

Appendix 4: Robert Payne Narara Ecovillage Flora and Fauna Gap Analysis Report-Update: Version 9



NARARA ECOVILLAGE

NARARA ECOVILLAGE FLORA AND FAUNA GAP ANALYSIS REPORT-UPDATE: Version 9

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I would like to acknowledge that Diane Warman provided very helpful assistance in the field during the flora surveys and Alf Britton provided me with some additional threatened fauna species information observed in the locality. Ross Wellington supplied the overall frog and reptile information presented in Appendix 10 and this update has been included because this section of the fauna component always appears to be the most under represented due to the cryptic nature of these species. Richard Cassells also provided some of the raptor data, organized the community bird field day led by Alan Morris and photographed the Long-nosed Bandicoot.

SUMMARY

The gap analysis survey for the Narara Ecovillage increased the number of fauna species from 45 to 118 and for flora from approximately 55 to over 310 species. This has eventuated because a number of additional habitats were identified which were then targeted for the extra surveys. Of particular note, one additional endangered ecological community Freshwater Wetland was identified along with an additional six threatened fauna species. No additional threatened plant species were found although one regionally rare plant species was located.

From a development perspective, the additional threatened fauna species should be able to be safeguarded because they are mainly restricted to the vegetated slopes and ridges and the dam, although, one species, the Black Bittern, was located in the Freshwater Wetland. However, only minor impacts are predicted here although management is required to be considered to curtail the Cumbungi from intruding into this wetland proper.

Large trees with hollows are prominent on the ridge of the property and are safeguarded within the DCP175 area which is an example of "old growth forest" on low nutrient soils. These hollows are ideal to function as roost sites and breeding sites within a wildlife corridor for numerous bird and mammal species. Trees with hollows are also found on the lowland floodplain and lower slopes with one tree hollow within the development area. Offset measures have been set down to artificially replace this tree with a roosting box in case they are used by microbats.

Given that the DCP 175 land, including the dam, will support most of the threatened species, the proposal is unlikely to have a significant impact on these threatened species under the commonwealth and state levels of legislation. One species the Black Bittern is present in the Freshwater Wetland which should be continually managed under the present mowing regime to avoid loss of its habitat by the intrusive Cumbungi sub-community.

1.0 INTRODUCTION AND BACKGROUND

The land, which applies to the Narara Ecovillage, is an area of 40.2 hectares and is known as Lot 13 in DP1126998 (Figure 1) and lies at the end of Research Road Narara (No. 25). Initial flora and fauna assessments were undertaken by Andrews-Neil (2006a; b) and these surveys and associated reporting covered mostly the cleared land and vegetation remnants associated with the valley floor. Thus the original focus of these surveys was placed upon the alluvial riparian environment which encompassed remnant vegetation patches and fauna habitat along Narara Creek, on cleared alluvial flats. Fauna survey sites outside this zone were restricted to lower slopes that had been cleared or disturbed.

Although vegetation mapping for the study area has also been prepared for the Gosford local government area only some information was known about the botany of this valley in 2006. The botany of the cleared alluvial flats was then adequately surveyed and one vegetation map unit was considered to originally occur along the valley floor which was a closed forest dominated by the emergent Sydney Blue Gum *Eucalyptus saligna*. This valley vegetation was not considered to be an example of the endangered ecological community "Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions" although one threatened plant species was found on the floodplain, namely the Magenta Lilly Pilly, *Syzygium paniculatum*, which is now listed as 'endangered' on the *Threatened Species Conservation Act, 1995 (TSC Act)* and vulnerable under the *Commonwealth Environment Protection and Biodiversity Conservation Act, 1999 (EPBC Act)* (Office of Environment & Heritage NSW, 2012).

Fauna surveys were also undertaken for microbats, reptiles, amphibians, birds and nocturnal animals throughout these two habitats of the northern part of the cadastral area with a south-western aspect. Threatened fauna species that were recorded and found were the Eastern Bent-wing Bat, *Miniopterus schreibersii oceanensis*, the Powerful Owl, *Ninox strenua*, the Sooty Owl, *Tyto tenebricosa* (both owls being offsite), the Grey-headed Flying Fox, *Pteropus poliocephalus* along with evidence of the Yellow-bellied Glider, *Petaurus australis*. All of the above mentioned species are listed as threatened on the *TSC Act, 1995* whilst the Grey-headed Flying Fox is also listed under the *Commonwealth EPBC Act, 1999*.

Although this project is for a residential development three major management issues were recognized at the early stage which were the preparation of a weed management strategy, care and control during landscaping involving the Magenta Lilly Pilly and restriction of artificial night lighting to ameliorate the ultimate impacts on nocturnal fauna.

Rezoning of the subject land for residential purposes took place in 2008 under Development Control Plan (DCP) 175. Although a basic plan is presented in the Andrews-Neil (2006a;b) reports the Applicant has been requested to submit a Development Application to Gosford City Council for a revised master plan and staged development which must include construction of infrastructural services and a subdivision that involves 40 lots with residential 2(a) zoning. Whilst a revised master plan is required, the yield and footprint of the proposed development will not be altered and will be consistent with DCP175.

Given the lapse in time since the previous flora and fauna surveys were completed Council has requested an updated flora and fauna report to an acceptable standard that satisfies the NSW OEH guidelines (NSW DEC, 2004). This report provides that information and was carried out over a two year period.

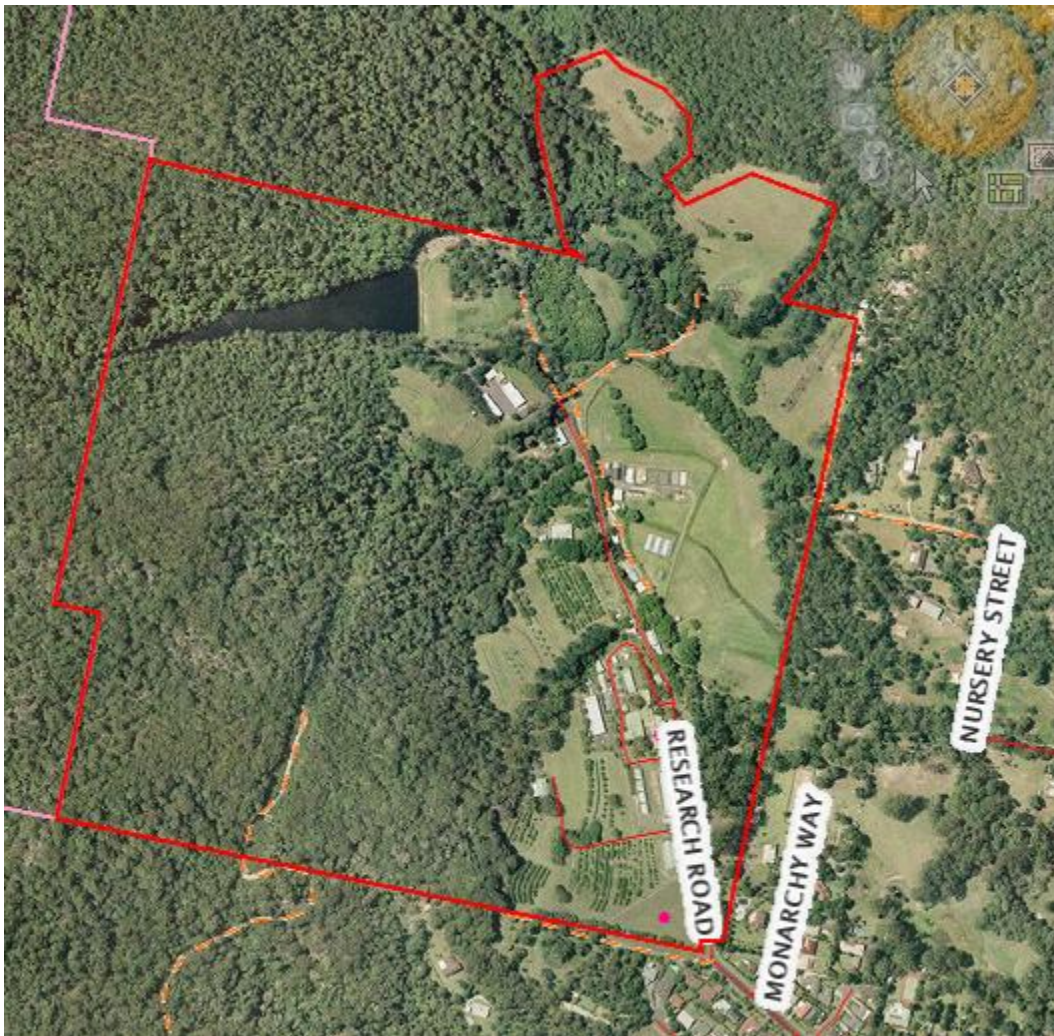


Figure 1: Aerial photograph showing Lot 13 in DP1126998 which is the subject land for this development application.

1.1 The study area description

Figure 1 shows the study area and occurs at the end of Research Road Narara. On the Gosford 1:25 000 topographical mapsheet the ecovillage study area can be located at Australian Map Grid (Australian Geodetic Datum) co-ordinates $344\ 280E$, $63\ 04\ 125N$. The study area is also found within the Parish of Gosford, the County of Northumberland and the City of Gosford.

At a finer scale the surveyed boundaries of the study area can be found on Lot 13 DP 1126998 (Figure 2) which is found from the end of Research Road Narara and extends north to the boundary of Strickland State Forest.

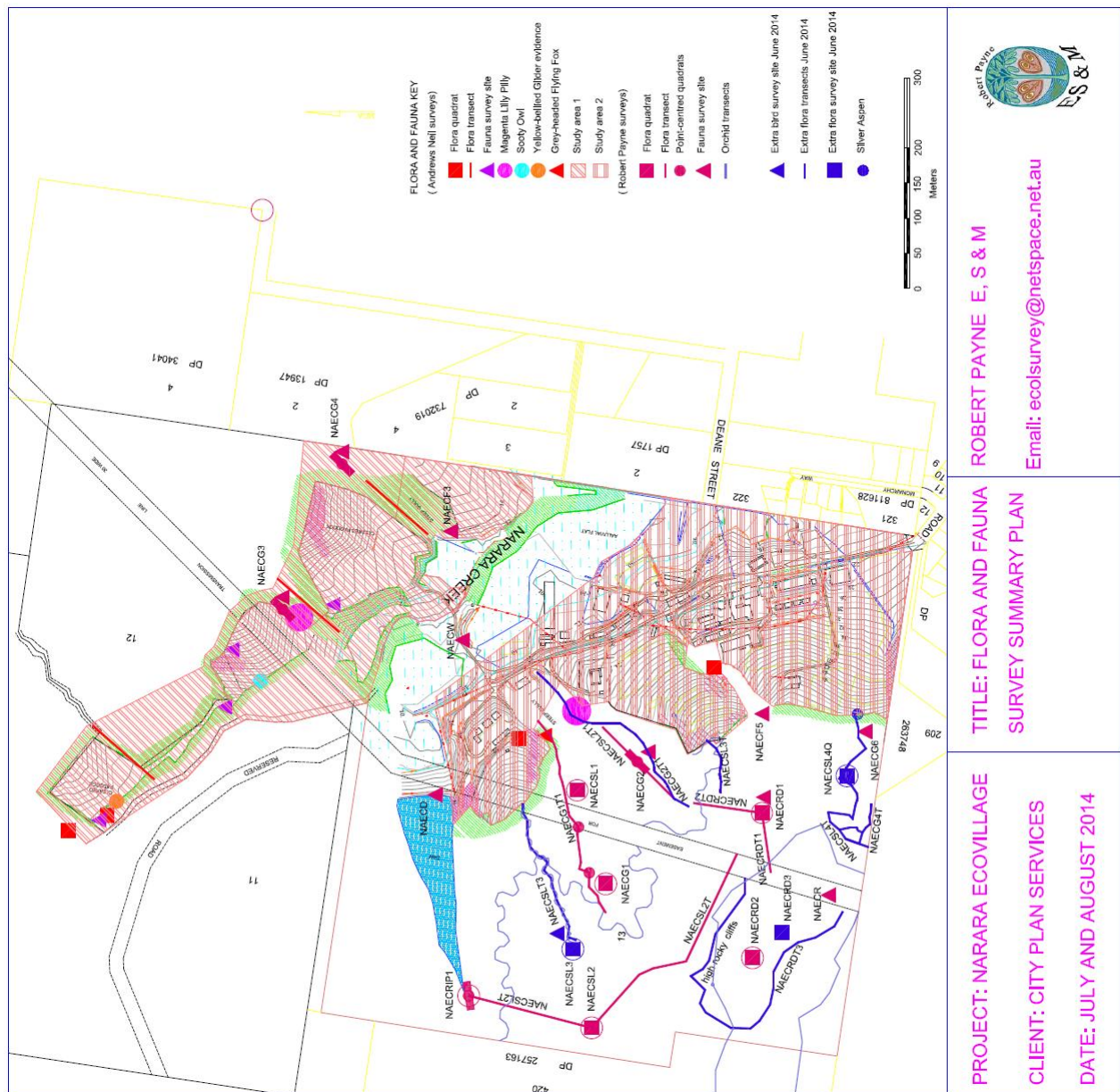













Figure 2: Detailed base plan prepared by Chase, Burke & Harvey showing the previous study areas that have been surveyed for flora and fauna and those additional sites chosen under this study.

Previous vegetation mapping is shown in Figure 3, but it appears to have been based on and relies upon the local government area broad scale mapping of Bell (2004). Several vegetation communities are shown, however, based on geology. Only two geological units occur which are the Quaternary Holocene gravels and sands (Qa) along the valley floor and the middle Triassic Terrigal Formation (Rnt) found on the slopes, which are comprised of interbedded laminate, shale and quartz, lithic quartz sandstone and red claystone (NSW Department of Trade & Investment, 2003).

LEGEND

 Subject Site
 Survey Area
 Drainage Line

Vegetation Communities (Bell 2004)

 Coastal Mallee Moist Forest
 Coastal Warm Temperate Rainforest
 Disturbed - Canopy Only
 Disturbed - exotic vegetation
 Disturbed Regrowth
 Exposed Hawkesbury Woodland
 Hawkesbury Peppermint Apple Forest
 Sandstone Hanging Swamps

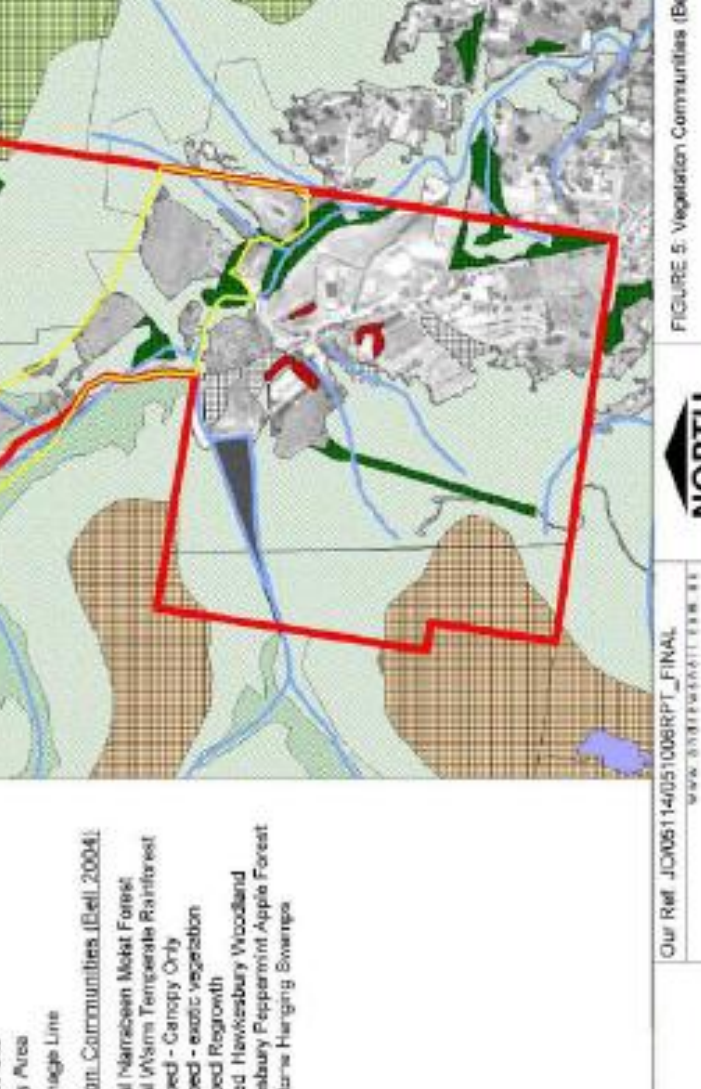


FIGURE 5: Vegetation Communities (Bell 2004)

PROJECT: Flora and Fauna Assessment

CLIENT: Department of Commerce

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DATE: 27/09/2008
SCALE: 1:10000

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2.0 SURVEY REQUIREMENTS

2.1 Stratification of the study area

The subject study area was firstly classified into two stratification units:-

- The riparian alluvial flats made up of Quaternary Alluvium (the Yarramalong/Alluvial soil landscape unit) and
- The slopes of the Terrigal Formation (the Watagan soil landscape unit).

These two units were adopted as the stratification units for the project based on the soil landscape units (SLU's) of Murphy (1993). Both units were separated and based upon the geology of the area to enable easier landscape interpretation in the field. These unit differences were also chosen because they also feature as significant physical landscape differences. For example, the riparian unit appears as the predominantly cleared low flat floodplain subject to inundation and the Terrigal Formation unit appears as the smooth undulating lower slopes with rugged steep cliffed upper slopes. These features can be clearly seen in Figures 1 and 3.

2.2 Survey design

To adequately complete a sample design for flora and fauna on these two stratification units the standard guidelines (NSW DEC, 2004) were used. Within the study area an extra 12 flora 20m x 20m or 40m x 10m quadrats were laid out for the Watagan unit. Four of the extra quadrats were chosen in riparian locations of the Terrigal Formation steep gullies because these habitats were eliminated in the previous surveys (see Andrews Neil 2006a; b). Four quadrats had already been surveyed by Andrews Neil (2006a; b) so that gave a total of 14 quadrats in all for the riparian, slopes and ridge areas. Three transects were sampled by Andrews Neil (2006a; b) and eight additional transects were chosen for this update. The location of the quadrats is shown on Figure 2 and the relevant details are set out in Table 1.

As well as undertaking botanical quadrat based surveys several random plotless based surveys were also sampled to determine the dominant canopy trees (alliances) within the side gullies. This added survey data would be used to determine the important percentage of each tree species in these gullies based on relative frequency, which will help determine if the endangered ecological community "Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions" is present.

Sampling design for this project involved constraints. Almost the entire moist lower Narrabeen slope was initially dominated by Lantana making access onto the slopes for flora work impossible. Only one quadrat could be achieved on these lower slopes within the property boundaries at that time although it was chosen where the vegetation was originally representative. The remainder of the slope quadrats and transects was chosen along gully lines where access was possible and that would enable the project to comply with the guidelines. Access onto the ridge vegetation posed no problem and quadrats and transects were selected in vegetation areas that were representative for the ridge and upper drier slopes. One additional quadrat and transect was added in June 2014 following clearing of an old snig track (Figure 2) to enable access onto these slopes and further vegetation was sampled on the ridge and in the south of the property.

Table 1: Flora survey site details according to stratification units.

