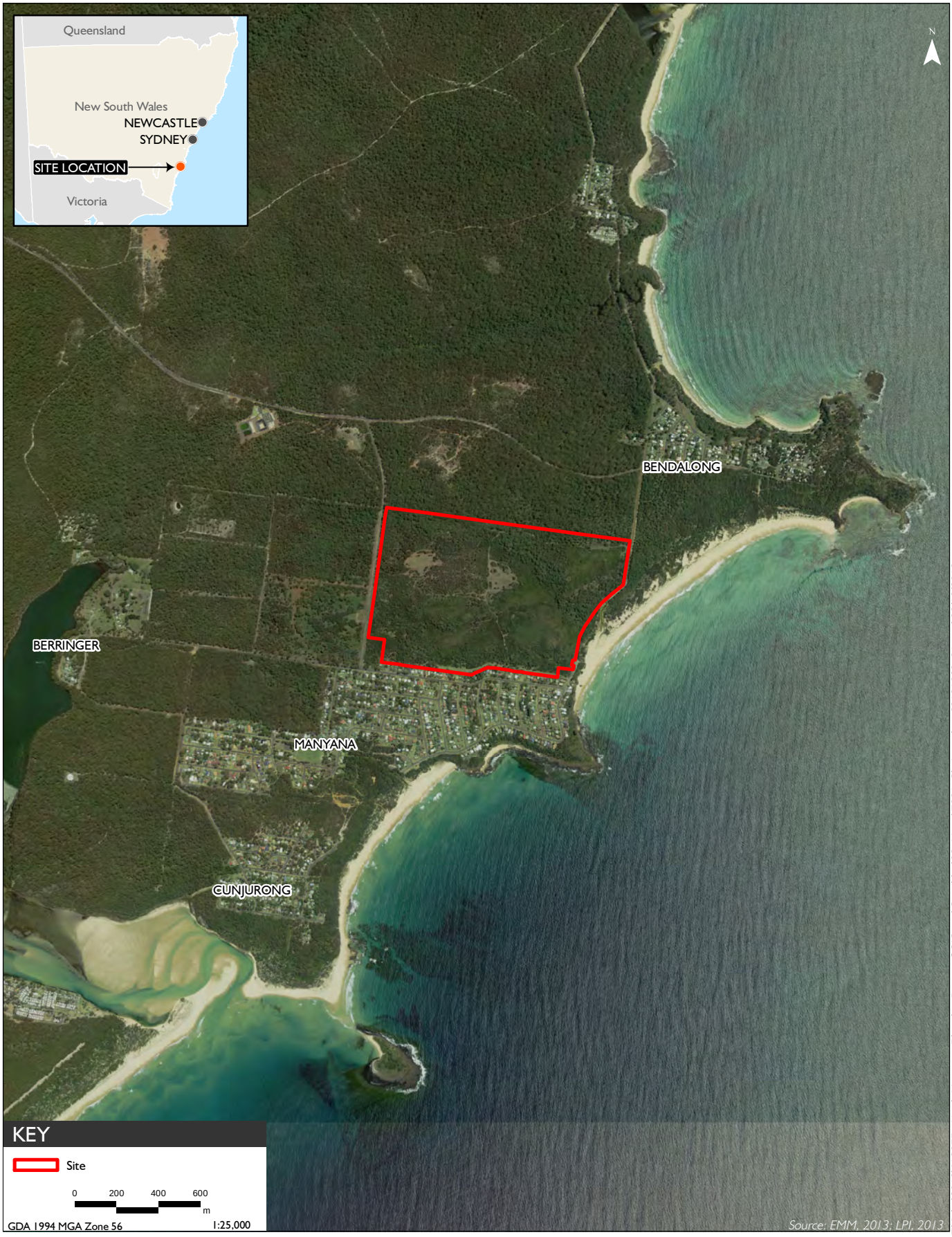
This ecological assessment aims to:

- provide a summary of the ecological assessments undertaken in the Site to date;
- provide an inventory of the species and ecological communities recorded in the Site;
- identify sensitive ecological features in the Site which represent potential constraints to future development;
- assess the likely significance of the proposed rezoning on identified sensitive ecological features; and
- provide a proposed offset strategy to compensate for the rezoning impacts on biodiversity.

1.2 The Site

The Site, comprising Part of Lot 106 in DP 755923 (Curvers Drive, Manyana) and Part of Lot 2 in DP 836591 (Curvers Drive, Manyana), is located to the north of the small township of Manyana. It is bound by Inyadda Drive to the west, Sunset strip and Maple Street to the east, the rear of residential properties fronting Curvers Drive to the south and undeveloped Crown Land to the north. The South Pacific Ocean is located to the east of Sunset Strip and Maple Street (see Figure 1.1). The subject site is referred to herein as 'North Manyana' or the Site.

Originally cleared for farming, with further clearing between the 1950s and 1970s, the vegetation has regrown with some areas containing dense shrub-lands and others tall forests. The northern and western parts of the Site were affected by bushfires in 2001. Trail motorbike enthusiasts have cleared and re-contoured two large areas in the Site without Kylor's approval. The only other visible development is a transmission line easement, which runs along the eastern boundary of the Site, and a grave belonging to the original grantees of the property.



Location of the site

North Manyana Rezoning Proposal: Ecological Assessment

Figure 1.1

2 Methods

2.1 Desktop assessment

Prior to field investigations, a desktop assessment was undertaken to identify the potential ecological values of North Manyana. This included a review of previous ecological assessments undertaken for the Site and surrounding areas, and database reviews to identify threatened species known from, or with potential to occur at North Manyana. The following were reviewed as part of the desktop assessment:

- ERM (2004) Manyana North Flora and Fauna, for Kylor Pty Ltd;
- PB (2006) Manyana Draft Local Environmental Plan Review;
- PMA Consulting (2007) Revised Flora and Fauna Assessment: Proposed subdivision for Vacenta Pty Ltd, Lot 682 DP 568678, Lot 705 DP 61385, and Lot 810 DP 247285, Manyana;
- Kevin Mills & Associates (2008) Flora and Fauna Assessment: proposed residential subdivision Lot 682 DP 568678, Lot 705 DP 61385, and Lot 810 DP 247285, Manyana Drive, Manyana;
- Whelans Insites (2008) Lot 6 and Lot 108 in DP 755923 Bringer Road Manyana, Proposed Caravan Park Flora and Fauna Assessment Report;
- NSW National Parks and Wildlife Service (NPWS) Wildlife Atlas records of threatened species and ecological communities within 10 km of the project area (OEH 2012a); and
- Department of Sustainability Environment Water Populations and Communities (DSEWPC) protected matters database records within 10 km of the project area.