NUMBER	EAST	NORTH	DETAILS/STRATIFICATION UNIT
NEAN1Q	344229	6304858	Yarramalong alluvial/Coastal Narrabeen Moist Forest
NEAN2Q	344250	6304803	Yarramalong alluvial/Coastal Warm Temperate Gallery Rainforest
NEAN3Q	344360	6304214	Watagan lower slope/Coastal Narrabeen Moist Forest/regrowth
NEAN4Q	344461	6303936	Watagan lower slope/Coastal Narrabeen Moist Forest/regrowth
NEAN1T	344341	6304726	Yarramalong alluvial/Coastal Warm Temperate Gallery Rainforest
NEAN2T	344521	6304462	Watagan lower slope/Coastal Narrabeen Moist Forest/riparian
NEAN3T	344661	6304335	Watagan lower slope/Coastal Narrabeen Moist Forest/riparian
NAECD1	344254	6303867	Watagan ridge/Coastal Narrabeen Dry Forest
NAECD2	344057	6303871	Watagan ridge/Coastal Narrabeen Dry Forest
NAECDT1	344179 to 344254	6303845 to 6303867	Watagan ridge/Coastal Narrabeen Dry Forest
NAECDT2	344254 to 344278	6303867 to 6303955	Watagan ridge/Coastal Narrabeen Dry Forest
NAECSL1	344287	6304111	Watagan slope/Coastal Narrabeen Moist Forest
NAECG1	344153	6304091	Watagan gully/Coastal Narrabeen Moist Forest
NAECG1T	344153 to 344332	6304091 to 6304143	Watagan gully/Coastal Narrabeen Moist Forest
NAECG2	344337	6304035	Watagan gully/Coastal Narrabeen Moist Forest
NAECG2T	344287 to 344386	6303986 to 6304085	Watagan gully/Coastal Narrabeen Moist Forest
NAECG3	344544	6304553	Watagan gully/Coastal Narrabeen Moist Forest
NAECG4	344780	6304468	Watagan gully/Coastal Narrabeen Moist Forest
NAECRIP1	344003	6304276	Watagan gully/Coastal Narrabeen Moist Forest
NAECSL2	343957	6304101	Watagan dry slope/Coastal Narrabeen Dry Forest
NAECSL2T	343957 to 344208	6304101 to 6303892	Watagan dry slope/Coastal Narrabeen Dry Forest
NAECSL3	344079	6304118	Watagan dry slope/Coastal Narrabeen Dry Forest
NAECSL3T	344079 to 344277	6304118 to 6304199	Watagan dry slope/Coastal Narrabeen Dry Forest
NAECD3	344013	6303839	Watagan ridge/Coastal Narrabeen Dry Forest
NAECDT3	343123 to 344186	6303742 to 6303882	Watagan ridge/Coastal Narrabeen Dry Forest
NAECG2T1	344465 to 344261	6304179 to 6303959	Watagan gully/ Coastal Narrabeen Moist Forest
NAECSL3T	344273 to 344356	6303911 to 6303984	Watagan dry slope/Coastal Narrabeen Dry Forest
NAECSL4Q	344307	6303726	Watagan dry slope/Coastal Narrabeen Dry Forest
NAECSL4T	344405 to 344225	6303725 To 6303657	Watagan dry slope/Coastal Narrabeen Dry Forest
NAECG4T	344240 to 344277	6303747 to 6303701	Watagan gully/ Coastal Narrabeen Dry Forest

State Forests had conducted fauna surveys of their lands in the adjoining Strickland State Forest, to the north east and the initial intention was to rely partly upon their fauna results for the project. However, the reports relating to Strickland State Forest were not able to be

accessed and therefore further fauna work was conducted on the valley side slopes in addition to the surveys of the valley floor undertaken by Andrews Neil (2004a; b).

3.0 INITIAL ASSESSMENT

3.1 Identifying subject species, populations and/or ecological communities

New South Wales Wildlife atlas databases from the Royal Botanic Gardens, the Office of Environment and Heritage and the Australian Museum along with the Protected Matters search tool databases were all accessed to determine threatened species, endangered ecological communities and other protected matters that are likely to occur in the area of interest. Table 2 presents this initial list of these species and communities and their status on the relevant Acts.

Table 2: List of initial threatened species relevant to the study area as determined from the NSW Office of Environment & Heritage and Royal Botanic Garden websites. Access to the Australian Museum website failed.

COMMON NAME	LATIN NAME	STATUS
PLANTS		
	<i>Cynantheum elegans</i>	E TSC; E EPBC; OEH
	<i>Hibbertia puberula</i>	E TSC; OEH
Spreading Guinea Flower	<i>Hibbertia procumbens</i>	E TSC; RBG; OEH
	<i>Senna acclinis</i>	E TSC; OEH
	<i>Grammitis stenophylla</i>	E TSC; OEH
	<i>Prostanthera askania</i>	E TSC; E EPBC; RBG; OEH
Netted Bottle Brush	<i>Callistemon linearifolius</i>	V TSC; RBG; OEH
Magenta Lilly Pilly	<i>Syzygium paniculatum</i>	E TSC, V EPBC; RBG; OEH
	<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	V TSC; V EPBC; OEH
	<i>Epacris purpurascens</i> var. <i>purpurascens</i>	V TSC; RBG; OEH
	<i>Lindsaea fraseri</i>	E TSC; RBG; OEH
	<i>Persoonia hirsuta</i> subsp. <i>hirsuta</i>	E TSC; E EPBC; RBG; OEH
A Spider Orchid	<i>Dendrobium melaleucaphilum</i>	E TSC; RBG; OEH
	<i>Melaleuca biconvexa</i>	V TSC; V EPBC; RBG; OEH
	<i>Darwinia glaucophylla</i>	V TSC; RBG; OEH
	<i>Cryptostylis hunteriana</i>	V TSC; V EPBC; RBG; OEH
	<i>Eucalyptus glaucina</i>	V TSC; V EPBC; RBG; OEH
FROGS		
Giant Burrowing Frog	<i>Heleioporus australiacus</i>	V TSC; V EPBC; OEH
Stuttering Frog	<i>Mixophyes balbus</i>	E TSC; V EPBC; OEH
Giant Barred Frog	<i>Mixophyes iteratus</i>	E TSC; E EPBC; OEH
Red-crowned Toadlet	<i>Pseudophryne australis</i>	V TSC; OEH
Green-thighed Frog	<i>Litoria brevipalmata</i>	V TSC; OEH
Littlejohns Tree Frog	<i>Litoria littlejohnii</i>	E TSC; V EPBC; OEH
REPTILES		
Pale-headed Snake	<i>Hoplocephalus bitorquatus</i>	V TSC; OEH
Stephens' Banded Snake	<i>Hoplocephalus stephensii</i>	V TSC; OEH
BIRDS		
Wompoo Fruit-dove	<i>Ptilinopus magnificus</i>	V TSC; OEH
Rose-crowned Fruit-dove	<i>Ptilinopus regina</i>	V TSC; OEH
Superb Fruit-dove	<i>Ptilinopus superbus</i>	V TSC; OEH;
Emerald Dove	<i>Chalcophaps indica</i>	V TSC;
Australasian Bittern	<i>Botaurus poiciloptilus</i>	V TSC; E EPBC; OEH
Black Bittern	<i>Ixobrychus flavicollis</i>	V TSC; OEH;
Little Eagle	<i>Hieraaetus morphnoides</i>	V TSC; OEH;

Square-tailed Kite	<i>Lophoictina sura</i>	V TSC; OEH
Glossy Black Cockatoo	<i>Calyptorhynchus lathamii</i>	V TSC; OEH;
Little Lorikeet	<i>Glossopsitta pusilla</i>	V TSC; OEH;
Powerful Owl	<i>Ninox strenua</i>	V TSC; OEH;
Sooty Owl	<i>Tyto tenebrios</i>	V TSC; OEH;
Varied Sitella	<i>Daphoenositta chrysoptera</i>	V TSC; OEH;
Scarlet Robin	<i>Petroica boodang</i>	V TSC; OEH
Flame Robin	<i>Petroica phoenicea</i>	V TSC; OEH
MAMMALS		
Spotted-tailed Quoll	<i>Dasyurus maculatus</i>	V TSC; OEH
Koala	<i>Phascolarctos cinereus</i>	V TSC, V EPBC; OEH;
Eastern Pygmy Possum	<i>Cercartetus nanus</i>	V TSC; OEH
Yellow-bellied Glider	<i>Petaurus australis</i>	V TSC; OEH;
Long-nosed Potoroo	<i>Potorous tridactylus</i>	V TSC; V EPBC; OEH;
Grey-headed Flying Fox	<i>Pteropus poliocephalus</i>	V TSC; V EPBC; OEH
Yellow-bellied Sheath-tail Bat	<i>Saccolaimus flaviventris</i>	V TSC; OEH;
Eastern Free-tail Bat	<i>Mormopterus norfolkensis</i>	V TSC; OEH
Little Bent-wing Bat	<i>Miniopterus australis</i>	V TSC; OEH;
Eastern Bent-wing Bat	<i>Miniopterus schreibersii</i> <i>ssp. oceanensis</i>	V TSC; OEH;
Large-footed Myotis	<i>Myotis macropus</i>	V TSC; OEH;
Eastern False Pipistrelle	<i>Falsistrellis tasmaniensis</i>	V TSC; OEH; AM
Greater Broad-nosed Bat	<i>Scotoanax rueppellii</i>	V TSC; OEH; AM
ENDANGERED ECOLOGICAL COMMUNITIES		
Lowland Rainforest in NSW North Coast and Sydney Basin Bioregion.		
OTHER MIGRATORY/MARINE BIRD SPECIES		
Cattle Egret	<i>Ardea ibis</i>	Ma Mi We
Glossy Ibis	<i>Plegadis falcinellis</i>	Ma Mi We
White-bellied Sea Eagle	<i>Haliaeetus leucogaster</i>	Ma Mi
Fork-tailed Swift	<i>Apus pacificus</i>	Ma Mi
White-throated Needletail	<i>Hirundapus coudacutis</i>	Ma Mi
Black-faced Monarch	<i>Monarcha melanopsis</i>	Ma Mi
Satin Flycatcher	<i>Myiagra cyanoleuca</i>	Ma Mi
Rufous Fantail	<i>Rhipidura rufifrons</i>	Ma Mi
Ma = marine; Mi = migratory; We = wetland; T = terrestrial (EPBC Act); V = Vulnerable, E = Endangered		

There was a nil result from the protected matters search tool.

Table 3: List of the subject species and their relevance to the property in question.

COMMON NAME	LATIN NAME	RELEVANCE TO SUBJECT PROPERTY
PLANTS		
	<i>Cynantheum elegans</i>	Possibly in rainforest
	<i>Hibbertia puberula</i>	Possibly on slopes & ridges
Spreading Guinea Flower	<i>Hibbertia procumbens</i>	Possibly on ridges
	<i>Senna acclinis</i>	Possibly in rainforest
	<i>Grammitis stenophylla</i>	Possibly in rainforest
	<i>Prostanthera askania</i>	Recorded just near northern boundary
Netted Bottle Brush	<i>Callistemon linearifolius</i>	Possibly on ridges
Magenta Lilly Pilly	<i>Syzygium paniculatum</i>	Previously recorded (see Figure 2)
	<i>Grevillea parviflora</i> subsp. <i>parviflora</i>	Requires moist areas on low slopes. Maybe present.
	<i>Epacris purpurascens</i> var. <i>purpurascens</i>	Sandstone hanging swamps. Could occur on ridges.
	<i>Lindsaea fraseri</i>	Open forested slopes. Possibly.
	<i>Persoonia 12tilizi</i> subsp. <i>hirsuta</i>	Open forested slopes. Possibly.

A Spider Orchid	<i>Dendrobium melaleucaphilum</i>	Melaleuca forests. Unlikely
	<i>Melaleuca biconvexa</i>	Melaleuca forests. Unlikely
	<i>Darwinia glaucophylla</i>	Ridges. Too far out of range.
	<i>Cryptostylis hunteriana</i>	Dry forests with drainage line. Unlikely.
	<i>Eucalyptus glaucina</i>	Unlikely well out of range but there is a sample from Gosford in Nat. Herb. NSW
FROGS		
Giant Burrowing Frog	<i>Heleioporus australiacus</i>	On ridges – previously recorded in Strickland SF.
Stuttering Frog	<i>Mixophyes balbus</i>	Rainforests/riparian forests –confirmed by ecologist
Giant Barred Frog	<i>Mixophyes iteratus</i>	Rainforests/riparian forests – possibly
Red-crowned Toadlet	<i>Pseudophryne australis</i>	On ridges – previously recorded in Strickland SF.
Green-thighed Frog	<i>Litoria brevipalmata</i>	Rainforests/possibly
Littlejohns Tree Frog	<i>Litoria littlejohnii</i>	
REPTILES		
Pale-headed Snake	<i>Hoplocephalus bitorquatus</i>	Open forests
Stephens' Banded Snake	<i>Hoplocephalus stephensii</i>	Open forests
BIRDS		
Wompoo Fruit-dove	<i>Ptilinopus magnificus</i>	Rare visitor; rainforests-possibly; last recorded 2001.
Rose-crowned Fruit-dove	<i>Ptilinopus regina</i>	Rare visitor; rainforests-possibly; last recorded 1997.
Superb Fruit-dove	<i>Ptilinopus superbus</i>	Rare visitor; rainforests-possibly; last recorded 1994.
Australasian Bittern	<i>Botaurus poiciloptilus</i>	Possibly if any reedlands are present.
Black Bittern	<i>Ixobrychus flavicollis</i>	Possibly – coastal streams
Little Eagle	<i>Hieraaetus morphnoides</i>	Likely- previous records nearby
Square-tailed Kite	<i>Lophoictina sura</i>	Rare visitor but previous records nearby
Glossy Black Cockatoo	<i>Calyptrorhynchus lathamii</i>	likely- prefer drier forests on ridges
Little Lorikeet	<i>Glossopsitta pusilla</i>	likely- prefers flowering coastal eucalypts; hollows for nesting
Powerful Owl	<i>Ninox strenua</i>	Previously recorded onsite
Sooty Owl	<i>Tyto tenebricos</i>	Previously recorded onsite
Varied Sitella	<i>Daphoenositta chrysoptera</i>	Uncommon breeding resident. Previously recorded in area.
Scarlet Robin	<i>Petroica boodang</i>	Very rare visitor- unlikely
Flame Robin	<i>Petroica phoenicea</i>	Very rare visitor- unlikely
MAMMALS		
Spotted-tailed Quoll	<i>Dasyurus maculatus</i>	Occurs in forests – possibly but very rare on Central Coast
Koala	<i>Phascolarctos cinereus</i>	Possibly if browse trees are present.
Eastern Pygmy Possum	<i>Cercartetus nanus</i>	Previously recorded in Strickland SF. Very likely
Yellow-bellied Glider	<i>Petaurus australis</i>	Likely – sap site trees found (see Figure 2)
Long-nosed Potoroo	<i>Potorous tridactylus</i>	Occurs in forests – possibly but now very rare on Central Coast. Used to be very common at Narara.
Grey-headed Flying Fox	<i>Pteropus poliocephalus</i>	Previously recorded (see Figure 2)
Yellow-bellied Sheath-tail Bat	<i>Saccolaimus flaviventris</i>	Possibly with high quality forest nearby
Eastern Free-tail Bat	<i>Mormopterus norfolkensis</i>	Possibly with high quality forest & cleared land onsite.
Little Bent-wing Bat	<i>Miniopterus australis</i>	Possibly on cliffed rocky ridges
Eastern Bent-wing Bat	<i>Miniopterus schreibersii ssp. oceanensis</i>	Previously recorded (refer to Andrews Neil 2006b)
Large-footed Myotis	<i>Myotis adversus</i>	Possibly – site close to drainage line.
Eastern False Pipistrelle	<i>Falsistrellis tasmaniensis</i>	Possibly – if forest supports suitable hollows
Greater Broad-nosed Bat	<i>Scotoanax rueppellii</i>	Possibly – if forest supports suitable hollows

ENDANGERED ECOLOGICAL COMMUNITIES		
Lowland Rainforest in the NSW Sydney Basin & North Coast bioregions.		Possibly - needs further surveys
OTHER MIGRATORY/MARINE BIRD SPECIES- EPBC ACT		
Cattle Egret	<i>Ardea ibis</i>	Possibly- cleared paddocks present
Glossy Ibis	<i>Plegadis falcinellis</i>	
White-bellied Sea Eagle	<i>Haliaeetus leucogaster</i>	Unlikely – mainly coastal.
Fork-tailed Swift	<i>Apus pacificus</i>	Rare summer visitor – possibly
White-throated Needletail	<i>Hirundapus coudacutis</i>	Common summer visitor – likely
Black-faced Monarch	<i>Monarcha melanopsis</i>	Rainforest & wet sclerophyll forest – likely
Satin Flycatcher	<i>Myiagra cyanoleuca</i>	Uncommon summer visitor – unlikely
Rufous Fantail	<i>Rhipidura rufifrons</i>	Common summer migrant Rainforest & forest – likely

The list is repeated in Table 3 and shows which species are relevant to the property. Those species that are very unlikely to occur from the list have been highlighted but because of the presence of wet forests and rainforests in the area a large number of threatened species can be expected. More precise information on birds was able to be gathered because of the publication by Morris (2006).

4.0 LITERATURE REVIEW

4.1 Initial survey

A detailed flora and fauna investigation of the area south east of the dam and south west of Narara Creek was conducted by Andrews Neil (2006a; Figure 2), and involved two 400m² flora quadrats, a random meander traverse, a spotlighting survey, an "Anabat" detection survey, an owl call playback survey and a bird survey. Conclusions from the survey showed the area of vegetation adjacent to the proposed development did not support rainforest which fell within Gosford City Council's Rainforest Policy. In addition this vegetation was classified as Coastal Narrabeen Moist Forest of Bell (2004). One threatened plant species; the Magenta Lilly Pilly *Syzygium paniculatum* was identified on a steep slope along the gully behind the previous foreman's residence and on the floodplain along with one threatened fauna species, the Grey-headed Flying Fox *Pteropus poliocephalus* which was apparently detected foraging on the subject site. Thus it was concluded that the effects of the proposed development on threatened species would be insignificant, assuming no native vegetation along the two gullies, situated on the subject site, would be removed. Nevertheless, this survey neglected the vegetated slope lands but covered mainly the cleared lands on lower slopes and alluvial flats which supported only isolated remnant vegetation patches.

4.2 Second survey

The second report involved the remnant vegetation along Narara Creek and north east to the upper edge of the cleared lands and the beginning of the slope vegetation (Andrews Neil 2006b). Specifically the surveys were undertaken within the northern section of the subject site to determine whether vegetation within the creek line and gully would satisfy the definition of "rainforest" as provided in the Gosford City Council Rainforest Policy and to determine if there were any threatened species present which may be affected by the proposed development. The survey concluded that the pockets of vegetation surveyed in the quadrats were consistent with this definition and as such, a 50m development exclusion zone would be required around these areas. Field surveys resulted in the identification of one further threatened tree of *Syzygium paniculatum* the Magenta Lilly Pilly and four threatened fauna species, the Yellow-bellied Glider *Petaurus australis* (as anecdotal evidence), the Eastern Bent-wing Bat *Miniopterus schreibersii oceanensis*, the Sooty Owl

Tyto tenebricosa and the Powerful Owl *Ninox strenua*. (The Sooty Owl had been recorded previously; Andrews Neil, 2006a). Further to this, as a result of a desktop study, there appeared to be evidence that the subject site could provide habitat for three additional flora species and 14 additional fauna species. As a result, these flora and fauna species were assessed pursuant to s.5A of the *Environmental Planning & Assessment Act, 1979*. In conclusion the assessment stated again that the proposed development was unlikely to have a significant impact on these species which was largely due to the small area of habitat likely to be removed and the large area of habitat being retained. Slope vegetation was not specifically assessed during this survey and desktop analysis.