2.2 Field investigations

EMM assessed the ecology of North Manyana using the following survey methods:

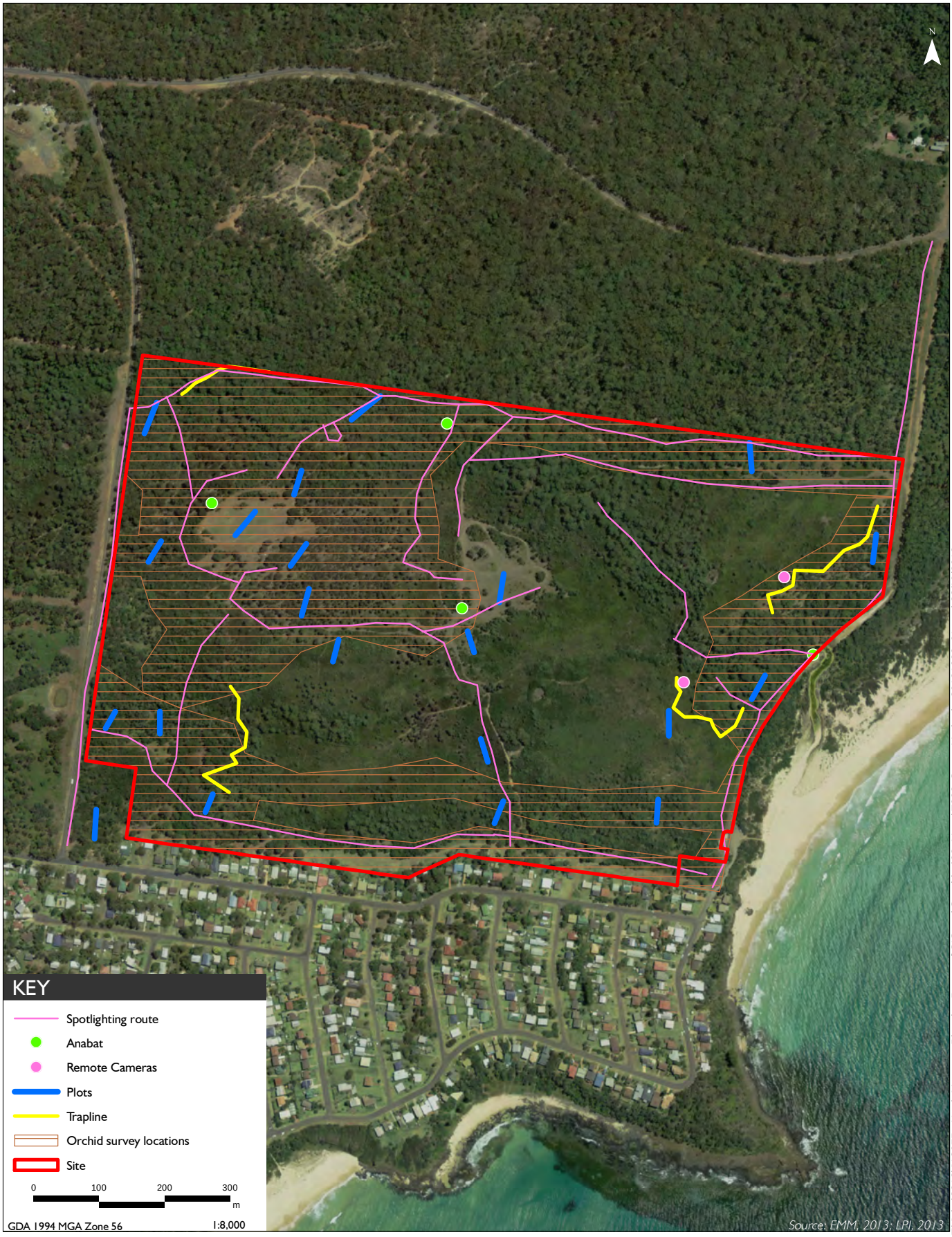
- vegetation plots surveys in line with the Biobanking methodology;
- random meanders to:
    - document fauna habitats and habitat features in the project area;
    - assess the general condition of vegetation and habitats in the project area;
    - document the flora species present in the project area and locate any significant species;
    - record the bird species present in the project area; and
    - map vegetation type boundaries.
- morning and afternoon timed point census survey for birds;
- small and medium sized mammal trapping (ground and arboreal);
- anabat call detection for microbats;

- spotlighting and call playback for nocturnal mammals and birds;
- targeted searches for reptiles and nocturnal surveys for frogs in suitable habitat; and
- investigation of the species occupying and habitat provided by waterbodies, that had been identified from aerial photograph interpretation.

All fauna and flora species encountered during the field investigations were recorded. An overview of the survey effort undertaken for the Site is provided in Table 2.1 and shown spatially in Figure 2.1.

Table 2.1 Survey effort

Target group	Survey method	Survey effort
Flora	Vegetation plots	21 plots
	Random meanders for threatened flora	8 person hours
Fauna	Bird surveys	7 timed areas searches (30 mins or 1 hr at dawn/dusk)
	Elliot and cage trapping (arboreal and ground-based)	800 Elliot trap nights and 24 cage trap nights
	Anabat call detection	8 detector nights
	Spotlighting and call playback (includes frog surveys)	4 timed searches (1 to 2 hrs)
	Searches for signs of use	8 person hours



Survey methods

North Manyana Rezoning Proposal: Ecological Assessment

Figure 2.1

3 Results

3.1 Desktop assessment

Database search results have identified the locality as providing habitat for a range of threatened flora and fauna species. Previous ecological assessments of the Site and surrounding areas have identified a number of these significant ecological features at North Manyana.

3.1.1 Database searches

A search of the NPWS Wildlife Atlas revealed that 47 threatened fauna species (not including marine species) and eight flora species listed under the *Threatened Species Conservation Act 1995* (TSC Act) have been previously recorded within 10 km of the Site (NSW Office of Environment and Heritage (OEH) 2012a). These species are listed in Appendix A along with an assessment of their likelihood of occurrence at North Manyana.

A search for matters of National Environmental Significance (NES) or other matters protected by the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) revealed an additional 11 threatened fauna and migratory species and one plant potentially occur at the Site (DSEWPC 2012). These species are listed in Appendix A, along with consideration of their potential occurrence.

A number of threatened ecological communities listed under the TSC Act are known to occur in the Jervis Catchment Management Area (CMA) sub-region (OEH 2012b). These include:

- Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions;
- River-Flat Eucalypt Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions;
- Milton Ulladulla Subtropical Rainforest in the Sydney Basin Bioregion;
- Littoral Rainforest in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions;
- Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions;
- Themeda grassland on seacliffs and coastal headlands in the NSW North Coast, Sydney Basin and South East Corner Bioregions;
- Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions; and
- Swamp Oak Floodplain Forest of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions.

3.1.2 Previous ecological assessments

Vegetation mapping of the Site by ERM in 2004 identified twelve communities including:

- Bangalay – Sydney Green Wattle Woodland;
- Paperbark – Hakea Heathland;
- Bangalay – Banksia – Teatree – Sydney Green Wattle Woodland;
- Bangalay Woodland;
- Teatree – Paperbark – Sydney Green Wattle Heathland;
- Peppermint – Bangalay Forest;
- Peppermint – Bangalay Regrowth Forest;
- Woolybutt Regrowth Woodland;
- Acacia regrowth;
- Casuarina Woodland;
- Disturbed Bangalay – Rough-barked Apple Woodland; and
- Cleared Grassland.