Recommendations were prepared to further reduce impacts of any proposed development on threatened species of flora and fauna and these recommendations included the following;

- A weed management strategy whose primary aim would be to reduce the density of exotic species in remnant bushland surrounding the drainage lines, specifically *Lantana camara*, and to allow regeneration of naturally occurring native species.
- Plants used for landscaping within the proposed development should not include any species known to be invasive.
- Any *Syzygium spp.* should not be used, to avoid cross breeding with the naturally occurring threatened species *S. paniculatum*.
- Artificial night lighting has been shown to adversely affect the 15tilizin of some nocturnal species. Therefore, external night lighting associated with the proposed development should be designed to ensure that there is minimal light wash into forest areas adjacent to the development.

4.3 Narara Creek aquatic survey

McCormack (2011) undertook aquatic surveys north of Gosford in the respective stream tributaries leading into Narara Creek although only the mid reaches were sampled in the vicinity of Reeves Road and Carrington Street. Stony Creek in Strickland State Forest was included. Results from the survey showed that the Freshwater Crayfish *Euastacus australiensis* and *E. spinifer* both occur in these sub-catchments. Freshwater Shrimp, such as the Fairy Shrimp, *Paratya australiensis*, were also captured in Narara Creek together with the Freshwater Crab, *Helograpsus haswellianus*. Narara Creek and its tributaries also revealed gudgeons, such as Cox's Gudgeon *Gobiomorphus coxii* and the Empire Gudgeon, *Hypselltris compressa*, which are still present along with the Common Jollytail, *Galaxias 15tilizing*, the Freshwater Eel, *Anguilla reinhardtii*, the Freshwater Snail, *Glyptophysa gibbosa*, mud-eyes, beetles, bugs and tadpoles. Populations of these species still exist in "good" numbers. *Gambusia holbrooki*, the Mosquito Fish was also recorded in areas where native vegetation cover had been removed. The main aquatic weeds, however, were *Myriophyllum aquaticum*, Parrots Feather and *Zantedeschia aethiopica*, Arum Lily and whilst the Mosquito Fish was ever present, the creeks still retained populations of the native Empire Gudgeons.

It was concluded Narara Creek was in excellent condition, with much of it considered pristine. The aquatic biodiversity was also considered excellent and dominated by native species.

Although the study was undertaken further downstream of the subject site the recommendations that have been suggested could be applicable to this development given it is relevant to the same catchment. Those recommendations that came from the study are;

- Serious consideration needs to be given to projects requiring landscaping and replacement of natural waterways with man-made structures. Human aesthetics and ease of construction are not acceptable to Australian native aquatic flora and fauna but are highly suitable to exotic pests and weeds.
- There should be continued support and encouragement of local environmental community or landcare groups to continue with riparian regeneration and weed control.
- Biodiversity monitoring and water quality monitoring of the freshwater catchment streams on an ongoing basis is also recommended by the waterwatch teams. To obtain significant information approximately 6 sites should be selected and monitored for aquatic biodiversity twice per year (winter/summer) on the same day.
- Continue to educate residents and commercial entities on pollution reduction at source points, dangers of exotic flora and fauna and the consequences of escapees into the environment and how to identify outbreaks in their streams at an early stage.

5.0 FLORA FIELD SURVEY

5.1 Method

At selected locations along Narara Creek, on slopes and ridges and within boulder strewn gullies 20m x 20m and 40m x 10m (400m²) quadrats were undertaken to sample the flora. Vegetation detail was recorded using the 2007 format sheet developed by *Hunter Councils* for the most recent regional based vegetation surveys. This format sheet utilizes an abundance score of 1-4 and a percentage cover score of 5-9. Additional plant species were recorded using transects along the alignment of the second order gullies and the slopes and ridges to comply with the NSW DEC (2004) guidelines. Additional transects and quadrats were added in June and August 2014 to refine the existing plant species and orchid data.

Plant species, recorded within each quadrat and transect, were mostly identified on site, but the more difficult specimens were collected and placed between sheets of newspaper in a plant press for later identification. Orchids, if found, would be collected whole and inserted in test tubes filled with water, also for later identification. Collected plant species were then identified in the office using a scientific binocular microscope. Biobanking surveys were also undertaken at some of the sites.

Both data from the Andrews-Neil (2006a; b) surveys and a further revision of the atlas data have been provided to determine which threatened plant species may occur in the area of interest. During the field survey, searches were made for these threatened species in botanical quadrats and along transects and whilst traversing the property overall. However, additional targeted searches, for particular threatened species, were also undertaken in specific habitats within the boundaries of the property. Orchid surveys began in July 2013 with two transects undertaken of the drier Watagan SLU western slopes and the "Exposed Hawkesbury Woodland" ridgetops to search for any local orchid species such as *Pterostylis nutans*, *Corybas barbarae*, *Corybas pruinosus* and *Thelymitra spp* (see transect on Figure 2). Further orchid surveys were completed in August 2014.

Those rare plant species which were targeted were those most likely to occur are as listed hereunder:

Watagan gullies/Yarramalong alluvial habitats

- *Cynantheum elegans*; a climber or twiner of rainforest in coastal districts between Gerroa on the south coast to north-west of Coffs Harbour. Recognised by its cream to fawn coloured stems which are often corky. The leaves are broad-ovate to ovate with a shortly acuminate point but the base is truncate. Very rare but could be found on either Watagan SLU or Yarramalong SLU alluvial geomorphology where rainforest type vegetation is present.
- *Hibbertia puberula*; a more recently described species not readily known because only a few collections exist. It is a small shrub, restricted to the greater Sydney region in sandstone habitats. The species has a sparse number of long wiry branches sometimes with hooked or curved hairs. Leaves are small and constricted but if present would occur on the Watagan SLU drier slopes and ridges.
- *Senna acclinis*; The Rainforest Cassia is found between the Illawarra region and the Queensland border. Although very rare it has compound leaves up to 15cm long comprising six pairs of oval shaped leaflets with a gland between any of the lower four pairs. Could occur on Yarramalong SLU alluvial or Watagan SLU geomorphology.
- *Grammitis stenophylla*; A lithophytic fern found in rainforest habitats with boulder strewn gullies. This species has narrower fronds that are winged almost to the base and are thin and leathery. The sorus occurs as dark circular or oval patches. If present would be restricted to Watagan gully SLU geomorphology.
- *Prostanthera askania*; normally a species confined to the Narrabeen sandstone habitats in moist habitats near drainage lines although it has now been found recently in Bouddi National Park in a drier habitat. Present in the adjoining Strickland State Forest. It can be recognized by the large distinctive toothed leaves and spreading hairs on the leaves as opposed to the curled hairs and shorter teeth on *P. incisa*. If present could be found in disturbed moist sites of the Watagan SLU.
- *Syzygium paniculatum* Magenta Lilly Pilly; A medium sized tree found along coastal dune habitats, embayments and riparian habitats on coastal sands. Already found onsite in a riparian habitat but on the moist slope of the Watagan SLU. The species is difficult to distinguish from *S. australe* with the former having rounded smooth green to brown branchlets and the latter having four angled winged smooth reddish brown branchlets. The outer bark of the former is pinkish to reddish brown and the latter brownish grey. However, the most distinctive feature is the fruit differences with the former being magenta coloured, oval and on cutting the fruit a single polyembryonic seed is revealed but it can have up to nine embryos. The latter has an ovoid or pear shaped fruit with a single seed and single embryo.
- *Grevillea parviflora ssp. parviflora*; is a small shrub species of *Grevillea* with narrow leaves and ascending branches. It has been recorded just north of Wyong and although unlikely to occur it will be kept in mind during targeted searches.
- *Lindaea fraseri*; is a small tufted forest fern with a straw coloured stipe that is less than the height of the lamina. The fern has ovate sterile fronds with upper pinnae as long as wide. Fertile fronds have narrower pinnae with occasional narrow incisions. Occurs in forested habitats.

- *Persoonia 18tilizi subsp. 18tilizi*; Not a great deal of information is known about this species but it is a shrub with linear narrow oblong leaves. It is unlikely to occur because it is restricted to the Sydney Sandstones and prefers sandy and stony soils in lower nutrient forest types on this geology.
- *Corunastylis ruppilii*; Very few collections of this species exist and very little information is known about its flowering habit. Recent collections have been made at Narara north of the property.

5.2 Flora survey results

The Andrews Neil (2006a, b) surveys recorded 106 plant species for the Yarramalong alluvial flat and Watagan lower to mid slope remnants, but those surveys were restricted to Narara Creek in upstream sections and the slopes in the north-eastern area of the property. Among the plant species recorded was the Magenta Lilly Pilly, *Syzygium paniculatum* an endangered species now listed on the *TSC Act, 1995* and as vulnerable on the *EPBC Act, 1997*, for which there is a national Recovery Plan (NSW OEH, 2012) available to manage this species. One tree was located approximately 10 metres from the edge of one of the clearings and has since been found although the second tree could not be located (see Figure 2). Two regionally significant species, *Ripogonum fawcettianum* and *Parsonsia velutina*, were identified in their quadrat 1 of which both are at their known southern limits of distribution at Gosford. The identity of these three species was confirmed by the Royal Botanic Gardens Botanical Information Service.



Photo 1: Typical *Syzygium paniculatum* showing, crowded stamens, red tinged calyces with spent stamens and fully developed flowers and psyllid riddled leaves.

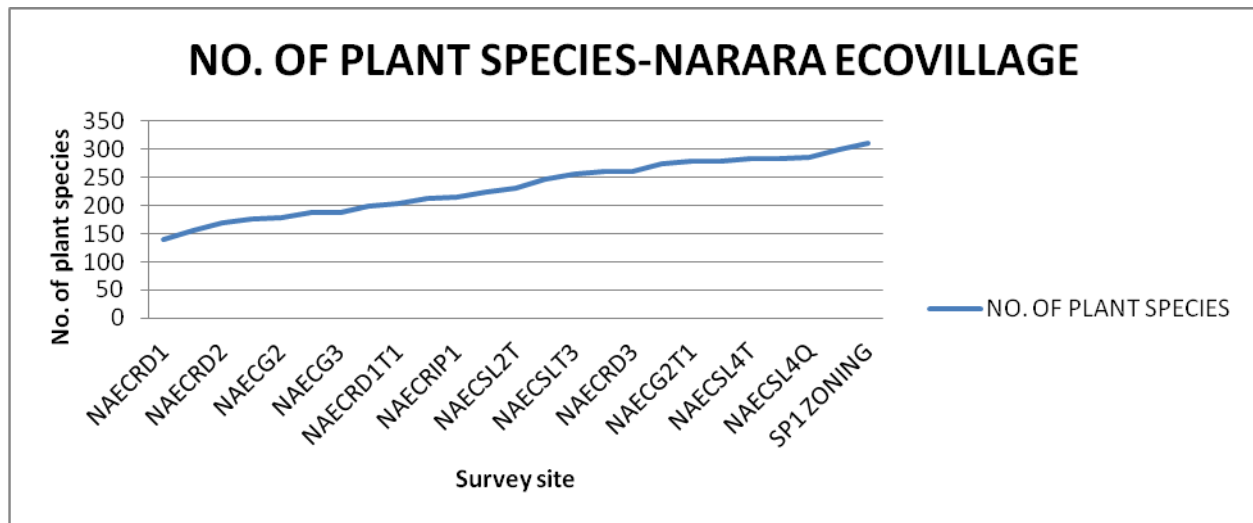


Figure 4: Cumulative plant species graph as the survey proceeded.

Whilst it is not possible to determine the number of species recorded from the initial quadrat and transect data (Andrews-Neil, 2006a, b), it is possible to determine total plant species from each of the study areas and this information is included in Figure 4 as AN1 and AN2. For study area one, 76 plant species were recorded which increased to 106 species after the completion of study area 2 (Figure 3). Following on with additional slope and ridge botanical surveys from this study, the number of plant species increased considerably rising to over 299 but different habitats were involved (Figure 4). From the plant data gathered overall the following rare and localized plant species were recorded:

- *Acronychia wilcoxiana* Silver Aspen (photo 2); this small tree was found on the slopes in Community MU7. Very rare in Gosford and recognized by the large but wide bluntly pointed shiny leaves with a notched apex. Petioles are typically long and pale silvery coloured with a pulvinus at the base of the petiole and at the apex of the petiole (upper pulvinus).
- *Asplenium attenuatum* Simple Spleenwort and *Asplenium polyodon*; Small lithophytic ferns found at three locations in the Watagan gullies. Common from the Blue Mountains northwards but very rare in Gosford.
- *Gmelina leichhardtii* White Beech; A magnificent large deciduous tree which occurs as a loner in the Terrigal Formation entrenched gullies. Found as a single specimen in one gully on the western slope. Locally rare in the Gosford LGA.
- *Ottochloa gracillimus* remnant native riparian grasslands. One of the most important features of the vegetation on this property is the remnant floodplain grasslands, which occur at the interface with the cleared paddock areas and the slope drainage vegetated lines, which mostly have been designated as the "Lowland Rainforest EEC".
- *Parsonsia velutina* Hairy Silkpod; A small climber found in rainforest which reaches its southern limit at Gosford. Highlighted by Andrews Neil (2006a, b), but previously known to be quite well represented in the Watagan gullies of the property. Well represented on the Gosford LGA.

- *Ripogonum fawcettianum* Small Supplejack; Also a small climber found in rainforest which reaches its southern limit at Gosford and highlighted by Andrews Neil (2006a; b). Common in the Terrigal Formation gullies and very common in the Gosford LGA.
- *Syzygium paniculatum* Magenta Lilly Pilly; the trees found by Andrews-Neil (2006a; b) near the managers residence in the Watagan SLU gully was relocated along with the second tree on the floodplain. The re-location of this species is shown on Figure 2 and the tree has been surveyed in position with theodolite and electronic distance measuring equipment (photo 1).



Photo 2: Silvery pale stems of the Silver Aspen showing the upper and lower pulvinus on the petiole.

- *Grevillea speciosa* x *G. oldei*; a small undershrub found in shady habitats and is confined to the Narrabeen ridgetops. About 16 plants were finally found during the later survey with two plants on Lot 13 and considered to be rare in the Gosford LGA. The determination by the National Herbarium of NSW (No. 18716; R.O. Makinson; 10th October) states "*hybrids or intergrades are known between these species known further to the west [Kulnura area], and plants similar to this also known from the Maroota area (well SW of current range of G. oldei but suggestive of past gene exchange). G. speciosa is definitely the dominant parentage for this plant, but some features (ie leaves) do suggest G. oldei hybridity*".

Although the grasslands are presently in a remnant state their presence adds a further dimension to the property's vegetation importance, because floodplain grasslands are relatively unknown on the Central Coast. Some effort, therefore, together with a nursery established for native riparian grasses could focus on the embellishment of these grasslands within the relevant buffer zones. That process would require the collection of seed, raising seedlings, establishing grasses and most importantly of all, overcoming competition from the paddock grasses so that they can survive. These habitats have not been fully investigated as yet but can be at the final design stage in late summer, when the grass species is in flower.

As at 26th July 2013 and 14th August 2014 no ground orchids had been found and only one tree orchid species, *Sarcochilus falcatus* Orange Blossum Orchid, had been located, which was found growing on paddock trees. *Liparis relexa* the Onion Orchid was also found in the entrenched gullies.

5.3 Vegetation community descriptions

For Narara Creek Andrews Neil (2006a) report that the southern strip of vegetation had a high degree of weed infestation including *Pinus 21tilizi* Radiata Pine, *Lantana camara* Lantana, *Solanum mauritianum* Wild Tobacco and *Asparagus aethiopicus* Asparagus Fern. In its original state, this vegetation community was an open forest dominated by *Eucalyptus saligna* Sydney Blue Gum with scattered *Syncarpia glomulifera* Turpentine and *Livistona australis* Cabbage-tree Palm. Although there were some infrequent occurrences of rainforest species such as *Acmena smithii* Lilly Pilly *Cryptocarya microneura* Murrogun, *Smilax australis* Sarsparilla, *Gymnostachys anceps* Settlers Twine and *Doodia aspera* Prickly Rasp Fern, these were found to make up very small percentages of the cover abundance. Field texture tests showed soils to be sandy clay.

The northern strip of vegetation surrounds two drainage lines. A high proportion of this vegetation along the most northern drainage line was exotic, including Radiata Pine and Lantana.

A core area of more intact native vegetation along the deeper drainage line was used for comparison with Bell's (2004) map unit descriptions. Following further field investigation this vegetation community was classified as an Open Forest dominated by *Syncarpia glomulifera* Turpentine, *E. saligna* Sydney Blue Gum, *Glochidion ferdinandi*, Cheese Tree and *Alphitonia 21tiliz* Red Ash, making up the remainder of the canopy. The sparse midstorey consisted mainly of young Cabbage-tree Palms and Lantana. The ground cover was also particularly sparse on the steep slopes of the gully, possibly due to erosion. The flat gully floor was covered with a mixture of native and exotic grasses, the dominant being *Oplismenus imbecillis* Basket Grass. The soil at this location was found to be a sandy clay loam.

Areas of native vegetation lining the drainage lines on the subject site were compared with the Gosford local government area (LGA) Map Units E1a-Coastal Warm Temperate Rainforest and E6a-Coastal Narrabeen Moist Forest (Bell, 2004). Dominant canopy species for each of these communities is shown hereunder with "Alluvial flats forming the Yarramalong SLU". Vegetation along the drainage lines was found to have some similarities to each of these map units. Canopy dominants such as Turpentine and Sydney Blue Gum were consistent with both Coastal Warm Temperate Rainforest and Coastal Narrabeen Moist Forest but the sparse understorey, the position of the vegetation along a gully and the Erina SLU were indicative of Coastal Warm Temperate Rainforest. Overall, the vegetation was

found to have few “true rainforest tree species” such as *Doryphora sassafras* Sassafras, *Ceratopetalum apetalum* Coachwood, *Claoxylon australe* Brittlewood and *C. microneura* Murrogun. The scarcity of these species and the open forest structure of the vegetation were stated to be more consistent with the Bell (2004) description of Coastal Narrabeen Moist Forest.

Thus the following revised vegetation description from Andrews Neil (2006a; b) is given for the drainage line:-

Alluvial flats forming the Yarramalong SLU

MU1: Closed Forest with emergents: *Livistona australis*-*Doryphora sassafras*-*Cryptocarya glaucescens* (Taken from Andrews Neil 2006a; b)

Structure: Remnant Closed Forest

Habitat: Alluvial flats along valley floors

Distribution: Narara Creek

Floristic composition: The emergents are *Eucalyptus saligna* Sydney Blue Gum, *Livistona australis* Cabbage Palm and *Doryphora sassafras* Sassafras and these species make up the main closed canopy composition, but other canopy species can include *Cryptocarya glaucescens* Jackwood, *Acmena smithii* Lilly Pilly and *Sloanea australis* Maidens Blush. A few species form the taller mid stratum layer occur as scattered individuals, such as *Eupomatia laurina* Bolwarra and *Ficus 22tilizin* Sandpaper Fig but the lower midstratum layer comprises *E. laurina*, *Gymnostachys anceps* Settler’s Flax, *Neolitsea dealbata* White Bolly Gum, *Cyathea australis* Rough Treefern, *Archontophoenix cunninghamiana* Bangalow Palm, *Hymenosporum flavum* Native Frangipani, *Glochidion ferdinandi* Cheese Tree, *Diploglottis cunninghamii* Native Tamarind, *Alectryon subcinereus* Native Quince, *Rhodamnia rubescens* Scrub Turpentine, *C. glaucescens* and *Synoum glandulosum* Scentless Rosewood. A ground layer also occurs and is made up of *Calochlaena dubia* Common Ground Fern, *F. 22tilizin* Sandpaper Fig, *L. australis*, Cabbage-tree Palm and *Ligustrum sinense*, Small-leaved Privet. There is also a vine layer of *Morinda jasminoides*, *Cephalalaria cephalobotrys* Climbing Panax, *Smilax australis* Lawyer Vine, *Melodinus australis* Southern Melodinus, *Palmeria scandens* Anchor Vine, *Cissus antarctica* Water vine and *Ripogonum fawcettianum* Small Supplejack.

Disturbance: *Ligustrum sinense*, Small-Leaved Privet seedlings were recorded in both quadrats and the second quadrat had an invasion of *Tradescantia fluminensis* Wandering Jew. The southern strip of vegetation in study area 1 (Figure 2) had a high degree of weed infestation including *Pinus 22tilizi* Radiata Pine, *Lantana camara* Lantana, *Solanum mauritianum* Wild Tobacco and *Asparagus aethiopicus* Asparagus fern. Along the most northern drainage line in study area 2 exotic species were also present such as Radiata Pine and Lantana.

Related mapping units: E1a-Coastal Warm Temperate Rainforest of Bell (2004) and possibly MU 49 Lilly Pilly/Sydney Blue Gum wet sclerophyll rainforest of coastal ranges and tablelands escarpment (Somerville, 2009). Refer to quadrats AN1, AN2. The vegetation community is equivalent to biometric vegetation type HU 639 Sydney Blue Gum moist shrubby open forest on coastal ranges of the north coast and northern Sydney Basin. This vegetation does not qualify as potential Koala habitat under SEPP 44.



Photo 3: Closed Forest with emergents of Sydney Bluegum growing along the alluvial flats of Narara Creek.

The following descriptions of vegetation communities were derived from this survey.

MU2: Remnant Freshwater grassland with rushland/sedgeland: *Paspalum distichum*-*Juncus articulatus* ?-*Isolepis prolifer*-*Typha orientalis*

Structure: Remnant freshwater wetland with aquatic herbs and aquatic grasses up to 0.2m high and with a dense cover of prominent sedges amongst the main paddock grass.

Habitat: Permanently inundated alluvial flats along the Narara Creek floodplain.

Distribution: Narara Creek floodplain.

Floristic composition: The main introduced paddock grass is *Axonopus fissifolius* Narrow-leaved Carpet Grass. Herbs mainly comprise *Callitriche stagnalis* Common Starwort and *Persicaria decipiens* Slender Knotweed in areas of inundation whilst the main native grass appears to be *Paspalum distichum* Water Couch. Rushes *Juncus articulatus*? and *Isolepis prolifer*, are the main species between the drain and Narara Creek. *Typha orientalis* occurs as a taller rushland along the drain.

Disturbance: This vegetation community occurs as a remnant amongst a paddock between Narara Creek and the drain (see Photo 4).

Related mapping units: E 46a Freshwater Typha Wetland of Bell (2004); MU 200 Typha rushland of Somerville (2009). Equivalent to biometric vegetation type HU 673 *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin. This vegetation does not qualify as potential Koala habitat under SEPP 44.



Photo 4: Closed remnant freshwater grassland with sedgeland/rushland along the alluvial flats of Narara Creek.

Terrigal Formation slopes forming the Watagan SLU

MU3: Moist Closed Forest with emergents: *Eucalyptus saligna*-*Syncarpia glomulifera*- *Cryptocarya glaucescens*

Structure: Closed Forest.

Habitat: Lower moist slopes on the Terrigal Formations.

Distribution: North, south and east facing lower slopes above major drainage lines.

Floristic composition: *Eucalyptus saligna* Sydney Blue Gum occurs on the lower slopes and beside streams. This species together with *Syncarpia glomulifera* Turpentine, *Angophora floribunda* Rough-barked Apple, *Cryptocarya glaucescens* Jackwood and *Pittosporum undulatum* Sweet Pittosporum are the main canopy dominants forming emergents. The sub-closed canopy on moist slopes is made up of *Acmena smithii* Lilly Pilly, *C. glaucescens* Jackwood, *Livistona australis* Cabbage Tree-palm and *Rhodamnia rubescens* Brush Turpentine but other sub-canopy species can be present such as *Diospyros australis* Black Plum, *Wilkia huegeliana* Veiny Wilkiea, *Diploglottis australis* Native Tamarind, including *A. smithii* Lilly Pilly . The ground layer is a very sparse cover of *Lomandra longifolia* Spiny-headed Mat-rush and sometimes *Dianella caerulea* and *Gahnia aspera*. Grasses are very poorly represented and where present it is mainly *Oplismenus imbecillis* Basket Grass. Climbers are well represented and those that were commonly recorded were *Morinda jasminoides* Morinda, *Smilax australis* Barbed-wire Vine, and *Geitonoplesium cymosum* Scrambling Lily, *Ripogonum fawcettianum* Small Supplejack and *Dioscorea transversa* Native Yam.

Disturbance: *Ligustrum sinense* Small-Leaved Privet seedlings are poorly represented, but the open floor area is very heavily invaded by *Lantana camara* Lantana and could be considered impenetrable. This weed occurs throughout most of the lower slope area and

probably originated from the clearing for the transmission line. This weed favours the moist Watagan soils.

Related mapping units: E1a-Coastal Warm Temperate Rainforest of Bell (2004) and MU 49 Lilly Pilly/Sydney Blue Gum wet sclerophyll rainforest of coastal ranges and tablelands escarpment of Somerville (2009). Refer to quadrats NAECSL1 and NAECSG2. Could possibly form part of the lowland rainforest endangered ecological community where palm pockets occur. Equivalent to biometric vegetation unit HU 529 Coachwood-Crabapple warm temperate rainforest of the north coast and northern Sydney basin bioregions. This vegetation does not qualify as potential Koala habitat under SEPP 44.



Photo 5: Moist Closed Forest with emergents: *Eucalyptus saligna*–*Syncarpia glomulifera*–*Cryptocarya glaucescens* on the Terrigal Formations at the northern end of the site.

Terrigal Formation gullies forming the Watagan SLU

MU4: Palm gully open to closed forest: *Livistona australis*–*Cryptocarya glaucescens*–*Acmena smithii*

Structure: Open to closed forest.

Habitat: Deeply entranced boulder strewn gullies on the Terrigal Formation geology.

Distribution: Confined only to hillslope drainage lines leading into Narara Creek.

Floristic composition: *Livistona australis* Cabbage-tree Palm, *Cryptocarya glaucescens* Jackwood, *Syncarpia glomulifera* Turpentine and *Eucalyptus saligna* Sydney Bluegum form the main canopy and sub-canopy species with a sparser representation of *Glochidion ferdinandi* var. *ferdinandi* Cheese Tree, *Acmena smithii* Lilly Pilly, *Wilkiea heugeliana* Veiny Wilkiea, *Syncarpia glomulifera* Turpentine, *C. glaucescens*, *L. australis*, *Pittosporum revolutum* Hairy Pittosporum, *Ceratopetalum apetalum* Coachwood, *Neolitsea dealbata*

White Bolly Gum, *Doryphora sassafras* Sassafras, *Trochocarpa laurina* Tree Heath, *Allocasuarina torulosa* Forest Oak, *Eupomatia laurina* Bolwarra and *Guioa semiglauca* Guioa. Sometimes the gully floor has pockets of a fern cover comprising *Blechnum cartilagineum* Gristle Fern, *Calochlaena dubia* Common Ground Fern, *Lastreopsis decomposita* Trim Shield Fern and *Adiantum hispidulum* Rough Maidenhair. A dense pocket of *Lantana camara* Lantana, *Ochna serrulata* Ochna surrounds most of these gullies but within the boulder strewn gully sections a lithophytic flora is dominant and comprises *Carex 26tilizin*, *Doodia aspera* Rasp Fern, *Hymenophyllum cupressiforme* Common Filmy Fern, *Platyserum bifurcatum* Elkhorn, *Asplenium australasicum* Bird's Nest Fern and *Peperomia tetraphylla*. Pockets of *Pittosporum multiflorum* Orange Thorn also occur. Climbers include *Smilax australis* Barbed Wire Vine, *Palmeria scandens* Anchor Vine and *Aphanopetalum resinosum* Gum Vine.

Disturbance: The surrounding area of the gullies has been invaded with Lantana and Ochna and in downstream sections the Small-leaved Privet.

Related mapping units: Bell (2004) includes these units within E6ai Narrabeen Coastal Moist Forest but there is a different understorey flora present. MU8 Bangalow Palm/Coachwood/Sassafras gully rainforest of the Central Coast of Somerville (2009) also applies. Refer to quadrats NAECG1, NAECG3, NAECG4 and NAECRIP1. Some of the gullies are the "lowland rainforest endangered ecological community". Equivalent to biometric vegetation unit HU 529 Coachwood-Crabapple warm temperate rainforest of the north coast and norther Sydney basin bioregions. This vegetation does not qualify as potential Koala habitat under SEPP 44.



Photo 6: Palm dominated gully open to closed forest: *Livistona australis*-*Cryptocarya glaucescens*-*Acmena smithii*. This type of forest is found along all drainage lines on the slopes.



Photo 7: A lithophytic fern flora occurs in the boulder strewn palm dominated gullies. *Asplenium australasicum* forma *australasicum* and *Grammitis billardiarei* can be clearly seen.

Around the dam there is a large area of this community which has now been mapped (Figure 6). Significantly, there is a dominating regrowth Cabbage Tree Palm component amongst an earlier regrowth eucalyptus forest (MU 3) but many of the sclerophyll forest eucalypts have died back, collapsed and fallen to the ground. Sclerophyll forest eucalypts die back when other trees and palms block their access to sunlight.

MU5: Tall rushland pockets along Narara Creek: *Eleocharis sphacelata*

Structure: Tall open to closed rushland along dam silted areas of Narara Creek.

Habitat: Siltation areas that become colonized by reeds.

Distribution: On the large dam only in the north of the study area.

Floristic composition: *Eleocharis sphacelata* Spiny-headed Mat Rush is the only species present in areas of shallow water that have become silted.

Disturbance: No disturbance noted.

Related mapping units: Not identified in Bell (2004) but is equivalent to MU203 *Eleocharis sphacelata* freshwater wetland of Somerville (2009). No quadrat survey undertaken. Equivalent to biometric vegetation type HU673 *Phragmites australis* and *Typha orientalis* coastal freshwater wetlands of the Sydney Basin. This vegetation does not qualify as potential Koala habitat under SEPP44.

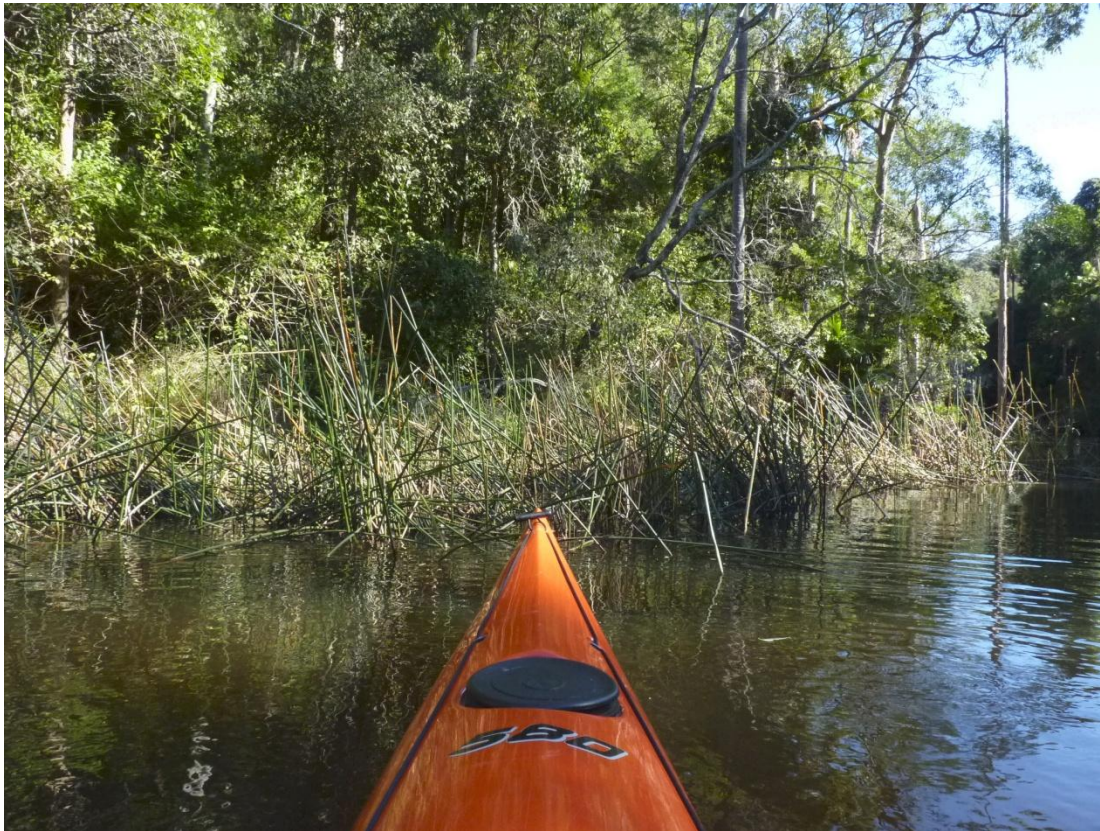


Photo 8: Tall rushland pockets colonizing the edge of the waterway.

Terrigal Formation rocky slopes forming the Watagan SLU

MU6: Exposed Terrigal Formation Woodland on ridges: *Angophora costata*-*Eucalyptus scias*-*Eucalyptus umbra*-*Corymbia gummifera*

Structure: Open woodland.

Habitat: Ridges and cliffs on the Watagan SLU of the Terrigal Formations.

Distribution: East and west of the transmission line near the southern boundary.

Floristic composition: *Angophora costata* Sydney Red Gum, *Eucalyptus scias* Large-fruited Mahogany, *Eucalyptus umbra* Bastard Mahogany, *Corymbia gummifera* Red Bloodwood and *Banksia serrata* Old Man Banksia make up the main canopy composition but *Syncarpia glomulifera* Turpentine and *A. costata* Sydney Red Gum and *Allocasuarina torulosa* Forest Oak also form the sub-canopy. The taller and mid shrub layers are mainly *Banksia serrata* Old Man Banksia, *Persoonia laevis* Geebung, *Leptospermum polygalifolium* Yellow Ti-tree and *Xanthorrhoea resinifera* a grass tree, which can occur as a dense layer. The ground layer can sometimes be absent but when present is tall and includes *Lomandra longifolia* Spiny-headed Mat-rush, *Lepidosperma laterale* and at times grasses and ferns such as *Imperata cylindrica* var. *major* Blady Grass, *Entolasia stricta* Wiry Panic and *Calochlaena dubia* Common Ground Fern. *Lomandra glauca* is also present.

Disturbance: East of the transmission line the vegetation is pristine, but west of the transmission line *Phytophthora cinnamomi* is evident.

Related mapping units: E26a–Exposed Hawkesbury Woodland of Bell (2004) and MU 97 Turpentine/Forest Oak/Smooth-barked Apple Shrubby Open Forest on ranges of the Central Coast of Somerville (2009). Refer to quadrats NAECD1, NAECD2 and NAECD3. Equivalent to biometric vegetation unit HU 622 Smooth-barked Apple-Sydney Peppermint-Turpentine heathy open forest on 29tilizi areas of the southern central coast, Sydney Basin. This vegetation does not qualify as potential Koala habitat under SEPP 44.



Photo 9: Exposed Terrigal Formation Woodland (Bell, 2004) found on the ridges of the property.

MU7: Coastal ranges mahogany-ironbark-apple forest on dry to moist smooth undulating slopes

Structure: Tall open forest

Habitat: Dry to moist depending on aspect smooth undulating slopes on the Watagan SLU of the Terrigal Formations.

Distribution: East and west of the transmission line near the southern boundary but below the ridges and rocky outcrops.

Floristic composition: *Eucalyptus agglomerata* Blue-leaved Stringybark, *Eucalyptus siderophloia* Grey Ironbark, *Eucalyptus acmeniodes* White Mahogany *Angophora costata* Sydney Red Gum and *Angophora floribunda* Rough-barked Apple are the main canopy tree species. At times there is *Eucalyptus piperita* subsp. *piperita* Sydney Peppermint. On these lower and more exposed slopes the sub-canopy is sparse and mainly comprises *Syncarpia glomulifera* Turpentine, *Angophora floribunda* Rough-barked Apple, *Allocasuarina torulosa* Forest Oak, *Glochidion ferdinandi* var. *ferdinandi* Cheese Tree and *Corymbia gummiifera* Red Bloodwood. *Persoonia linearis*, *Cryptocarya glaucescens* Jackwood, *Rhodamnia rubescens* Brush Turpentine, *Acacia prominens* Gosford Wattle, *Allocasuarina torulosa* Forest Oak and

Livistona australis Cabbage Tree Palm are the main taller regenerating trees whilst a lower layer small tree and shrub layer also occurs made up of *Breynia oblongifolia* Breynia and again *Persea linearis*. Shrubs include *Acacia ulicifolia* Prickly Moses and *Platysace lanceolata*. The ground layer is mostly *Lomandra longifolia* Spiny-headed Mat Rush, *Pteridium esculentum* Bracken, *Calochlaena dubia* False Bracken, *Pellaea 30tilizi* Sickie Fern, *Doodia aspera* Rasp Fern, *Entolasia stricta* Wiry Panic and *Imperata 30tilizing30e var. major* Blady Grass.

Disturbance: Patches of *Lantana camara* are evident.

Related mapping units: E26a–Exposed Hawkesbury Woodland of Bell (2004) and MU 97 Turpentine/Forest Oak/Smooth-barked Apple Shrubby Open Forest on ranges of the Central Coast of Somerville (2009). Refer to quadrats NAECSL2 and NAECSL3. Equivalent to biometric vegetation unit HU 622 Smooth-barked Apple-Sydney Peppermint-Turpentine heathy open forest on 30tilizi areas of the southern central coast, Sydney basin. This vegetation does not qualify as potential Koala habitat under SEPP 44.