The site has significantly regenerated since this study was completed almost a decade ago.

ERM did not identify any threatened ecological communities listed under the TSC Act at the Site. However, the regionally significant Blue Box (*Eucalyptus baureiana*) was identified at the Site. In addition, two threatened bat species were recorded, the Large Bent-wing Bat (*Miniopterus schreibersii oceansis*) and the eastern Freetail Bat (*Mormopterus norfolkensis*).

3.2 Field investigations

3.2.1 Conditions

Two ecologists completed the field investigations at North Manyana on 3 to 7 September 2012. Weather during the surveys was mild to warm with no rain. Weather data for the survey and surrounding period is provided in Table 3.1.

Table 3.1 Weather over the survey period (BOM 2012)

Date	Day	Temps		Rain	9:00 AM				3:00 PM			
		Min	Max		Temp	RH	Dir	Spd	Temp	RH	Dir	Spd
		°C	°C	mm	°C	%	km/h		°C	%	km/h	
1	Sa	4.5	15.7	4.0	12.0	49	SW	15	13.8	63	S	33
2	Su	6.8	16.4	0	14.0	45	WSW	4	14.8	58	ENE	7
3	**Mo**	**5.8**	**19.6**	**0**	**16.3**	**43**	**W**	**6**	**16.3**	**65**	**NNE**	**7**
4	**Tu**	**9.8**	**20.8**	**0**	**15.3**	**61**	**Calm**		**18.0**	**57**	**NE**	**9**
5	**We**	**10.0**	**27.1**	**0**	**16.9**	**47**	**NE**	**19**	**26.3**	**13**	**NNW**	**33**
6	**Th**	**16.0**	**23.9**	**0**	**19.7**	**34**	**SSE**	**7**	**22.6**	**28**	**W**	**22**
7	**Fr**	**15.2**	**18.0**	**0**	**16.3**	**36**	**W**	**28**	**16.5**	**36**	**WNW**	**28**
8	Sa	11.5	21.1	0	15.7	42	WNW	19	20.4	35	W	17
9	Su	11.8	18.3	0	17.3	43	WSW	9	16.5	59	ENE	9
10	Mo	8.1	20.6	0	13.6	67	N	9	17.4	66	NE	13

Note: ***Bold*** *denotes the five days field investigations were undertaken.*

Source: Bureau of Meteorology Ulladulla weather station (www.bom.gov.au accessed 24/9/12).

RH – relative humidity, Dir – wind direction, Spd – wind speed.

3.2.2 Vegetation types

The Site was cleared for settlement late last centenary and between the 1950's and 1970's for agriculture. The vegetation currently at North Manyana, has regrown from soil seed banks and natural regeneration from surrounding areas and is representative of the likely original vegetation. North Manyana contains five distinct vegetation types according to the Biometric Vegetation Type Database (DECCW 2008) in varying levels of condition:

- SR648 Swamp Mahogany swamp sclerophyll forest on coastal lowlands, Sydney Basin and South East Corner (Swamp Mahogany Forest);
- SR649 Swamp Oak - Prickly Tea-tree - Swamp Paperbark swamp forest on coastal floodplains, Sydney Basin and South East Corner (Swamp Oak Forest);
- SR512 Bangalay - Old-man Banksia open forest on coastal sands, Sydney Basin and South East Corner (Banksia Sand Forest);
- SR516 Blackbutt - Turpentine - Bangalay moist open forest on sheltered slopes and gullies, southern Sydney Basin (Blackbutt Turpentine Moist Forest); and
- SR544 Forest Red Gum - Rough-barked Apple - White Stringybark grassy woodlands on hills in dry valleys, southern South East Corner (White Stringybark Grassy Woodland) (Figure 3.1).

As the Biometric Vegetation Types Database provides broad vegetation community descriptions, the communities have been typed back according to the floristic composition, structure abotic factors as best as possible, and may differ slightly to those identified previously at the Site. A description of each of these communities is included in the following section.

a. Swamp Sclerophyll Forest (SR648)

Swamp Sclerophyll Forest at North Manyana is dominated by Bangalay (*Euclayptus botryoides*) and a hybrid of this species, Bastard Mahogany *(Eucalyptus botryoides x saligna)*. Swamp Sclerophyll Forest occurs in the lower parts of the Site, particularly along the intermittent drainage depressions on alluviums and sandy flats.

The community forms a low open forest with an open shrub layer and a dense groundcover of sedges and forbs where Bangalays are more mature. However, the shrub layer is tall and dense throughout the central and eastern part of the Site, where canopy species are missing. Swamp Sclerophyll Forest occurs in the southern and eastern parts of North Manyana.

The small tree and shrub layers are dominated by Tantoon (*Leptospermum polygalifolium*), Sydney Golden Wattle (*Acacia longifolia*) and paperbarks (*Melaleuca linarifolia* and *M. ericifolia*). Areas of Scrub She-Oak (Allocasuarina distyla) and Swamp Oak (*Casuarina glauca*) also occur throughout its distribution at North Manyana. Some areas also contain a diverse range of shrubs including Heath-leaved Banksia (*Banksia ericifolia*), Swamp Banksia (*Banksia paludosa*), *Melaleuca hypericifolia*, Narrow-leaved Bottlebrush (*Callistemon linearis*), Needlebush (*Hakea teretifolia*) and Tick Bush (*Kunzea ambigua*). The groundcover is dominated by Zig-zag Bog-rush (*Schoenus brevifolius*), Tall Saw-sedge (*Gahnia clarkei*), Blady Grass (*Imperata cylindrica var. major*) and Wiry Panic (*Entolasia stricta*).

Swamp Sclerophyll Forest most closely aligns with FoW p45 Coastal Sand Swamp Forest according to the Tozer (2010) mapping. However at North Manyana, it does not contain the characteristic Swamp Mahogany (*Eucalyptus robusta*) from this classification as this species only occurs north of Jervis Bay.

The community at the Site meets the description of Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions, which is listed as an endangered ecological community in NSW under the TSC Act.

b. Swamp Oak Forest (SR649)

Swamp Oak Forest occurs as a disturbed forest in the centre of the Site and a more intact forest on the south-west part of the Site associated with a small drainage depression. Swamp Oak (Casuarina glauca) is the dominant canopy species. In the central part of the Site, Swamp Paperbark (*Melaleuca ericifolia*) is a subdominant, with areas on the edge of disturbance containing a dense understorey of Blady Grass and exotic species.

In the south-western part of the Site, Black Wattle (*Acacia mearnsii*) occurs as a subdominant, with climbers including Common Silkpod (*Parsonsia straminea*) and a grassy, herbaceous groundlayer. Groundcovers include *Gahnia radula*, Ivy-leaved Violet (*Viola hederacea*), Basket Grass (*Oplismenus aemulus*), Couch (*Cynodon dactylon*), Maroonhood (*Pterostylis pedunculata*), Kidney Weed (*Dichondra repens*) and Native Wandering Jew (*Commelina cyanea*).

The community at North Manyana most closely aligns with FoW p105 Floodplain Swamp Forest according to the Tozer (2010) mapping. It also meets the description of Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions, which is listed as an endangered ecological community in NSW under the TSC Act.

c. Banksia Sand Forest (SR512)

Banksia Sand Forest occurs on deep coastal sands on the hind-dunes at the eastern side of North Manyana. The open canopy is dominated by Bangalay (*Eucalyptus botryoides*), Old-man Banksia (*Banksia serrata*) and Coast Banksia (*Banksia integrifolia* subsp. *integrifolia*).

At North Manyana, it contains a low grassy understorey with Bracken (*Pteridium esculentum*), Spiny-headed Matt-rush (*Lomandra longifolia*), Blady Grass and Blue Flax Lily (*Dianella caerulea)*. Some isolated patches of Lantana (*Lantana camera*) and Bitou Bush (*Chrysanthemoides monilifera*) occur in the area.

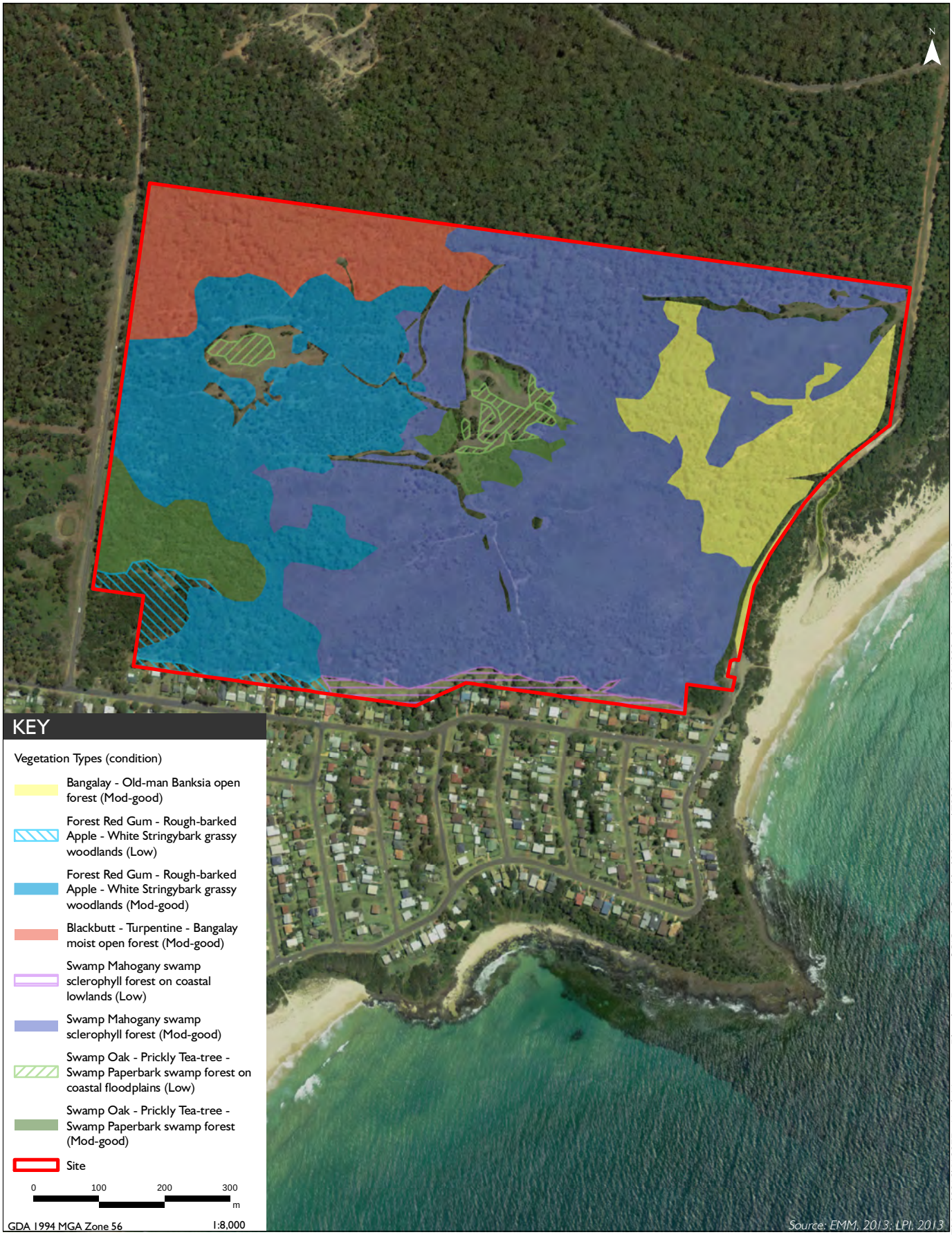
The community at North Manyana most closely aligns with DSF p64 Coastal Sand Forest according to the Tozer (2010) mapping. Banksia Sand Forest in the Site is also consistent with the definition of Bangalay Sand Forest in the Sydney Basin and South East Corner Bioregions, which is listed an endangered ecological community under the TSC Act.

d. Blackbutt Turpentine Moist Forest (SR516)

Blackbutt Turpentine Moist Forest occurs as a tall open forest in the north-western part of North Manyana. The community occurs on coastal lowlands, sheltered slopes and gullies with loamy soils with an annual rainfall in the range of 1,000 to 1,700mm.

At North Manyana, this community is dominated by Blackbutt (*Eucalyptus pilularis*), Bastard Mahogany, Turpentine (*Syncarpia glomulifera*) and Sydney Peppermint (*Eucalyptus piperita*). A small tree layer of Wild Yellow Jasmine (*Pittosporum revolutum*), Breynia (*Breynia oblongifolia*), Large Mock-olive (*Notelaea longifolia*), Scentless Rosewood (*Synoum glandulosum*) and Rough Treefern (*Cyathea australis*) occurs in some areas with a shrubby groundlayer including *Gahnia melanocarpa*, Climbing Guinea Flower (*Hibbertia scandens*), Spiny-headed Matt-rush (*Lomandra longifolia*), Bracken (*Pteridium esculentum*), Hoary Guinea Flower (*Hibbertia obtusifolia*), *Pultenaea daphnoides*, Lacy Wedge Fern (*Lindsaea microphylla*) and Ivy-leaved Violet (*Viola hederacea*).

Blackbutt Turpentine Moist Forest most closely aligns with WSF p99 Illawarra Gully Wet Forest according to the Tozer (2010) mapping. This community does not align with any threatened ecological communities listed under the TSC Act.