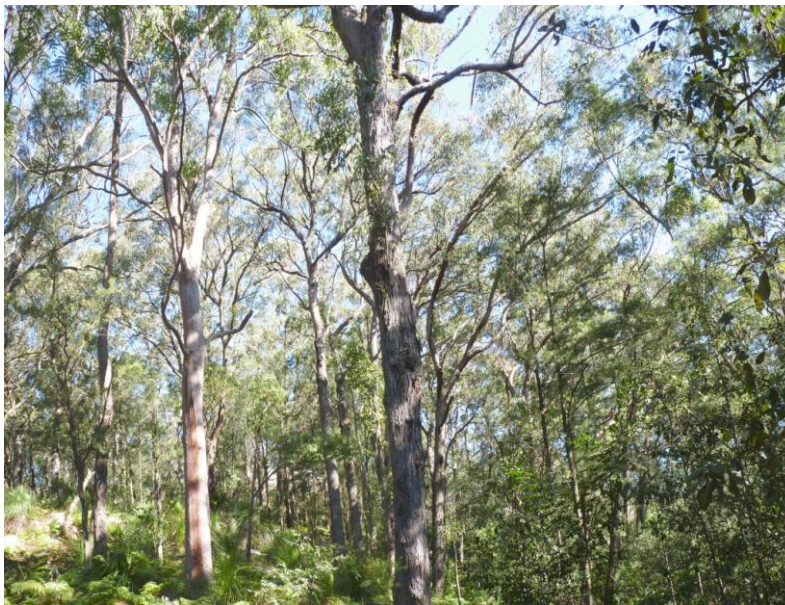


Photo 10: Coastal ranges mahogany-ironbark-apple forest on dry to moist smooth undulating slopes (MU7) found on the drier slopes below the ridge.

MU8: Remnant riparian grassland on slopes: *Ottochloa gracillimus*

Structure: Open Forest.

Habitat: Remnant disturbed areas between palm gully forests and paddock areas on the Terrigal Formations.

Distribution: Found only in one area on the eastern slope.

Floristic composition: *Ottochloa gracillimus* is the only species present beside the main paddock grass *Axonopus fissifolius* Narrow-leaved Carpet Grass.

Disturbance: The native grass is being outcompeted by the Narrow-leaved Carpet Grass and requires recovery.

Related mapping units: No known related mapping units. No known biometric vegetation unit equivalent.

Previously it was stated the quadrat data gathered during the 2013 surveys may be improved in the future but at that time the description of the vegetation communities was considered adequate for this project. Due to the lack of suitable access onto the Lantana infested slopes the vegetation data gathered for the moist and dry Terrigal Formation slopes was considered lacking. However, in June 2014 an old snig track was re-opened which allowed access through the Lantana in order that further transect, quadrat and orchid surveys could be completed.

From reading the vegetation descriptions above, there would appear to be a considerable overlap between the “*Moist closed forest with emergents*” (MU3) found on the Terrigal Formation slopes and the “*Palm gully open to closed forest*” (MU4) that occurs along the drainage lines on the slopes. The main emergent indicator species, the Sydney Blue Gum, for example, occurs on the alluvial flats forming a component of gallery rainforest (ie rainforest occurring on either side of a drainage line) but furthermore, it continues partly upslope and throughout re-entrants on the Terrigal Formations to occur within the palm gully rainforests (MU4). These two vegetation units are different in that the latter are distinctly palm dominated with a combination of having a unique lithophytic fern flora whereas the former does not (see photos 3, 6 & 7 for comparison).

Higher up on the Watagan slopes the soils are drier and rocky outcrops dominate and the mesic understorey disappears being replaced with a xeromorphic understorey (see Photo 9). Given this change, the canopy tree species are different between the drier soils and the moist lower slopes. To overcome the problem of recognition in the field, the vegetation that occurs on the Watagan rocky cliffs and the Watagan smooth dry slopes has been separated after further survey work in June 2014. The approach will then conform more to the analysis undertaken for the Gosford City Council LGA vegetation mapping at a finer scale rather than the LHCCREMS descriptions which was referred to originally (Somerville, 2009).

Part of the floodplain beside Narara Creek exhibits a remnant of Freshwater Wetland, but the remainder of the floodplain has now been turned to paddocks. This event having now occurred has led to the infiltration by the paddock weed, Fireweed, *Senecio madagascariensis* which has a complex ecological niche and will require a strong focus to eradicate the species. Further detail is provided in Payne & Inwood (2014).

5.4 Plotless sampling survey of Terrigal Formation gullies

Table 4 presents the results of the plotless sampling survey (Kent, 2012) to determine the primary and secondary canopy tree species within the palm dominated gully sections on the Terrigal Formation (MU4). Five surveys were undertaken in each gully and counts made to determine stand importance value of tree species based on relative density only. The counts are converted to a percentage for the density of each tree species and termed stand importance values. This method is based upon that of Floyd (1990) to determine vegetation alliances.

Table 4: Stand Importance Values calculated for canopy tree species in the various gullies.

Site	Dominant Species	SIV (%)	Co-ordinates	EEC
Western aspect				
Northern gully	<i>Livistona australis</i>	75.0	3 44 323E, 63 04 142N	Yes
	<i>Alphitonia excelsa</i>	8.3		
	<i>Angophora floribunda</i>	8.3		
	<i>Ficus rubiginosa</i>	8.3		
Middle gully	<i>Pyrus calleryana (introduced)</i>	40.0	3 44 484E 63 03 975N	No
	<i>Eucalyptus saligna</i>	10.0		
	<i>Livistona australis</i>	10.0		
	<i>Syncarpia glomulifera</i>	5.0		
Southern gully	<i>Livistona australis</i>	68.7	3 44 326E, 63 04 047N	Yes
	<i>Syncarpia glomulifera</i>	18.8		
	<i>Cryptocarya glaucescens</i>	12.5		
Eastern aspect				
Northern gully	<i>Syncarpia glomulifera</i>	50.0	3 44 558E 63 04 541N	Yes
	<i>Livistona australis</i>	50.0		
Southern gully	<i>Livistona australis</i>	50.0	3 44 763E 63 04 455N	Yes
	<i>Acmena smithii</i>	25.0		
	<i>Ceratopetalum apetalum</i>	25.0		
Southern aspect				
Only gully	Plotless sampling not undertaken; small patch of Cabbage Tree Palms in upper gully only.		3 44 277E 63 03 701N to 3 44 219E 63 03 718N & 3 44 240E 63 03 747N	Partly

From the results achieved the Watagan side gullies are palm dominated and would qualify as belonging to the *Archontophoenix-Livistona* suballiance 6 and given the disturbance of the vegetation overall, partly to the *Ceratopetalum, Diploglottis-Acmena* suballiance 34 or the *Ceratopetalum/Schizomeria-Acmena-Doryphora* 37 of Floyd (1990). Whilst the former alliance applies to the more nutrient rich sub-tropical rainforests of the north coast where excess soil moisture is present, the latter alliances apply to the more warm temperate rainforests in the Sydney Basin. The fit occurs at the very low end of the scale and applies to five of the gullies but not the middle-east facing gully.

5.5 Determination of Endangered Ecological Communities

Table 7 sets out the relevant details of the *Palm gully open to closed forest: Livistona australis-Cryptocarya glaucescens-Acmena smithii* in relation to the "Lowland Rainforest in the NSW Sydney Basin and North Coast bioregions" endangered ecological community". These parameters have been directly derived from the NSW Scientific Committee's website.

From the results obtained so far the *palm gully-open to closed forest* located on the side slopes in drainage lines would conform to the EEC classification but only at a minor level (see also Appendix 1). Perhaps this relationship would increase when weeding and regeneration is well underway. Part of the vegetation along Narara Creek beside the dam may also conform to this EEC as the moist humid environmental conditions are being aided

by the presence of the large dam. The above community also fits the soil nutrient status and the topographic units identified by the NSW Scientific Committee.

Part of the Narara Creek floodplain still supports a remnant of aquatic freshwater grassland with rushland. Most of the floodplain area was most likely to have been this community but gradual mowing and sedimentation as well as construction of the levee bank beside Narara Creek has led to its decline through the uintroductioin of paddock grasses. Even so, part of the wetland is in a relatively good condition and still supports waterbirds, one of which is listed as threatened under the *TSC Act, 1995*. As far as the conservation status of this wetland is concerned it should be regarded as the "Freshwater Wetlands on coastal floodplains of the NSW North Coast, Sydney Basin, and south-east corner bioregions" EEC.

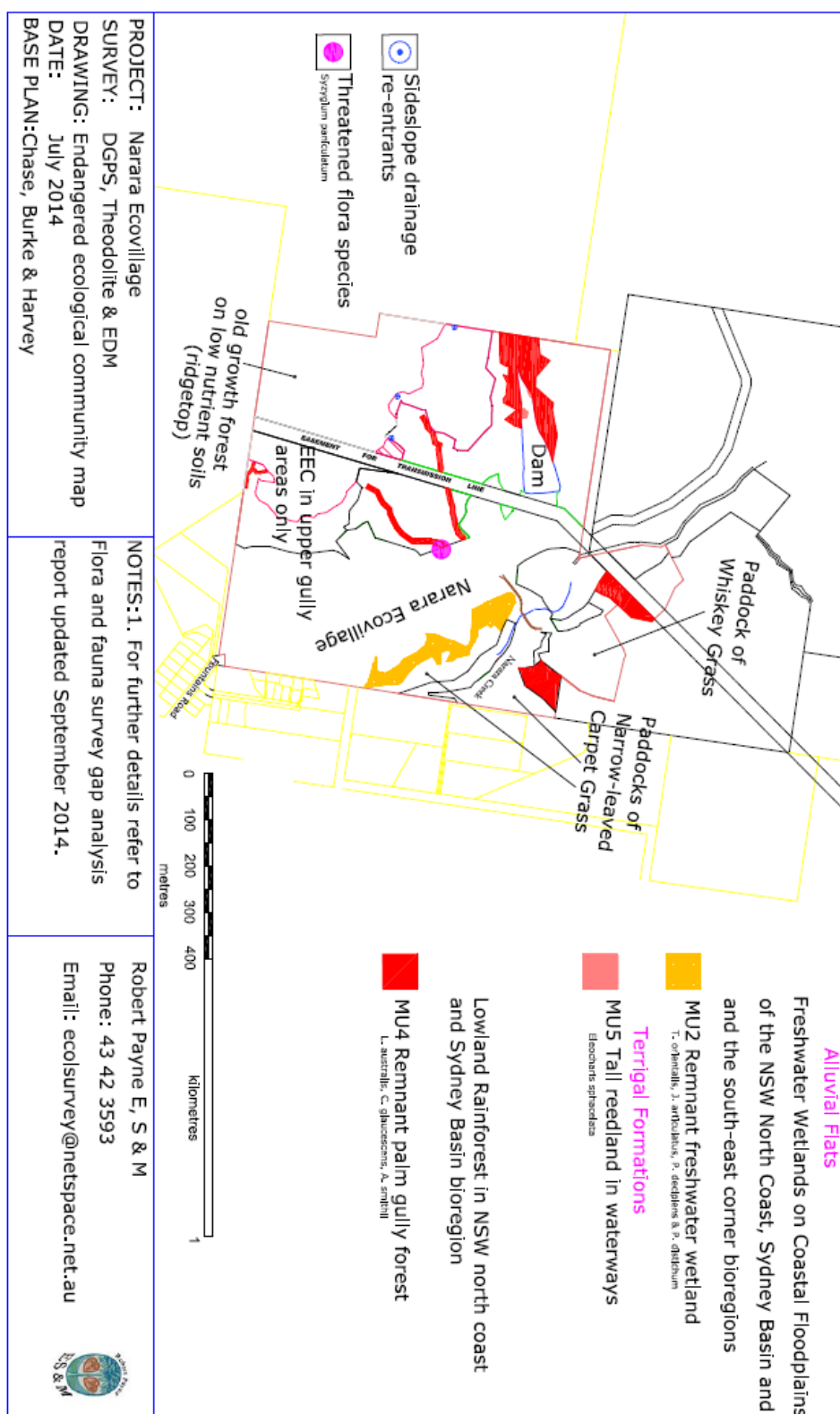


Figure 5: Map showing Endangered Ecological Communities.

The Tall Rushland in waterways (MU5 in Figures 5 & 6) also may qualify as the “Freshwater Wetland on coastal floodplains of the New South Wales north coast, Sydney basin and south-east corner bioregions” EEC but given this wetland has established because of siltation relating to the dam it could be argued otherwise.

5.6 Conservation status

Conservation status data varies between vegetation mapping at the LGA scale (Bell, 2002, 2004) and at the state wide scale (Floyd, 1990 for rainforest vegetation; Hager and Benson, 1994; Hubbard, Hager & Eager, 1994 for other non-forested and forested communities). In most cases minor vegetation reservation applies the detail of which is set out in Table 5.

At a regional scale, the conservation status of the various vegetation communities has not yet been identified (M. Greenwood, Hunter Councils pers. com.). To overcome this gap some data was collated separately from Gosford, Wyong and Lake Macquarie Councils (Bell, 2002; 2004) and Gosford City Council’s website and the details are also set out in Table 5.

It would appear from the results that only minor examples of the vegetation communities identified during this study appear in existing reserves and so it can be stated unequivocally that the property vegetation plan currently underway will contribute to the conservation of these vegetation communities. Most of the vegetation at the Gosford LGA scale is significant in that the reservation is totally inadequate at that level. However, the exception is the plam dominated forests for reservation of these forests appears adequate but only in the north coast of NSW (Floyd, 1990). Those that are found locally belong to the *Livistona* alliance whilst the alliance that is reserved is the *Archotophoenix-Livistona* alliance.

At the statewide scale further difficulty is apparent because the vegetation associations listed are much broader and so the nearest forest type has been used. In particular the *Eucalyptus 35tilizing35e* association (EF 116a & forest type121) was not reserved in 1994 when the last update on conservation achievements was prepared. In this instance the *Eucalyptus agglomerata* association applies to vegetation community MU7.

Table 5: Conservation status of site vegetation communities

Vegetation community	Gosford LGA, PVP & national conservation park	Regional classification	Statewide classification
MU1 Alluvial moist closed forest	Significant; small area added to Strickland SF under this proposal; not included in proposed PVP	Equivalent to warm temperate-subtropical rainforest MU1a Lake Macquarie; Small areas of MU1a reserved in Glenrock SRA; Larger areas of MU1 & MU1a occur in Jilliby SCA & Sugarloaf SCA; Small area reserved in Central Coast wetlands Tuggerah in Wyong LGA.	Alliance not recognized (Floyd, 1990)
MU2 Alluvial freshwater wetland: <i>Paspalum distichum</i> & <i>Typha orientalis</i>	Not designated in LGA mapping; Kahibah Creek wetlands; not included in proposed PVP	Partly equivalent to Typha wetland MU46a in Lake Macquarie; Not reserved in LMc LGA; reserved in Wyong LGA at Central Coast wetlands Tuggerah & Tuggerah NR;	
MU3 Moist closed forest with emergents on slopes	Significant; small areas protected in Bouddi NP, Kincumber Mountain CR & Wambina NR. Included in proposed PVP.	Equivalent to coastal wet gully forest MU1 Lake Macquarie; ; Larger areas of MU1 & MU1a occur in Jilliby SCA & Sugarloaf SCA;	Forest type 46a & although conserved is still inadequate (Hager & Benson, 1994)
MU4 Palm dominated wet gully forests	Not designated; Bouddi NP & Kincumber Mountain CR. Included in proposed PVP.	Equivalent to coastal wet gully forest MU1 Lake Macquarie; ; Larger areas of MU1 & MU1a occur in Jilliby SCA & Sugarloaf SCA; protected in Palmgrove NR.	Stotts Island NR, Mt. Warning NP, Nightcap NP, Minyon Falls FR, Brunswick Heads NR, Clarence Peak, Sugar Creek NR, Yahoou Island NR, Snapper Island NR (Floyd, 1990).
MU5 Tall reedlands in waterways: <i>Elaeocharis sphacelata</i>	Not designated. Included in proposed PVP.	Not designated	
MU6 Exposed Terrigal Formation woodland	Significant. Included in Bouddi NP and this proposed PVP.	Equivalent to Narrabeen peppermint apple forest MU25a Lake Macquarie; not reserved in LMc LGA; Not designated for Wyong LGA.	Forest types 105 & 130 & although conserved is still inadequate (Hager & Benson, 1994)
MU7 Coastal ranges stringybark-ironbark-apple forest	Significant. Included in this proposed PVP.	Equivalent to Narrabeen peppermint apple forest MU25a Lake Macquarie; not reserved in LMc LGA; Equivalent to MU21H in Wyong LGA not reserved.	Forest type 116a & not conserved (Hager & Benson, 1994)

5.7 Summary of flora survey

Table 6 provides the status of the flora survey which at this stage is almost completed. What is required is some minor field work yet to define the Palm Gully Rainforests on the eastern slope.

Table 6: Summary status of the vegetation survey

Component	Status
Vegetation mapping	Complete
Flora survey	Adequate and regarded as complete.
Orchid survey	Two transect surveys completed.
EEC Determination	Area beside the dam on Narara Creek to be finalized once access is established.

Table 7: Lowland Rainforest EEC details and their relevance to the gully and slope forests on the property.