Vegetation types at the site

North Manyana Rezoning Proposal: Ecological Assessment

Figure 3.1

e. White Stringybark Grassy Woodlands (SR544)

White Stringybark Grassy Woodland is typically dominated by Forest Red Gum (*Eucalyptus tereticornis*), however only a few individuals of this species were identified at North Manyana. Instead, this community is dominated by White Stringybark (*Eucalyptus globoidea*), Black Wattle (*Acacia mearnsii*), Rough-barked Apple (Angophora floribunda) and Blue Box (*Eucalyptus baueriana*).

The generally sparse shrub layer contains Hopbush (*Dodonea viscosa*) and Cherry Ballart (*Exocarpus cupressiformis*), while the grassy groundlayer contains Kangaroo Grass (*Themeda australis*), Right-angle Grass (*Entolasia stricta*), Basket Grass (*Oplismenus imbecillis*) and *Poa labillardierei*. It also contains a range of forbs, climbers and graminoid species including Kidney Weed (*Dichondra repens*), Native Raspberry (*Rubus parvifolius*), Native Geranium (*Geranium solanderi*), Rough Guinea Flower (Hibbertia aspera), False Sarsparilla (*Hardenbergia violacea*), Raspwort (*Gonocarpus teucrioides*), Flat Sword Sedge (*Lepidosperma laterale*) and Whiteroot (*Pratia purpurescens*).

White Stringybark Grassy Woodland most closely aligns with GW e20p229 Southeast Lowland Grassy Woodland according to the Tozer (2010) mapping, which generally occurs further south where it forms part of the Lowland Grassy Woodland in the South East Corner Bioregion endangered ecological community. The community at North Manyana does not meet the description of this or any other threatened ecological community.

3.2.3 Threatened species and ecological communities

Three of the vegetation types are consistent with threatened ecological communities (TEC) listed under the *Threatened Species Conservation Act* 1995 (TSC Act) (Figure 3.2). These are:

- Bangalay Sand Forest in the Sydney Basin and South East Corner Bioregions (represented by SR512 in moderate to good condition);
- Swamp oak floodplain forest of the NSW North Coast, Sydney Basin and South East Corner bioregions (represented by SR649 in moderate to good condition); and
- Swamp sclerophyll forest on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions (represented by SR648 in moderate to good condition).

3.2.4 Threatened flora

No threatened flora species have been recorded at North Manyana. Suitable habitat is present for the Leafless Tongue Orchid (*Cryptostylis hunteriana).* This species is known to occur in association with other *Cryptostylis* species which were recorded in White Stringybark Grassy Woodlands and Blackbutt Turpentine Moist Forest (leaves were visible however these were not yet in flower). Surveys were undertaken prior to the main flowering period for the species.

The regionally significant Blue Box (*Eucalyptus baueriana)* is common in the Site, particularly within the White Stringybark Grassy Woodlands and occasionally in the Swamp Mahogany Forest.

3.2.5 Noxious weeds

Sixteen weed species were recorded at North Manyana. Of these species, three are declared as noxious weeds in the Shoalhaven Council control area. These were Bitou Bush, Blackberry (*Rubus fruiticosus*) and Lantana. These species are Class 4 noxious weeds meaning the growth of the plants must be managed in a manner that reduces numbers, spread and incidence, and continuously inhibit reproduction. In addition, these plants must not be sold, propagated or knowingly distributed.

3.2.6 Threatened fauna

Fourteen fauna species listed as threatened under the TSC Act were recorded at North Manyana during the ecological surveys (Figure 3.2). These are:

- Eastern Bentwing Bat (*Miniopterus schreibersii*);
- Eastern False Pipistrelle (*Falsistrellus tasmaniensis*);
- East-coast Freetail Bat (Mormopterus norfolkensis) (recorded by ERM);
- Gang Gang Cockatoo (*Callocephalon fimbriatum*);
- Glossy Black Cockatoo (*Calyptorhynchus lathami*);
- Greater Broad-nosed Bat (*Scoteanax ruepellii*);
- Hooded Plover (*Thinornis rubricollis*) (recorded on dunes to the east of the Site);
- Little Bentwing Bat (*Miniopterus australis*);
- Little Lorikeet (*Glossopsitta pusilla*);
- Osprey (*Pandion haliaetus*);
- Pied Oyster Catcher (*Haematopus longirostris*) (recorded on dunes to the east of the Site);
- Sooty Owl (*Tyto tenebricosa*) (heard calling near the northern boundary of the Site);
- Sooty Oyster Catcher (*Haematopus fuliginosus*) (recorded on dunes to the east of the Site); and
- Square-tail Kite (*Lophoictinia isura*).

North Manyana provides foraging habitat for the identified threatened fauna species, however the Site provides only limited opportunities for nesting and roosting for many of these species. No trees were identified with hollows suitable for the Sooty Owl, and few hollow-bearing trees occur that would be suitable for the Little Lorikeet and hollow-roosting bat species. Further, no caves or suitable roosting habitat for cave-dwelling bat species occur in the Site, and no raptor nests were observed.

Eight additional threatened species, which have been identified in areas surrounding North Manyana or are likely to utilise the habitat present (see Appendix A), are also likely to occur:

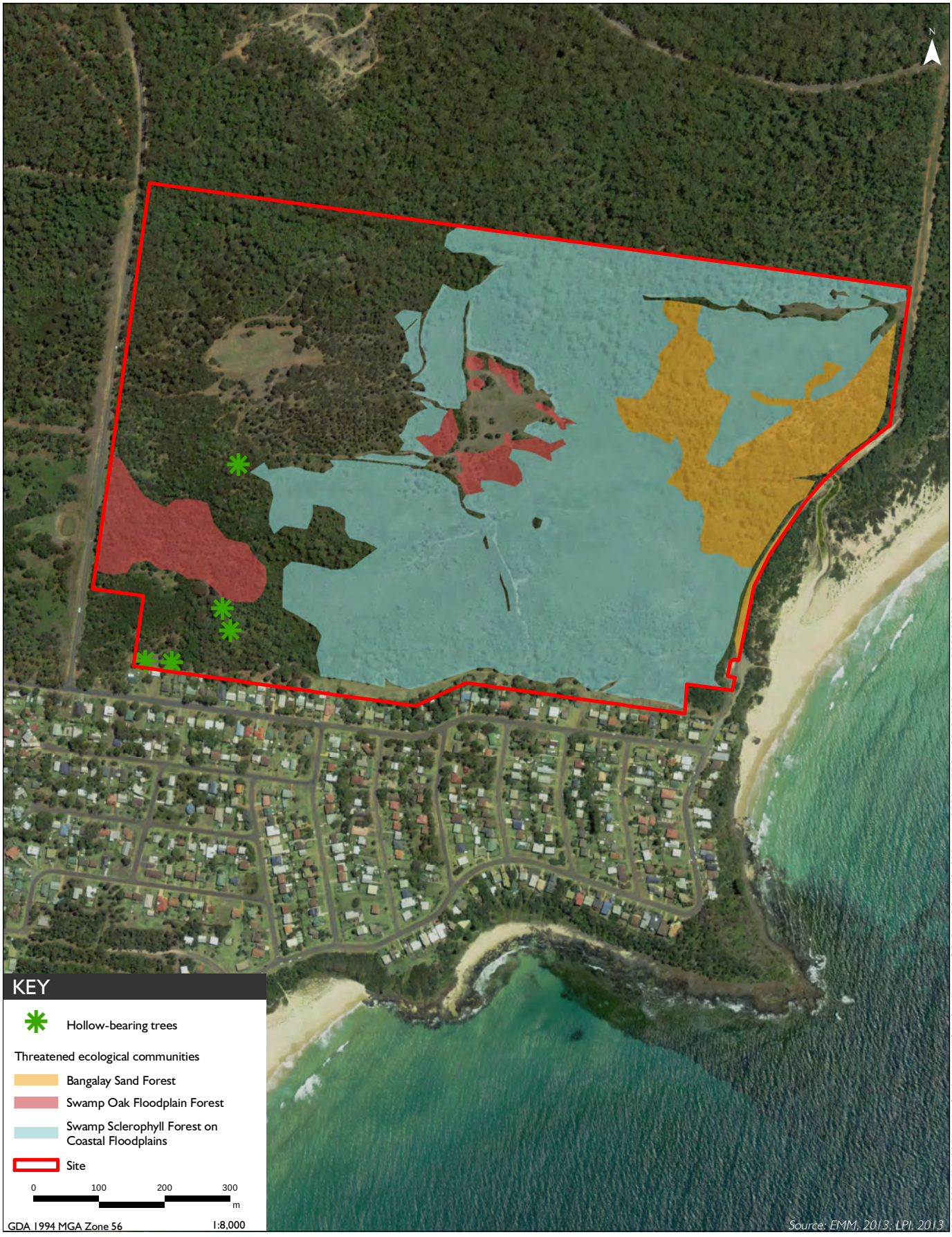
- Squirrel Glider (*Petaurus norfolcensis*);
- Eastern Ground Parrot (*Pezoporus wallicus wallicus);*
- Masked Owl (*Tyto novaehollandiae*);
- Powerful Owl (*Ninox strenua*);
- Spotted-tailed Quoll (*Dasyurus maculatus*);
- Southern Brown Bandicoot (*Isoodon obesulus obesulus*);
- Long-nosed Potoroo (*Potorous tridactylus tridactylus*); and
- Yellow-bellied Glider (*Petaurus australis*).

These additional species require hollow-bearing trees for roosting and nesting. As hollow-bearing trees are limited at North Manyana, the Site mainly provides foraging habitat for these species.

i SEPP 44 Koala habitat

State Environmental Planning Policy No 44 – Koala Habitat Protection (SEPP 44) encourages appropriate conservation and management of habitat for Koalas (*Phascolarctos cinereus*) to reverse the current trend of population decline. SEPP 44 defines potential Koala habitat as vegetation that contains at least 15% of the total number of trees, as Koala feed trees listed under Schedule 2. Core Koala habitat is defined as areas where a resident population of Koalas are present including breeding females.

North Manyana is within the Shoalhaven Local Government Area and is therefore needs to be assessed under SEPP 44. The only recognised feed tree under Schedule 2 that occurs at North Manyana is the Forest Red Gum (*Eucalyptus teriticornis*), however only a couple of individuals of this species were recorded during the surveys and therefore the Site does not contain potential Koala habitat. In addition, no Koalas were identified during the surveys, and no evidence of their use of the Site was recorded, so the Site is not considered to be core Koala habitat.



Threatened ecological communities and fauna habitat features at the site

North Manyana Rezoning Proposal: Ecological Assessment

Figure 3.2

ii Fauna habitat features

Four hollow-bearing trees and two dead stags were recorded at the Site. Most of the hollows present appear to be shallow and offer only limited potential nesting and roosting sites for fauna species. All identified hollow-bearing trees occur in the proposed development area for rezoning (Figure 3.2).

Table 3.2 Hollow-bearing trees

ID	Tree species	Hollows present	To be removed by rezoning proposal?
1	Wollybutt (*Eucalyptus longifolia*)	4 x small-medium and 5 x small	Yes
2	Wollybutt (*Eucalyptus longifolia*)	2 x small-medium	Yes
3	Dead stag	Fissures	Yes
4	Wollybutt (*Eucalyptus longifolia*)	3 x small-medium and 2 x medium	Yes
5	Dead stag (at same location as 6)	Fissures	Yes
6	Wollybutt (*Eucalyptus longifolia*)	2 x small-medium	Yes

3.2.7 Threatened populations

No threatened populations were recorded in the Site and none are considered likely to occur. As such, they are not discussed further in this report.

3.2.8 Critical habitat

Critical habitat at the Site has not been identified for threatened species under the TSC Act or EPBC Act. As such, critical habitat is not assessed further in this report.

3.2.9 Matters of NES

i Threatened species

No species listed under the EPBC Act were identified at North Manyana. However, potential habitat occurs for the following species which may use the resources in the Site:

- Spotted-tailed Quoll;
- Southern Brown Bandicoot; and
- Long-nosed Potoroo.

ii Migratory species

The Black-faced Monarch (*Monarcha melanopsis*) and Osprey (*Pandion haliaetus*) are listed as migratory species under the EPBC Act. Other migratory birds are likely to use the dune and beach habitat to the east of the Site and potentially the lagoon area.

4 Potential Impacts

4.1 Current zoning

The current zoning proposal for North Manyana would permit the development of 41.5 ha of land that contains native vegetation. This represents the development of up to 54% of the Site and within this 14.2 ha of vegetation contains TECs.

The current zoning would also permit the development of the western half of the Site, which would prevent the movement of fauna from the eastern side to surrounding habitat, greatly limiting the ecological value of the areas affected. The zoning of the eastern part of the site (Open space – recreation 6(b)) would potentially permit further development at the site, with a previous development concept including a golf course in this area, which would have required extensive clearing of existing vegetation.

4.2 Proposed rezoning

4.2.1 Avoidance

Detailed ecological surveys were conducted to determine the potential constraints to the development of the North Manyana site. The rezoning proposal was determined using this information and other environmental data including flood risk.