Number in determination	Details	Relevance to <i>Palm gully open to closed forest: Livistona australis-Cryptocarya glaucescens-Acmena smithii</i> (MU4)	Relevance to <i>Moist closed forest with emergents: Eucalyptus saligna – Syncarpia glomulifera – Cryptocarya glaucescens</i> (MU3)
1	Found on high nutrient geological substrates, notably basalts and fine grained sedimentary rocks on coastal plains and plateau, footslopes and foothills	Yes found on fine grained sedimentary rocks (sandstones and shales) on footslopes and foothills in gullies.	Yes found on fine grained sedimentary rocks (sandstones and shales) on footslopes and foothills in gullies.
2	Has a closed canopy characterized by a high diversity of trees whose leaves may be mesophyllous and encompass a wide variety of shapes and sizes. The trees form three major strata: Emergents, canopy and sub-canopy. Some have buttressed roots and there is a range of plant growth forms including Palms, vines and vascular epiphytes. Scattered Eucalypt emergents may be present.	Supports 48 tree species; has 3 layers of vegetation; buttressed roots present at times; Two species of palms present; 27 species of vines and five species of vascular epiphytes present; Two species of emergent eucalypts present. Conforms.	Parts of the lower slope vegetation have similar characteristics. These areas would conform.
3	Species list compliment	Forty species listed in determination present- conforms	Approximately forty species listed in determination present-conforms
4	Is it part of the <i>Archontophoenix-Livistona</i> sub-alliance 6 (see Table 4)	Conforms (see Table 4)	Conforms (see Table 6)
5	May have characteristics of other sub-alliances.	Yes part of the area has <i>Ceratopetalum apetalum-Diplogottes australis, Acmena smithii</i> sub-alliance 34 or <i>Ceratopetalum/Schizomeria-Acmena-Doryphora</i> 37	Yes part of the area has <i>Ceratopetalum apetalum-Diplogottes australis, Acmena smithii</i> sub-alliance
6	Not applicable		
7	Threatened species	May have Long-nosed Potoroo <i>Potoroos tridactylus</i> ? Does have Eastern Pigmy Possum, Powerful Owl and Sooty Owl.	May have Long-nosed Potoroo <i>Potoroos tridactylus</i> ? Does have Eastern Pigmy Possum, Powerful Owl and Sooty Owl.
8	Still survives on property.	Has not undergone total destruction, but is Lantana infested. Canopy and sub-canopy present.	Has not undergone total destruction, but is Lantana infested. Canopy and sub-canopy present.
9	High frequency fire is a threat to this rainforest.		
10	Weeds are present.	<i>Cinnamomum camphora, Lantana camara</i> and <i>Ligustrum sinensis</i> .	<i>Cinnamomum camphora, Lantana camara</i> and <i>Ligustrum sinensis</i> .
11	Livestock	Livestock not present	Livestock not present

12	Important for connectivity and maintenance of landscape scale ecological processes outside of the conservation reserves.	Confirmed through surveys	Confirmed through surveys
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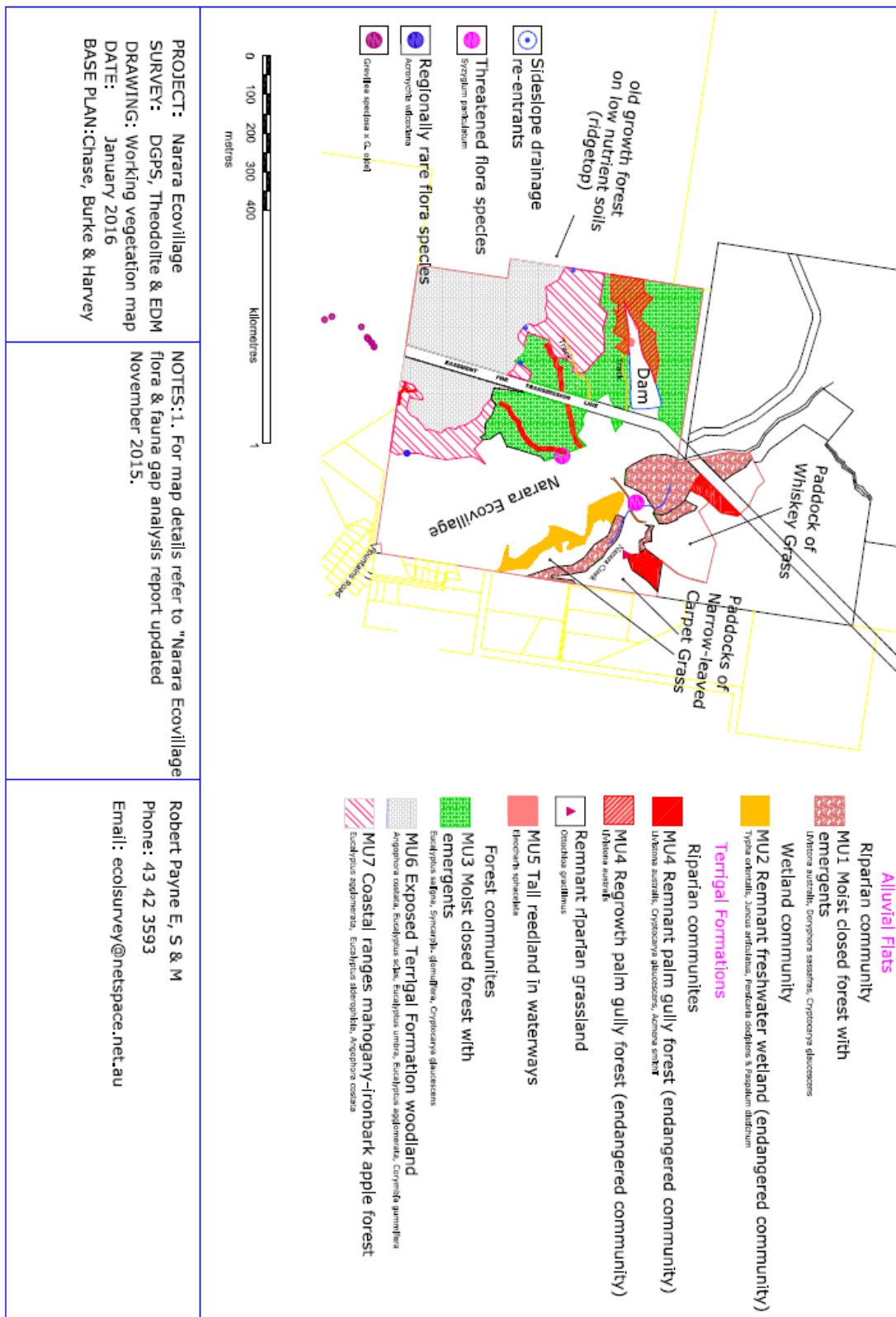


Figure 6: Vegetation map of the study area.

6.0 FAUNA FIELD SURVEY

Six fauna survey plots were initially selected on the Terrigal Formation slopes and gullies to undertake a mammal trapping survey because this procedure did not appear to have been completed during previous surveys (Andrews-Neil 2006a;b). As the subject site is large and largely inaccessible due to the significant Lantana infestation, access into the slope forest poses a major problem. In view of this boulder strewn more open gully habitats were selected as survey sites because the Lantana infestation in these habitats is less or mainly absent. The following sites were selected as shown in Table 8.

Table 8: Details of fauna survey cage trapping, Elliott B trapping and hair tube sampling

Site	Habitat	MGA Zone 56 co-ordinates
NAECG3	MU4: Palm gully open to closed forest (boulder strewn)	3 44 550E, 63 04 542N
NAECG4	MU4: Palm gully open to closed forest (boulder strewn)	3 44 762E, 63 04 457N
NAECF3	Remnant riparian forest (not boulder strewn)	3 44 666E, 63 04 299N
NAECSL2	MU4: Palm gully open to closed forest (not boulder strewn)	3 44 337E, 63 04 035N
NAECF5	MU4: Palm gully open to closed forest (boulder strewn)	3 44 405E, 63 03 855N
NAECF6	MU3: Moist Closed Forest with emergents	3 44 379E, 63 03 707N
NAECD1	MU6: Exposed Terrigal Formation Woodland on ridges	3 44 263E, 63 03 857N

No arboreal trapping program was included at this stage. This procedure will have to wait until the Lantana is mostly removed and access is possible into the slope forests to find hollow bearing trees.

6.1 Methods

Trapping

At the six sites two types of traps were used to target and capture small mammals and medium-sized mammals. This survey began on 11th March 2013 and extended through to March 21st 2013. Table 9 shows the details.

Table 9: Trap type and trapnights of fauna survey cage trapping, Elliott B trapping and hairtube sampling.

SITE	TARGET SPECIES	TRAP TYPE AND TRAP NIGHTS
NAECG3	Small mammals Long-nosed Potoroo Spotted-tailed Quoll	Elliott B; 24 trap nights Cage trap; 4 trap nights Cage trap; 4 trap nights
NAECG4	Small mammals Long-nosed Potoroo Spotted-tailed Quoll	Elliott B; 24 trap nights Cage trap; 4 trap nights Cage trap; 4 trap nights
NAECF3	Small mammals Long-nosed Potoroo Spotted-tailed Quoll	Elliott B; 32 trap nights Cage trap; 4 trap nights Cage trap; 4 trap nights
NAECSL2	As above	Elliott B; 32 trap nights Cage trap; 4 trap nights Cage trap; 4 trap nights
NAECF5	Small mammals Long-nosed Potoroo Spotted-tailed Quoll	Elliott B 24 trap nights Cage trap 4 trap nights Cage trap 4 trap nights
NAECF6	Small mammals Long-nosed Potoroo Spotted-tailed Quoll	Elliott B; 32 trap nights Cage trap; 4 trap nights Cage trap; 4 trap nights
Totals		Elliott B 160 trapnights

		Cage trapping for Long-nosed Potoroo 24 trapnights Cage trapping for Spotted-tailed Quoll 24 trapnights
NAECD2	Small mammals Long-nosed Potoroo Spotted-tailed Quoll	Small hairtubes 80 trapnights Medium sized hairtubes 80 trapnights

Elliott B traps were used to target the presence of *Antechinus stuartii* Brown antechinus, *Rattus fuscipes* Common Bush Rat, *Rattus lutreolus*, Swamp Rat and *Melomys cervinipes*, Fawn-footed Mellomys. *Antechinus swainsonii* Dusky Antechinus, although it occurs in the area is trap shy. Initially, the first session of cage trapping (baited with peanut butter, honey and rolled oats; Claridge, Seebeck & Rose, 2007) was undertaken to determine the presence of the Long-nosed Potoroo *Potorous tridactylus* and the Bandicoot species who are probably responsible for the diggings throughout these drainage lines. Secondly, a further session of cage trapping utilized fresh chicken as bait to target the presence of *Dasyurus 41tilizing*, Spotted-tailed Quoll.

Use of Elliot B trapping in conjunction with large trapping is a useful approach. What it achieves is a reduction in the cage traps being set off because the Elliot B traps are more preferred by small mammals. Consequently, this method achieves a greater chance of capturing medium sized mammals in cage traps because the Elliott B traps are visited first by the small mammals whilst foraging and are captured by these traps. That process leaves the cage trap available to capture any foraging medium-sized mammal (see Norton, French & Claridge, 2010)

Hair-tubes

The Terrigal Formation cliffed slopes were also sampled for mammals utilizing site NAECD1 (Figure 2). As this habitat is a long distance from the nearest road (> one kilometer) and the access track has a locked gate and is blocked by tree fall, hair tube traps were used as they are lighter to carry. At this site one line of 10 small stainless steel hair tubes and 10 medium PVC hair tubes were laid out along a transect line 100 metres long and baited with a mixture of peanut butter, honey and rolled oats (Figure 2). Traps were set out on 16th March 2013 and retrieved on 25th March 2013, providing a further 160 trap nights for small and medium sized mammals. This additional site enabled further sampling coverage of the large area of vegetation.

Spotlighting and stagwatching

Two evenings were utilized (25th March & 2nd April) to undertake spotlighting surveys, stagwatching and quiet listening for nocturnal fauna present on the ridge. This information was added to the fauna species list in Appendix 3. Led lenser spotlights and a pair of binoculars were used for this task.

Anecdotal evidence

During all fauna surveys data such as footprints, scats and diggings were recorded of animal evidence. One skull was collected and sent away for identification.

Bird surveys

The ridge was also surveyed for birds using the set point method. At least five additional surveys were undertaken on 13th February, 11th March, 17th March, 25th March, 2nd April,

22nd July and 26th July 2013. Further anecdotal sightings were also added during the time spent on all surveys. Additional bird surveys were undertaken of the lower Terrigal Formation slopes after access was made available, on the 17th June and 6th July 2014. After finalization of the project the NEV volunteer and member continued recording outstanding fauna species and this update includes some outstanding species not previously recorded.

Reptile and amphibian surveys

Reptile surveys were undertaken by traverses of the ridge and slopes on the same days as the bird surveys and spotlighting surveys. Searching techniques through the forest was the method used, particularly investigating caves, crevices and intercrises amongst the rocky outcrops on the ridge.

Amphibian surveys were undertaken on two nights in conjunction with the spotlighting surveys utilizing a small headlamp. Additionally, the ridge was investigated because the previous survey appeared to have only sampled the valley floor.

It should be noted that the Stuttering Frog *Mixophyes balbus* has been recorded and confirmed previously by others in the adjoining Strickland State Forest lands along Stony Creek. The Watagan gullies are habitat for this species but at this stage this part of the survey has not been completed due to access constraints but as time permits and with further access this survey can be completed.

Further specialist amphibian surveys were undertaken for the Red-crowned Toadlet on 17th September 2013 as this species calls in winter during sunny days after rain. This survey involved traversing the drainage re-entrants on the upper slopes below the ridge during the day. A further survey for the Giant Burrowing Frog was undertaken on 15th November 2013 following rain. Both surveys used the playback call methods in NSW DECC (2009).

Bat surveys

Andrews-Neil (2006b) carried out one anabat survey at the forest edge in the northern part of the site and whilst it would have recorded adequately the forest microbat species, the more specialized microbat species would be lacking. Therefore a more targeted approach was adopted and Anabat equipment was set up from sunset to sunrise at the dam, the freshwater wetland and the ridge amongst the tree hollows (Figure 2). On each night of these surveys a "Hastings Tinytag Datalogger" was set up to continuously record temperature and humidity.

6.2 Fauna results

Cage and Elliott Trapping

Mammal trapping surveys on the Terrigal Formation slopes returned captures of the Common Bush Rat, *Rattus fuscipes* (10.625%) and to a far lesser extent the Brown Antechinus, *Antechinus stuartii* (0.625%). Although captures of the latter are well under what was to be expected the larger Elliott B traps do not necessarily capture this species. *Antechinus stuartii* is able to avoid capture because of its very light weight and by not setting off the trip plate. No Bandicoot species, the Long-nosed Potoroo or the Spotted-tailed Quoll were captured (Table 11).

Hairtubes

Results of the hair tube analysis are shown in Appendix 5. Those native mammal species present on the ridge from which hair was captured are the Common Bush Rat *Rattus fuscipes* and the Swamp Wallaby *Wallabia bicolor*. The introduced House Mouse *Mus musculus* was also recorded.

Spotlighting and stagwatching

Spotlighting surveys of the ridge on two nights only resulted in the detection of the Sugar Glider *Petaurus breviceps*, the Barn Owl *Tyto alba* and the Tawny Frogmouth *Podargus strigoides*. Stagwatching on the same nights revealed no evidence of night animals or owls emerging from hollows. It should be noted that the ridge area has numerous vertical hollows which have potential as owl roost sites (see Figure 13).

During August 2017 the Sooty Owl *Tyto tenebricosa* was again observed along with the Mountain Brush-tail Possum *Tricosurus caninus*, the Sugar Glider *Petaurus breviceps* and the Common Ringtail Possum *Pseudocheirus peregrinus*. All sightings were at the northern end of the site near Strickland State Forest in July 2017.

Anecdotal evidence

Anecdotal evidence of tracks revealed the presence of the Eastern Grey Kangaroo *Macropus giganteus* on the ridge and the Swamp Wallaby *Wallabia bicolor* throughout the lower slopes. The skull collected in the drainage line is also from a Swamp Wallaby as preliminarily determined. Notwithstanding this, the most obvious of the animal signs are in the palm gully forests, where fresh deep narrow holes with obvious backward scratch marks can be seen. These diggings do not appear to be from Bandicoots but maybe a result of the Long-nosed Potoroo *Potorous tridactylus*, which used to be common in the area around Niagara Park (Mr. Lowe, Wildlife Carer, pers. com.) just west of the railway station. Despite an intensive trapping program the presence of any of these species, however, cannot be substantiated in the forest. However, a dead Long-nosed Bandicoot *Parameles nasuta*, presumably killed by dogs, was found near Narara Creek (Photo 11).



Photo 11: Long-nosed Bandicoot found on the property along Narara Creek (Courtesy Richard Cassels).

Bird surveys

A number of additional bird species have now been added to the database which is presented in Appendix 3. Notably, a group of four Glossy Black Cockatoos is present on the ridge. This species is listed on schedule 2 of the *TSC Act*. After the rains in January 2014 two Freckled Ducks *Stictonetta naevosa* were also noted using the dam (Figure 5) as a refuge along with up to 40 Wood Ducks *Chenonetta jubata* and a few Pacific Black Ducks, *Anas superciliata*. The Freckled Duck is also listed on schedule 2 of the *TSC Act, 1995*. On the 22nd July 2013 a single Black Bittern *Ixobrychus flavicollis* was flushed from the Typha wetland along the drain on the alluvial flats (see Photo 4).

On the 17th and 26th June 2014, after the access track was re-established through the forest on the lower slopes further bird species were seen and at this date a total of 73 species have been recorded, including flocks of Topknot Pigeons feeding on fruits of *Livistona australis* Cabbage Tree Palm (see Hawkins, 2014). Volunteers associated with the Narara Ecovillage Project, also reported the presence of the Black-faced Monarch *Monarcha melanopsis* and on the 6th July, when a special field day was organized several more bird species were recorded (See Appendix 3).

A Sooty Owl was recorded in August 2017 at the northern end of the site near Strickland State Forest.

Reptile and amphibian surveys

Reptile results were poor and the searches revealed only the Common Skinks *Lampropholis delicata* and *Lampropholis guichenoti* being present on the ridge along with the Lace Monitor *Varanus varius*. The Diamond Python *Morelia spilota*, however, was recorded just below the ridge on the 14th July 2013. Colleagues and neighbours, who have lived in the area for a long period of time, also advised of other reptile species present or likely to be present in the catchment, which amounted to 71 species (Table 10 & Appendix 10). Reptiles and amphibians are always regarded as the most under represented fauna component.

Due to the fact that reptiles are at times difficult to find Table 10 & Appendix 10 has been added to indicate what additional species may be expected to occur based on the early survey in the local and regional state forests, which included Strickland State Forest (Wellington & Wells, 1995).

The same approach was taken with amphibians because only the Common Eastern Froglet, *Crinia signifera*, Brown-striped Frog *Limnodynastes peroni*, Peron's Tree Frog, *Litoria peroni* the Red-crowned Toadlet *Pseudophryne australis* and possibly Lesueur's Frog *Litoria lesueurii* could be found or heard. Staff of State Forests advised that both the Giant Burrowing Frog, *Heleioporus australiacus* and the Red-crowned Toadlet, *Pseudophryne australis* are present on the ridges in the catchment and that the Stuttering Frog *Mixophyes balbus* had been recorded along the main stream (R. Wellington, pers.com.). All of the latter three species are listed on Schedule 2 of the *TSC Act, 1995*. On the 14th July 2013 the additional survey on the ridge and upper slope revealed the presence of large viable Red-crowned Toadlet populations occurring in the inundated drainage re-entrants of this habitat.

There is a possibility that the Green-thighed Frog *Litoria brevipalmata* is present in the gully rainforest (MU4) or the Tall Moist Forest (MU3) habitats also but at this stage access into these areas at night is not possible or feasible. Further survey can be undertaken once the Lantana is under management. This species is also listed on the *TSC Act, 1995*. Additionally

possible calls of the Stuttering Frog *Mixophyes balbus* may have been heard from the edge of the mid reaches of the dam in rainforest vegetation, which is generally inaccessible also.

Recorded detail of reptiles and amphibians has been added to Appendix 8 but additional species that could be expected are also included in the table (Table 10).

Table 10: Additional reptile and amphibian species expected to occur in the catchment. Species highlighted in green were found (Refer to Appendix 10).