The rezoning proposal aims to avoid the main ecological and environmental constraints identified in the Site, whilst maintaining its proposed future residential use. Ecological constraints identified that the proposal aims to avoid where possible include:

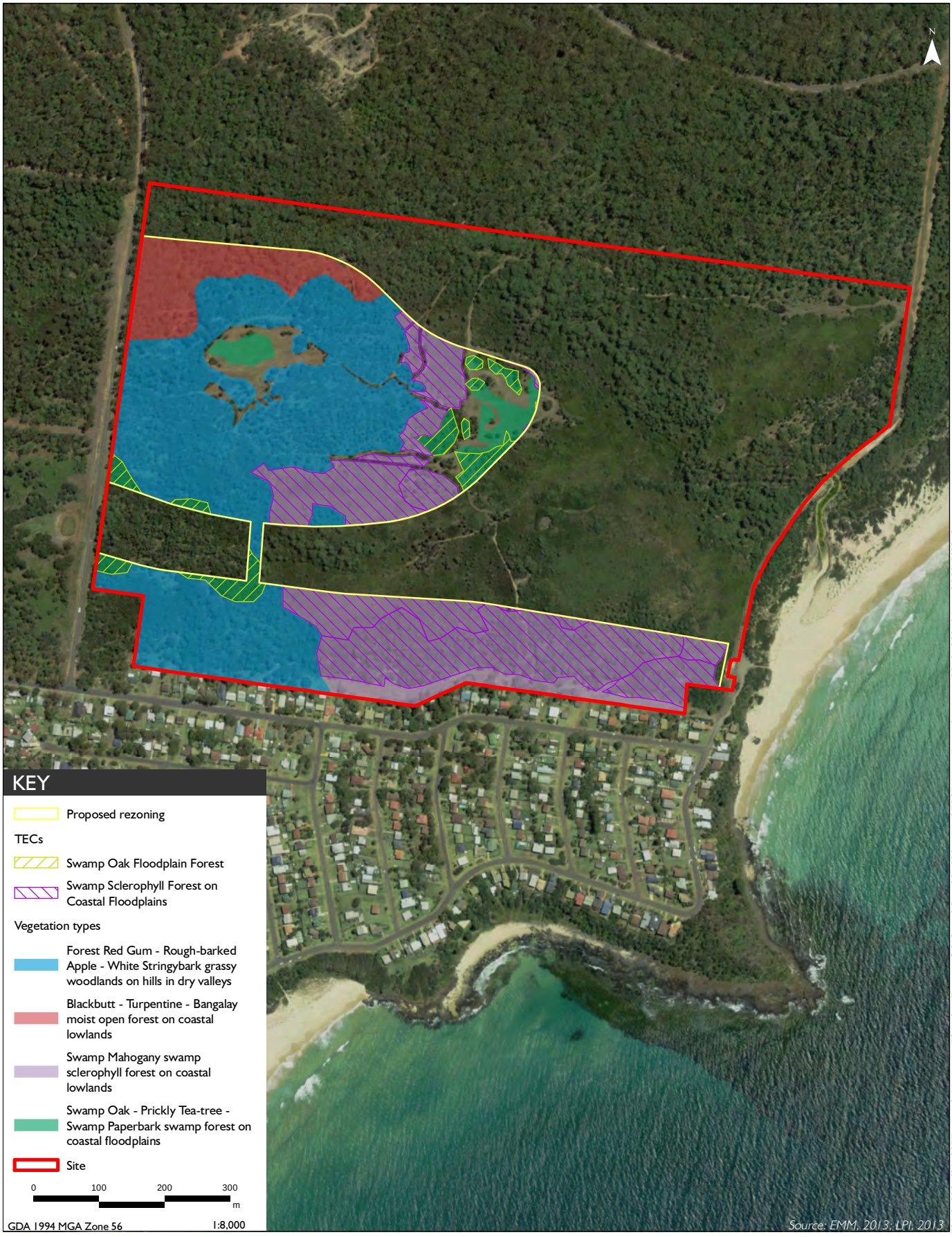
- TECs;
- riparian areas and associated vegetation and fauna habitat;
- buffers around TECs; and
- wildlife movement corridors.

Where such features were unable to be avoided, areas of lower quality habitat or communities that are already subject to edge effects or other disturbances were investigated as potential development areas. Approximate areas of TECs to be impacted for the proposed rezoning aimed to be similar or less than the current zoning during such investigations.

4.2.2 Native vegetation

The proposed rezoning allows for the development of approximately 32 ha or 44% of vegetated areas at North Manyana for residential areas (Table 4.1). This is 9.7 ha less native vegetation disturbed than the current zoning allows.

The majority of the vegetation to be disturbed for the proposed rezoning consists of woodland through the western part of the Site dominated by White Stringybark and Rough-barked Apple and dense heath in the south which dominates the eastern part of the Site (Figure 4.1).



Vegetation and TECs in the proposed rezoning development area

North Manyana Rezoning Proposal: Ecological Assessment

Figure 4.1

Table 4.1 Likely vegetation clearing from rezoning proposal

BVT	Vegetation type	Proposed development area (ha)	Total area onsite (ha)	Remaining onsite (ha)	Percent of type to be impacted on the Site
SR512	Bangalay - Old-man Banksia open forest on coastal sands	0.0	6.6	6.6	0%
SR516	Blackbutt - Turpentine - Bangalay moist open forest on sheltered slopes and gullies	2.7	6.9	4.2	39%
SR544	Forest Red Gum - Rough-barked Apple - White Stringybark grassy woodlands on hills in dry valleys	15.3	16.7	1.4	92%
SR648	Swamp Mahogany swamp sclerophyll forest on coastal lowlands	11.6	36.8	25.2	32%
SR649	Swamp Oak - Prickly Tea-tree - Swamp Paperbark swamp forest on coastal floodplains	2.2	4.9	2.7	45%
Total		**31.8**	**71.9**	**31.8**	**44%**

4.2.3 Fauna habitat

The vegetation to be impacted as a result of the proposed rezoning provides habitat for a range of common and rare fauna species. However, 9.7 ha less native vegetation will be disturbed for the proposed rezoning than the current zoning allows.

The proposed rezoning design provides wildlife corridors for habitat connectivity and the movement of fauna in the Site and to surrounding habitat areas. Wildlife corridors would be maintained along the two intermittent drainage lines in the north and the south-western part of the Site. The majority of the eastern part of the Site would also remain undeveloped and provide habitat and connectivity to the vegetated crown land to the north of the Site.

The Site contains few hollow-bearing trees, all of which could be removed for the proposed rezoning. However, these all occur in the current residential areas and could also be impacted by the development of the Site with the current zoning.

4.2.4 Indirect impacts

The Site is already subject to a range of edge effects from surrounding development and encroachment, roads, powerline easements and the motorbike tracks throughout the Site. These actions are promoting the introduction and spread of weeds into the Site and resulting in erosion and sedimentation into remnant native vegetation.

Residential development and roads will be encompassed within the proposed rezoning footprint. The proposal results in development to the north of existing residential areas where edge effects are greatest at the Site. It is likely that development of this area will incorporate a vegetated walkway to the beach, which will also act as a fire trail, and minimise the potential for further encroachment into areas of native vegetation.

The other main development area is in the north-west of the Site associated with the already disturbed motorbike track area and surrounding tracks, areas of rubbish bumping and associated disturbance.

i Introduced species

Disturbance of the soils and removal of native vegetation for the development could potentially cause weed invasion, particularly increasing the potential for the introduction and spread of noxious weeds that were recorded in the area. Weed control will be undertaken prior to clearing works to minimise the risk of introduction and spread of weeds to areas of remnant vegetation.