Latin name	Common name	Remarks
Reptiles		
<i>Chelodina longicollis</i>	Long-necked Tortoise	P
<i>Amalosia lesueurii</i>	Lesuer's Velvet Gecko	P
<i>Phyllurus platurus</i>	Broad-tailed Gecko	P
<i>Lialis burtonis</i>	Burton's Snake Lizard	P
<i>Pygopus lepidopodus</i>	Common Scaly-foot	P
<i>Acritoscincus platynotus</i>	Red-throated Skink	P
<i>Concinnia tenuis</i>	Barred-sided Skink	P
<i>Cyrtoblepharus pulcher</i>	Elegant Snake-eyed Skink	P
<i>Ctenotus robustus</i>	Robust Ctenotus	P
<i>Ctenotus taeniolatus</i>	Copper-tailed Skink	P
<i>Egernia cunninghami</i>	Cunningham's Skink	P
<i>Eulamprus quoyii</i>	Eastern Water Skink	P
<i>Cyclodomorphus gerrardii</i>	Pink-tongued Skink	P
<i>Cyclodomorphus michaeli</i>	Mainland She-oak Skink	P
<i>Lampropholis delicata</i>		P
<i>Lampropholis guichenoti</i>		P
<i>Liopholis whitii</i>	Whites Skink	P
<i>Saiphos equalis</i>	Three-toed Skink	P
<i>Saproscincus mustelinus</i>	Weasel Skink	P
<i>Tiliqua scincoides</i>	Eastern Blue-tongue	P
<i>Amphibolurus muricatus</i>	Jacky Lizard	P
<i>Hypsilurus spinipes</i>	Angle-headed Dragon	P

<i>Intellagama lesueurii</i>	Eastern Water Dragon	P
<i>Pogona barbata</i>	Bearded Dragon	P
<i>Rankinia diemensis boylani</i>	Mountain Dragon	P
<i>Varanus rosenbergi</i>	Rosenberg's Heath Goanna	V,P
<i>Varanus varius</i>	Lace Monitor	P
<i>Bellatorias major</i>	Land Mullet	P
<i>Ramphotyphlops nigrescens</i>	Blackish Blind Snake	P
<i>Morelia spilota</i>	Diamond Python	P
<i>Boiga irregularis</i>	Brown Tree Snake	P
<i>Dendrelaphis punctulatus</i>	Common Tree Snake	P
<i>Acanthophis antarcticus</i>	Common Death Adder	P
<i>Cryptophis nigrescens</i>	Eastern Small-eyed Snake	P
<i>Demansia psammophis</i>	Yellow-faced Whip Snake	P
<i>Hoplocephalus stephensii</i>	Stephens' Banded Snake	V, P
<i>Notechis scutatus</i>	Tiger Snake	P
<i>Pseudechis porphyriacus</i>	Red-bellied Black Snake	P
<i>Pseudonaja textilis</i>	Eastern Brown Snake	P
<i>Vermicella annulata</i>	Bandy Bandy	P
Amphibians		
<i>Adelotus brevis</i>	Tusked Frog	P
<i>Crinia signifera</i>	Common Eastern Froglet	P
<i>Heleioporus australiacus</i>	Giant Burrowing Frog	V, P
<i>Lechriodus fletcheri</i>	Fletcher's Frog	P
<i>Limnodynastes dumerilii grayi</i>	Eastern Banjo Frog	P
<i>Limnodynastes peronii</i>	Brown-striped Marsh Frog	P
<i>Limnodynastes tasmaniensis</i>	Spotted Marsh Frog	P
<i>Mixophyes balbus</i>	Stuttering Frog	E1, P, 2

<i>Mixophyes fasciolatus</i>	Giant Barred Frog	P
<i>Mixophyes iteratus</i>	Giant Barred River Frog	E1, P, 2
<i>Pseudophryne australis</i>	Red-crowned Toadlet	V,P
<i>Uperoleia laevigata</i>	Smooth Toadlet	P
<i>Litoria brevipalmata</i>	Green-thighed Frog	V,P
<i>Litoria caerulea</i>	Green Tree Frog	P
<i>Litoria chloris</i>	Red-eyed Green Tree Frog	P
<i>Litoria dentata</i>	Bleating Tree Frog	P
<i>Litoria fallax</i>	Eastern Dwarf Tree Frog	P
<i>Litoria freycineti</i>	Freycinet's Frog	P
<i>Litoria latopalmata</i>	Broad-palmed Frog	P
<i>Litoria lesueurii</i>	Lesueur's Frog	P
<i>Litoria littlejohni</i>	Littlejohn's Tree Frog	P
<i>Litoria peronii</i>	Peron's Tree Frog	P
<i>Litoria phyllochroa</i>	Leaf-green Tree Frog	P
<i>Litoria verreauxii</i>	Verreaux's Frog	P

Anabat microbat surveys

Initial microbat surveys (Andrews-Neil, 2006a, b) recorded five species but further targeted surveys of the ridge, dam and freshwater wetland increased that number to 13 species. Most of the additional species were recorded over the dam waters but two additional forest bats were recorded on the ridge.

As suspected the Southern Myotis *Myotis macropus*, a threatened species listed on the *TSC Act*, was detected over the dam waters and many calls of this species were recorded although some calls were indefinite. However, it is highly likely this species is present given that the species forages for small fish along coastal streams in NSW. Past experience with this species shows that the roost site will be in close proximity to the dam.

Other threatened species recorded that are listed on the *TSC Act*, were the Little Bent-wing Bat *Miniopterus australis* (over the dam but only as a possible species), the Eastern Bent-wing Bat *Miniopterus shreibersii oceanensis* (over the dam and on the ridge) and the Eastern Free-tail Bat *Mormopterus norfolkensis* (also over the dam, on the ridge and the freshwater wetland). The Greater Broad-nosed Bat was also recorded over the freshwater wetland. The results are set out in Table 12 according to the habitat where they were recorded.

Of the threatened species identified by call analysis, it should be possible to positively identify the Little Bent-wing Bat, the Greater Broad-nosed Bat and the Eastern Freetail bat provided that the calls are of good quality and a long call sequence is obtained. The remaining two species, Eastern Bent-wing Bat and the Southern Myotis can be easily confused with other species. Non-threatened species that are difficult or impossible to identify are the long-eared bats (virtually impossible to separate to species level) and members of the *Vespadelus* genus, which demonstrate significant regional changes to the characteristic end frequency value of the call sequence. In addition the characteristic frequency can overlap and the shape of the pulse can change, sometimes making positive identification to the species level impossible. The calls should be substantiated by harp trapping but in the case the presence of the large dam, where most of the microbats were identified is not suitable for the use of such equipment.

Table 11: Summary of small and medium sized mammal survey

Species	Rattus fuscipes Common Bush Rat								
Night of capture	1	2	3	4	5	6	7	8	Sub-total
No. of trap nights	20	20	20	20	20	20	20	20	160
Total captures	3	2	1	2	1	2	4	2	17
Trap success (%)	15	10	5	10	5	10	20	10	10.625
Species	Antechinus stuartii Brown Antechinus								
Night of capture	1	2	3	4	5	6	7	8	Sub-total
No. of trap nights	20	20	20	20	20	20	20	20	160
Total captures	0	1	0	0	0	0	0	0	1
Trap success (%)	0	5	0	0	0	0	0	0	0.625
Species	Potorous tridactylus Long-nosed Potoroo/Parameles nasuta Long-nosed Bandicoot								
Night of capture	1	2	3	4	No mammals captured				Sub-total
No. of trap nights	6	6	6	6					24
Total captures	0	0	0	0					0
Trap success (%)	0	0	0	0					0
Species	Dasyurus 49tilizing Spotted-tailed Quoll								
Night of capture	No mammals captured				1	2	3	4	Sub-total
No. of trap nights					6	6	6	6	24
Total captures					0	0	0	0	0
Trap success (%)					0	0	0	0	0

Table 12: Summary of Anabat microbat survey

Orange infill indicates definite calls; Blue infill indicates indefinite calls

SPECIES	FOREST EDGE (Site AN2)	DAM (Site NAECD)	RIDGE (Site NAECD)	WETLAND (Site NAECD)
	Andrews-Neil 2006 survey	This survey		
<i>Rhinolophus megaphyllus</i> Eastern Horseshoe-bat				
<i>Mormopterus norfolkensis</i> Eastern Freetail-bat				
<i>Mormopterus sp. 2</i> A Freetail-bat				
<i>Tadarida australis</i> White-striped Freetail-bat				
<i>Miniopterus australis</i> Little Bent-wing Bat				
<i>Miniopterus shreibersii oceanensis</i> Eastern Bent-wing Bat				
<i>Chalinolobus gouldii</i> Gould's Wattled Bat				
<i>Chalinolobus morio</i> Chocolate Wattled Bat				
<i>Myotis macropus</i> Southern Myotis				
<i>Scoteanax rueppellii</i> Greater Broad-nosed Bat				
<i>Scotorepens orion</i> Eastern Broad-nosed Bat				
<i>Vespadelus darlingtoni</i> Large-forest Bat				
<i>Vespadelus pumilus</i> Little Eastern Forest Bat				
<i>Vespadelus vulturnus</i> Little Forest Bat				

6.3 Summary

Additional fauna species data collected by undertaking additional survey is shown in Figure 7 below and the most notable contribution was the bird component and the few additional mammal species including microbats. Reptiles and amphibians would increase to a minor degree as would mammals with further work over a longer time period. For example, the Eastern Pigmy Possum *Cercatetus nanus* is known from the catchment but these surveys have to be undertaken with specialized nest boxes utilizing a much longer time period but since it has been captured in the adjoining state forest, it would be present on this property given the ridge habitat is similar. Further work using cameras may be able to determine the animal more precisely that is responsible for the diggings in the palm gully forest (MU4) areas and further survey work with increased access is needed to determine the presence of the Stuttering Frog.

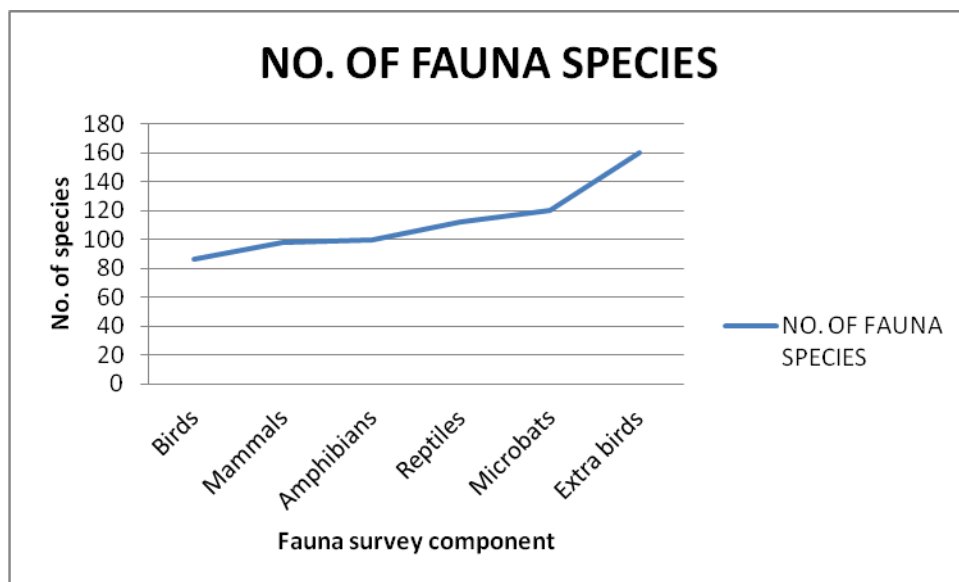


Figure 7: Graph showing the cumulative increase in fauna species relative to the appropriate survey categories as a result of this gap analysis survey.

7.0 TREE HOLLOW SURVEY

Further survey work with the differential global positioning system (DGPS) was undertaken to locate significant trees with hollows (see Photo 12). This survey was confined to the ridgetop area where a large number of trees with hollows occur within a small area. Arboricultural survey detail gathered by (Shaw, 2013) was also added of those trees with hollows found in the lowland stratification unit. At least nine trees with medium to large hollows were found on the ridge but only a few were found on the lowland area.

Tree locations are shown on Figure 13 together with a schedule of the trees with hollows. The ridge area where they are located is considered to be an example of "old growth forest on low nutrient soils" and this notation has been added to Figure 13. Within the area some of the trees are old large vertical hollows suitable as habitat for owls (12). Not all the hollow trees have been shown although the most obvious were located in position.



Photo 12: Large and medium sized tree hollows are abundant on the ridge, a large number of which are medium sized to large and sometimes vertical. Such hollows are suitable for large owls and gliders.

8.0 WEATHER

Weather detail recorded during the main survey period was ideal for fauna surveys with mostly warm days. Nights mostly had high humidities. Rain did occur at the start of the survey period but during that time the survey was terminated. The mean daily rainfall for the survey was 11.9 mm and the mean minimum and maximum temperatures were 16.6°C and 26.5°C respectively (Figures 8 & 9). More detailed daily weather observations, derived for the Gosford weather station are given in Appendix 4.

For the separate microbat surveys further humidity and temperature details are presented in Figures 10, 11 & 12 with a summary in Table 12 for each tagged survey site. Mean temperatures for those surveys ranged between 15-17°C but relative humidities were always very high and over 90%.

Table 13: Tree hollow schedule (refer to Figure 13) NB. Co-ordinates presented are those determined using DGPS by the Arborist & the Botanist/Wildlife Ecologist.

Tree No.	Easting	Northing	Details
FOREST SPECIMENS			
1	3 44 243	63 03 817	<i>Eucalyptus umbra</i> – 1 x large vertical hollow
2	3 44 315	63 03 859	<i>Eucalyptus umbra</i> – 1 x large vertical hollow
3	3 44 219	63 03 833	<i>Angophora costata</i> – 1 x large vertical hollow
4	3 44 239	63 03 823	Stag – 1 x vertical hollow
5	3 44 155	63 03 933	<i>Eucalyptus umbra</i> – 2 x medium sized hollows
6	3 44 155	63 03 733	<i>Angophora costata</i> – 1 x medium sized hollow; 1 x large hollow
7	3 44 118	63 03 848	<i>Corymbia gummifera</i> – 1 x large hollow; 1 x medium sized hollow
8	3 44 312	63 03 839	<i>Corymbia gummifera</i> – 3 x medium sized hollows; 1 x large hollow
9	3 44 175	63 03 997	Stag – several large sized hollows
10	3 44 342	63 03 916	Stag – several small hollows; 2 x medium sized hollows
11	3 44 313	63 03 901	Stag (ironbark) several medium sized hollows
12	3 44 290	63 03 891	Stag (<i>E. umbra</i>) – 1 x vertical large hollow
13	3 44 301	63 03 866	<i>Angphora costata</i> – 1 x vertical hollow; 2 x large side hollows
14	3 44 311	63 03 856	Stag – 1 x large vertical hollow; 2 x medium sized side hollows
HORTICULTURAL SPECIMENS			
23	3 44 653	63 03 765	<i>Eucalyptus saligna</i> – habitat hollows
24	3 44 658	63 03 773	<i>Eucalyptus saligna</i> – habitat hollows & cockatoos
27	3 44 671	63 03 797	<i>Eucalyptus saligna</i> – habitat hollows
35	3 44 680	63 03 790	<i>Eucalyptus saligna</i> – habitat hollows
70	3 44 654	63 03 838	<i>Eucalyptus saligna</i> – habitat hollows
141	3 44 593	63 03 932	<i>Carya illoinensis</i> – habitat hollow in main leader
143	3 44 585	63 03 945	<i>Carya illoinensis</i> – habitat hollow
146	3 44 580	63 03 983	<i>Carya illoinensis</i> – small hollow main trunk
151	3 44 604	63 03 975	<i>Carya illoinensis</i> – hollow south side
191	3 44 427	63 04 094	<i>Callistemon viminalis</i> – hollow at base

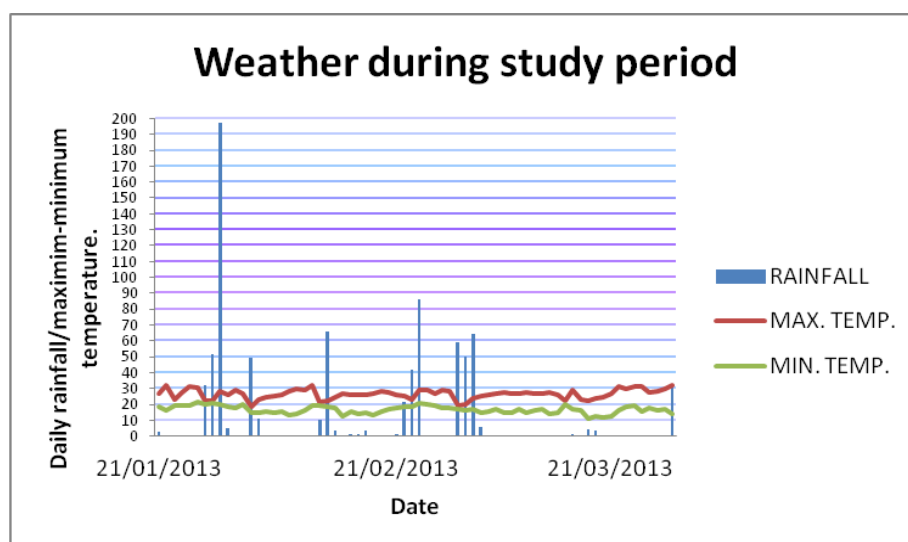


Figure 8: Daily rainfall, maximum and minimum temperatures for the main survey period. Source: Narara weather station.

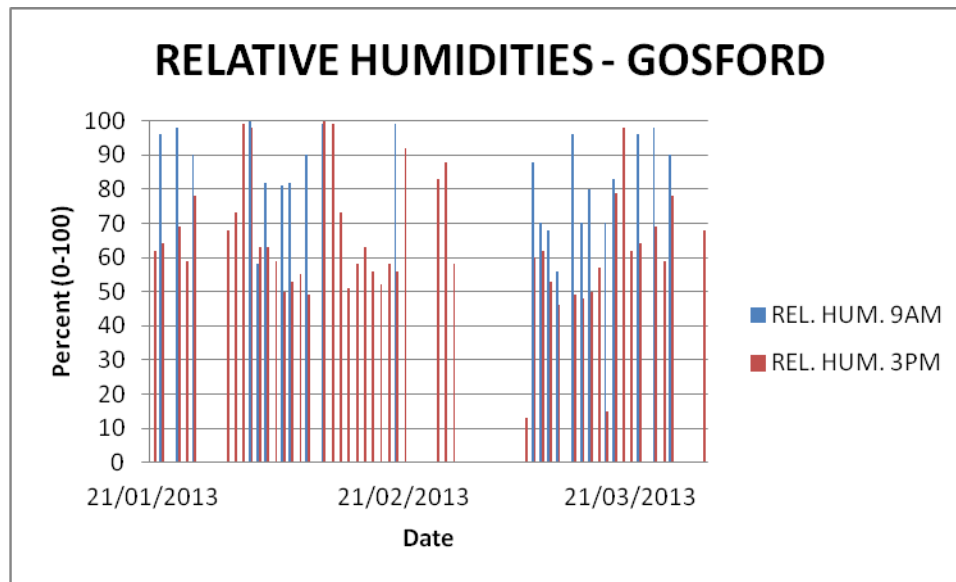


Figure 9: Daily relative humidities for the survey period. Source: Gosford weather station. Note that not all daily figures are available.

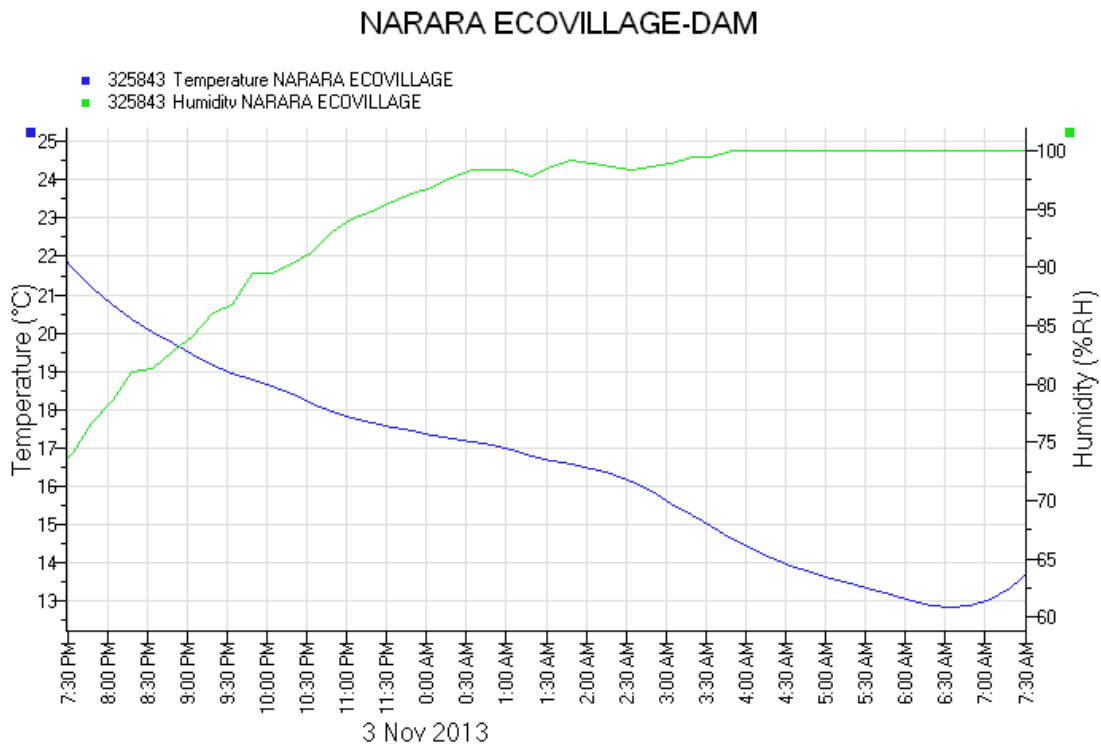


Figure 10: Temperature-humidity results for the dam microbat survey.