The proposed rezoning is unlikely to increase the abundance or distribution of feral animal species. North Manyana is already disturbed from current unauthorised use, which has created extensive movement corridors for pest species.

4.2.5 Threatened biodiversity

i Endangered ecological communities

The proposed rezoning requires the removal of 11.7 ha of vegetation that is listed as TECs in moderate to good condition (Table 4.2). However, this is 2.5 ha less than the current zoning could remove. This difference is represented in the amount of Swamp Oak Floodplain Forest endangered ecological community to be impacted.

Table 4.2 Comparison of extent of TECs impacted and conserved at North Manyana for the current zoning and proposed rezoning

	Current zoning (ha)		Proposed zoning (ha)		
TEC	Habitat impacted	Habitat conserved	Habitat impacted	Habitat conserved	Difference in impact (ha)
Bangalay Sand Forest	0.0	6.6	0.0	6.6	0.0
Swamp Oak Floodplain Forest	3.9	0	1.3	2.6	2.6
Swamp Sclerophyll Forest	10.3	15.3	10.4	25.2	-1.0
Total	14.2	21.9	11.7	34.4	2.5

Assessments of significance (see Appendix C) in accordance with section 5A of the NSW *Environment Planning and Assessment Act* 1979 (EP&A Act) were completed to quantify impacts of the proposed development on the Swamp Oak Floodplain Forest, Bangalay Sand Forest and Swamp Sclerophyll Forest endangered ecological communities. The assessments, which are also known as seven-part tests) determined that significant impacts to the TECs were unlikely as no Bangalay Sand Forest will be removed or indirectly impacted, only 11.7 ha (25%) of Swamp Oak Floodplain Forest and Swamp Sclerophyll Forest will be removed (compared with 14.2 ha with the current zoning), the rezoning will not fragment patches of the communities and impacts will be compensated by the protection and enhancement of remaining TEC areas.

ii Threatened species

Threatened fauna species represent a constraint to development, however as North Manyana would mainly be used as foraging habitat for identified and potentially occurring species, the significance of the Site for such species in the locality is low. The importance of the Site is reduced further when considering the amount and quality of habitat in surrounding areas, particularly to the north of the Site.

While the proposed rezoning would allow for the development of some areas which contain threatened species habitat, it is likely that the outcome would be similar or less than the expected impacts under the current zoning of the Site. The proposed rezoning maintains or reduces the amount of potential habitat for known and likely threatened fauna species to be impacted, when compared to the current zoning (Table 4.3).

Table 4.3 Comparison of extent of threatened fauna habitat impacted and conserved at North Manyana for the current zoning and proposed rezoning

	Current zoning (ha)		Proposed zoning (ha)		
Threatened species	**Habitat impacted**	**Habitat conserved**	**Habitat impacted**	**Habitat conserved**	**Difference in impact (ha)**
Raptors					
Osprey	0	0	0	0	0
Square-tailed Kite	41.5	35.5	31.8	40.1	9.7
Woodland birds					
Little Lorikeet	41.5	35.5	31.8	40.1	9.7
Gang-gang Cockatoo	41.5	35.5	31.8	40.1	9.7
Glossy Black Cockatoo	15.5	26.2	13.8	27.9	1.7
Marine birds					
Hooded Plover	0.0	0.0	0.0	0.0	0.0
Pied Oyster Catcher	0.0	0.0	0.0	0.0	0.0
Sooty Oyster Catcher	0.0	0.0	0.0	0.0	0.0
Forest owls					
Powerful Owl	41.5	35.5	31.8	40.1	9.7
Masked Owl	41.5	35.5	31.8	40.1	9.7
Sooty Owl	41.5	35.5	31.8	40.1	9.7
Cave-roosting bats					
Eastern Bentwing Bat	41.5	35.5	31.8	40.1	9.7
Little Bentwing Bat	41.5	35.5	31.8	40.1	9.7
Tree-roosting bats					
Eastern False Pipistrelle	41.5	35.5	31.8	40.1	9.7
East-coast Freetail Bat	41.5	35.5	31.8	40.1	9.7
Greater Broad-nosed Bat	41.5	35.5	31.8	40.1	9.7
Non-flying mammals					
Squirrel Glider	34.2	32.8	29.6	37.4	4.6
Yellow-bellied Glider	23.6	0	18	5.6	5.6
Ground-dwelling birds					
Eastern Ground Parrot	10.6	26.2	11.6	25.2	-1

Table 4.3 Comparison of extent of threatened fauna habitat impacted and conserved at North Manyana for the current zoning and proposed rezoning

	Current zoning (ha)		Proposed zoning (ha)		
Threatened species	**Habitat impacted**	**Habitat conserved**	**Habitat impacted**	**Habitat conserved**	**Difference in impact (ha)**
Ground-dwelling mammals					
Spotted-tailed Quoll	41.5	35.5	31.8	40.1	9.7
Southern Brown Bandicoot	41.5	35.5	31.8	40.1	9.7
Long-nosed Potoroo	41.5	35.5	31.8	40.1	9.7
Migratory species					
Black-faced Monarch	41.5	35.5	31.8	40.1	9.7

Assessments of significance were completed in line with the TSC Act and/or EPBC Act guidelines for the fauna species identified as having the potential to occur in the proposed gravel pits (Appendix C). The assessments concluded that impacts were unlikely to be significant for:

- raptors as limited potential breeding habitat is present, potential foraging habitat is common in the locality and the proposed rezoning reduces the amount of potential habitat removed;
- woodland birds as limited potential breeding habitat is present, potential foraging habitat is common in the locality for these highly mobile species and it reduces the amount of potential habitat removed;
- marine birds as no breeding or foraging habitat is present and potential indirect impacts to habitat for these species will be mitigated;
- forest owls as no breeding habitat will be impacted and roosting habitat is limited, it reduces the amount of potential habitat removed, indirect impacts such as noise disturbance will only be temporary and owls have extensive home ranges and are highly mobile;
- cave-roosting bats as no breeding habitat will be removed, a contiguous patch of foraging habitat will remain and suitable habitat is abundant in the locality;
- tree-roosting bats as no breeding habitat will be removed, it reduces the amount of potential habitat removed and the proposed rezoning only removes six hollow-bearing trees;
- non-flying mammals as only a small amount of low quality breeding habitat is present, it reduces the amount of potential foraging habitat removed and suitable habitat is abundant in the locality;
- ground-dwelling birds as only a small portion of potential lower quality foraging and breeding habitat will be removed, it reduces the amount of potential habitat removed and a large portion of potential foraging and breeding habitat will be retained;
- ground-dwelling mammals as only a small amount of potential foraging and breeding habitat is present, it reduces the amount of potential foraging habitat removed and suitable habitat is abundant in the locality; and