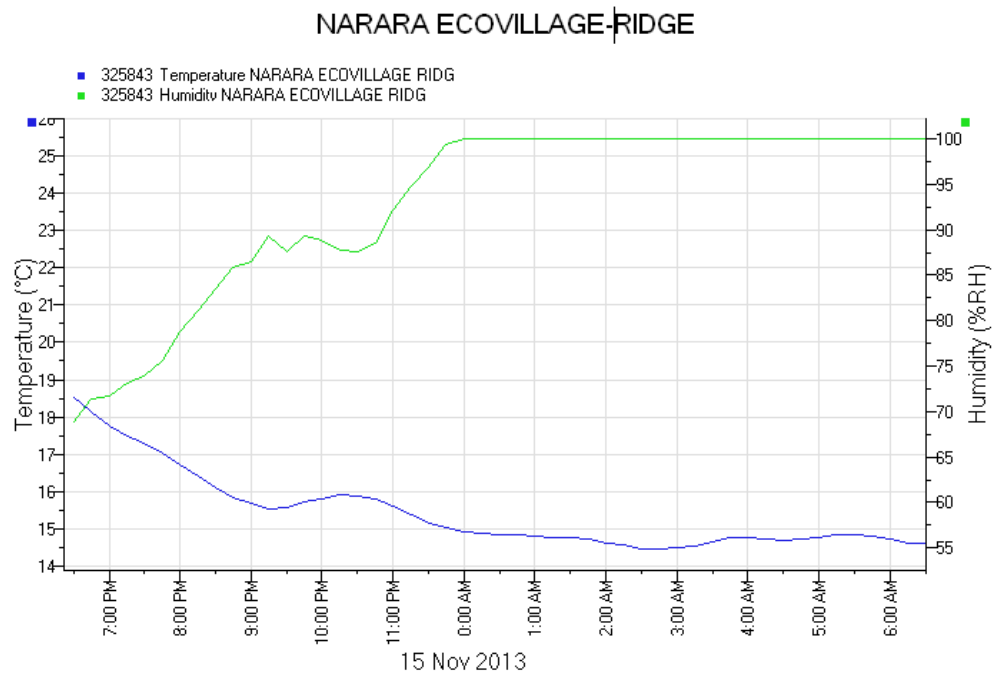


Figure 11: Temperature humidity results for the ridge microbat survey.

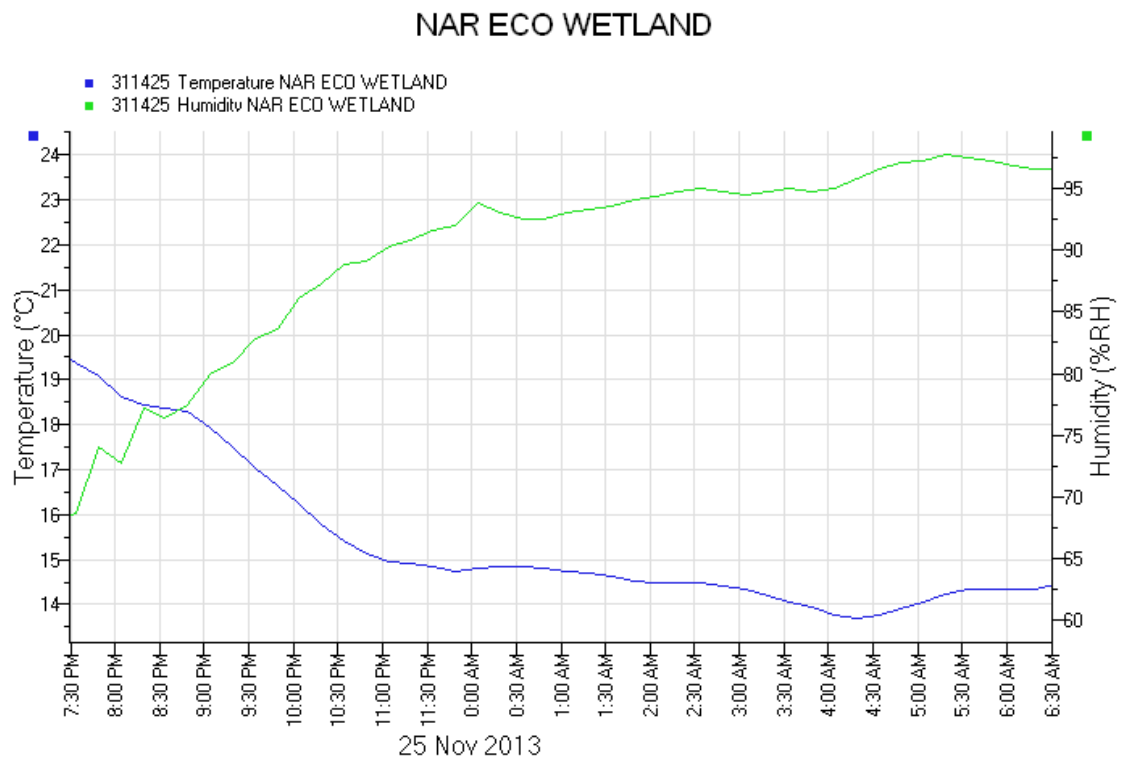


Figure 12: Temperature-humidity results for the freshwater wetland microbat survey.

Table 14: Weather data summary for the microbat survey from the datalogger: logging interval 15 minutes.

Parameter	Dam	Ridge	Freshwater Wetland
Date	2/3 Nov. 2013	15/16 Nov. 2013	24/25 Nov. 2013
Start time	19:30	18:30	19:30
Finish time	06:34	06:30	06:30
No. of readings	45	49	48
Minimum temperature	12.8°C	14.5°C	13.7°C
Maximum temperature	21.7°C	18.5°C	21.3°C
Mean temperature	16.7°C	15.4°	15.8°C
Minimum humidity	74.2%	68.8%	88.3%
Maximum humidity	100%	100%	97.7%
Mean humidity	94.3%	92.9%	66.2%

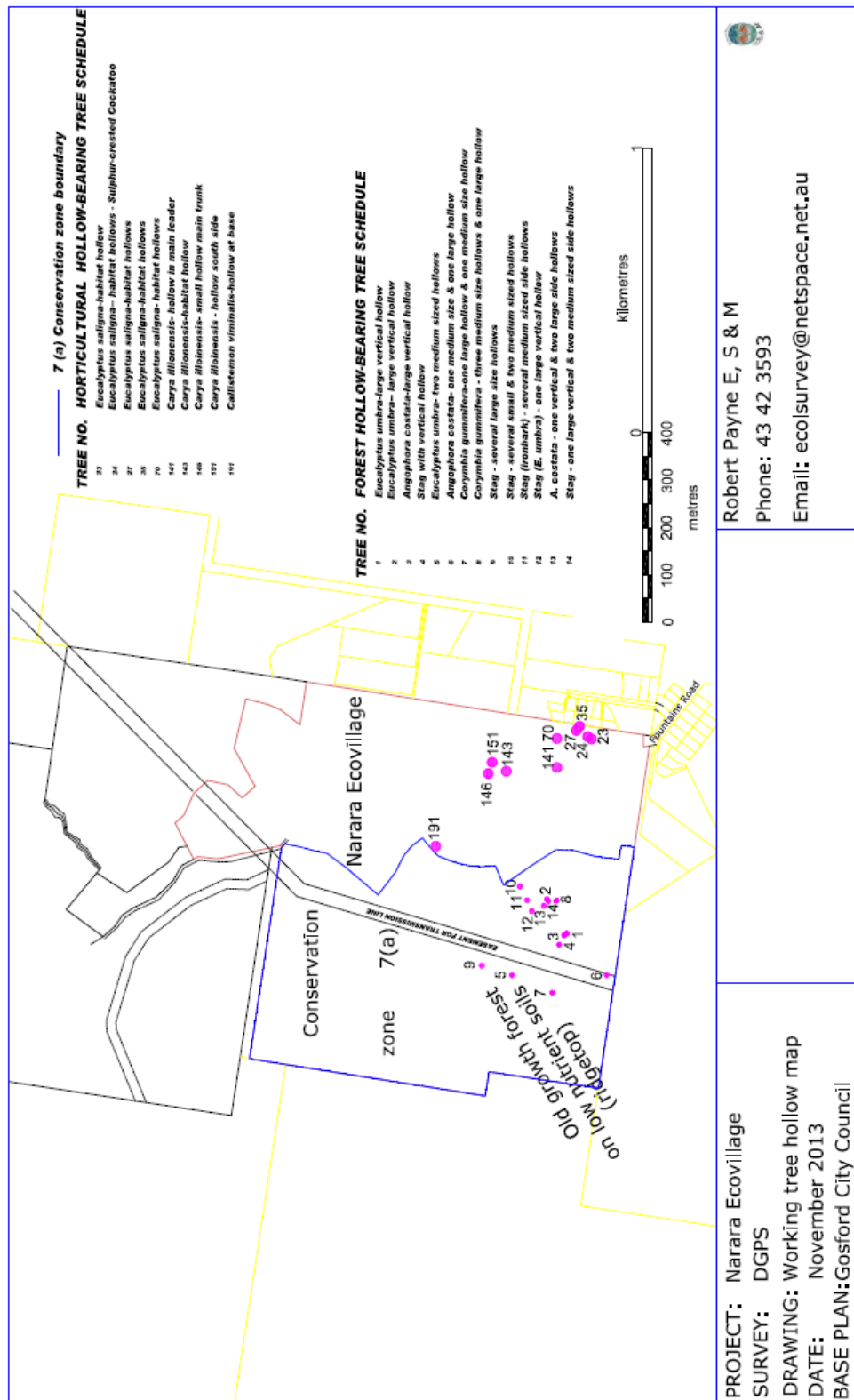


Figure 13: Survey map of tree hollows (see Table 12 for schedule).

9.0 SPECIFIC PEST MANAGEMENT

Weed management has been dealt with in the Ecological Restoration Plan (Payne & Inwood, 2013) and only pest management of fauna will be dealt with in this section.

9.1 The European fox and rabbit

The European Fox and Rabbit were seen several times during the surveys. Both the European Fox and the European Rabbit are listed as key threatening processes under the *TSC Act, 1995*. To reduce the impact on the ground mammal and waterbird populations the 1080 fox baiting program should be introduced, in consultation with the Authorities, until this impact is eradicated. Rabbits and the European Fox are present on the lower slopes.

Their eradication is required and further updated advice should be sought from the *NSW Department of Primary Industries*. Information regarding the fox baiting program can be obtained from the NSW DPI website at www.dpi.nsw.gov.au/agriculture/pests-weeds/vertebrate pests/pest-animals-in-nsw/fox-control. In summary it would be advisable to work with adjoining landholders regarding the control of foxes.

As rabbits are the main prey of foxes, their reduction will help to suppress the fox population. Details of rabbit control can be found at www.dpi.nsw.gov.au/agriculture/pests-weeds/vertebrate pests/pest-animals-in-nsw/rabbit-control. It should be noted that rabbits are declared noxious in NSW and need to be removed. Similarly, the rabbit control program should involve adjoining properties.

The number of rabbits on the property is not high (low density) and so the aim will be to eradicate them quickly so they cannot recover. Poisoning is the most effective during the non-breeding season in mid to late summer and should be undertaken prior to development.

The program is now well underway.

9.2 Feral cats and wild dogs

A feral cat was often seen amongst the buildings near the lower access road. Feral cats are difficult to capture and bait. As the whereabouts of the individual is known, setting a cage trap amongst vegetation nearby is the recommended method (Mitchell & Ballogh, 2007). The cat can then be professionally euthanased but care should be taken when handling these animals due to spread of disease.

Wild dog management is a sensitive issue because it is difficult to discern between which dogs are pets and which are wild. Management of this species is presently under the umbrella of the Live Stock and Pest Authority (LSPA) with the nearest office being at Morisset. Regular courses conducted by this authority are held on the management of wild dogs, together with foxes and rabbits, usually at Palmdale or Kulnura. It is recommended one of the Narara Ecovillage members undertake this course in order that the NAEC understands the processes involved and the association with adjoining landholders that is needed to undertake faunal pest management control. The responsible authority is the new government department NSW Local Land Services.

This program is now well underway.

10.0 MANAGEMENT OF THE MAGENTA LILLY PILLY

The only threatened plant species found on the property from the three surveys is the Magenta Lilly Pilly *Syzygium paniculatum* (NSW OEH, 2012) with single trees re-located at the edge of one of the gullies (MU3) and on the floodplain growing in a sandy soil. It is highly unlikely that this tree will be disturbed by the development but there is a recovery plan in place setting out measures to protect populations of the species. Whilst the recovery plan does not provide adequate detail for management of populations of this species on private property, the tree should be protected in an environmentally sensitive manner, because it is listed as endangered under state and vulnerable under commonwealth acts. At present the tree is surrounded by weeds and other exotic trees that have escaped from the orchard. These exotic species should be removed by standard bush regeneration techniques and the area returned to natural bushland to allow the Magenta Lilly Pilly to reproduce naturally. In particular, no horticultural specimens of the Magenta Lilly Pilly should be re-introduced into the property because some of the horticultural specimens sold at nurseries are crossed varieties and such a practice is likely to result in further introduction of non-pure forms of the species. As an interim measure allow a 20 metre buffer zone, with weed removal, for protection as set out in DCP175.

11.0 PROPOSED DEVELOPMENT

The proposed development is shown on Figure 13. Since a number of threatened species have been found on the property, each species was assessed individually as to their impact by the development. Table 14 sets out these details.

The proposal is contained within the 2(a) zoned land and provides for 54 small allotments of variable size and additionally the land upon which the allotments and internal roads are proposed is previously cleared land, some of which support orchards and trees that are not considered to be of heritage value. A general store and community facilities are proposed for the existing buildings.

Table 15: Summary of threatened species impact from the proposed development

Species	Identified impact on individual species
Magenta Lilly Pilly	One tree located in the 7(a) zoned land. Twenty metre exclosure zone set (see Figure 13). Second tree unable to be located. Will not be impacted.
Yellow-bellied Glider	Sap site tree found during previous Andrews Neil (2006a,b) survey and area added to Strickland State Forest. Now protected in Strickland SF. YBG not present on site.
Grey-headed Flying Fox.	Possibly feeding in orchards and perhaps in Grey Ironbark on slopes. Therefore maybe some loss of orchard feed trees. Grey Ironbarks will be protected under the PVP. Expected minimal impact from development except for any lighting at forest edges, where some feed trees exist.
Eastern Bent-wing Bat	Would feed between and beside forest remnants. Lighting could impact feeding regime.
Little Bent-wing Bat	Would feed between and beside forest remnants. Lighting could impact feeding regime.
Eastern Free-tail Bat	Forest edges and clearing for foraging. Roosts in tree hollows. Lighting could impact feeding regime.
Southern Myotis	Feeds over dam. Requires roosts in tree hollows nearby but may use some of the old buildings, even culverts and bridges. Lighting could impact feeding regime.
Greater Broad-nosed Bat	Feeds over freshwater wetland. Requires roosts in tree hollows. Unlikely to be impacted to any significant degree.
Sooty Owl	Requires forest areas for breeding, roosting and feeding. Minimal impact from development except for any lighting at forest edges.
Powerful Owl	Requires forest areas for breeding, roosting and feeding. Minimal impact from development except for any lighting at forest edges.
Glossy Black Cockatoo	Confined to DCP vegetated land. Large hollows found on ridge & food trees are found on dry slopes. Will not be impacted. Protected by PVP.
Red-crowned Toadlet	Confined to DCP land in ephemeral re-entrants on the ridge. Will not be affected.

	Protected by PVP.
Giant Burrowing Frog	Confined to DCP land in ephemeral re-entrants and wet areas on the ridge. Will not be affected. Protected by PVP.
Stuttering Frog	Prefers rainforest riparian habitats. Will not be affected. Protected by PVP.
Black Bittern	Confined to alluvial flats in wetland. Outside zone for this development application.
Endangered ecological community	
Lowland Rainforest	Unlikely to be impacted provided infrastructure is kept well away from relevant gullies. Some gullies protected by PVP.
Freshwater Wetland	Confined to alluvial flats in wetland. Outside zone for this development application.

All trees with hollows were overlaid onto the development plan but it is obvious those on the ridge will not be impacted because they are found in the DCP175 land. Those identified by Shaw (2013) are found along the lower slope and floodplain except for tree 191, some of which are in the development area.

The only vegetation clearing that will be required and which will call in the *Native Vegetation Act, 2003*, is the middle western gully, where depending on discussion between Gosford City Council, the NSW Department of Water and the Hunter Central Rivers Catchment Management Authority, a small area will be required to accommodate a fire asset protection zone beside an access road. At this location there is a short gully present which is not shown on the state mapping system and some native riparian vegetation will need to be removed from the southern side slope on the bank and overbank.

Figure 13 shows the trees with hollows, as located more accurately by the Surveyor, that maybe impacted by the proposed development. Table 16 presents further details in relation to the development and details of any setbacks required under the Australian Standard.

Table 16: Trees with hollows detail in the development footprint together with setbacks if any.

Tree	Species	Easting	Northing	Dbh (m)	Relation to development	Required setback/action (AS-4970)
23	<i>E. saligna</i>	3 44 651	63 03 767	0.70	outside	Nil
24	<i>E. saligna</i>	3 44 658	63 03 771	0.80	outside	Nil
27	<i>E. saligna</i>	3 44 665	63 03 795	1.14	outside	Nil
35	<i>E. saligna</i>	3 44 679	63 03 793	1.20	outside	Nil
70	<i>E. saligna</i>	3 44 652	63 03 838	1.00	outside	Nil
141	<i>C. illoinensis</i>	3 44 594	63 03 928	0.80	outside	Nil
143	<i>C. illoinensis</i>	3 44 584	63 03 945	0.38	outside	Nil
146	<i>C. illoinensis</i>	3 44 579	63 03 985	0.40,0.80, 0.40	outside	Nil
151	<i>C. illoinensis</i>	3 44 605	63 03 974	0.60	outside	Nil
191	<i>C. viminalis</i>	3 44 427	63 03 094	Multi	Within proposed road	4.8m est./ suggest removal

All of the trees except tree number 191 lie outside the development footprint. Tree No 191 is a multistemmed *Callistemon viminalis* with a hollow at the base. It will be recommended that this tree be removed because it will be within the road reserve and its removal offset and substituted with a bat roosting box. It is expected tree numbers 143, 146 & 151 can be retained.

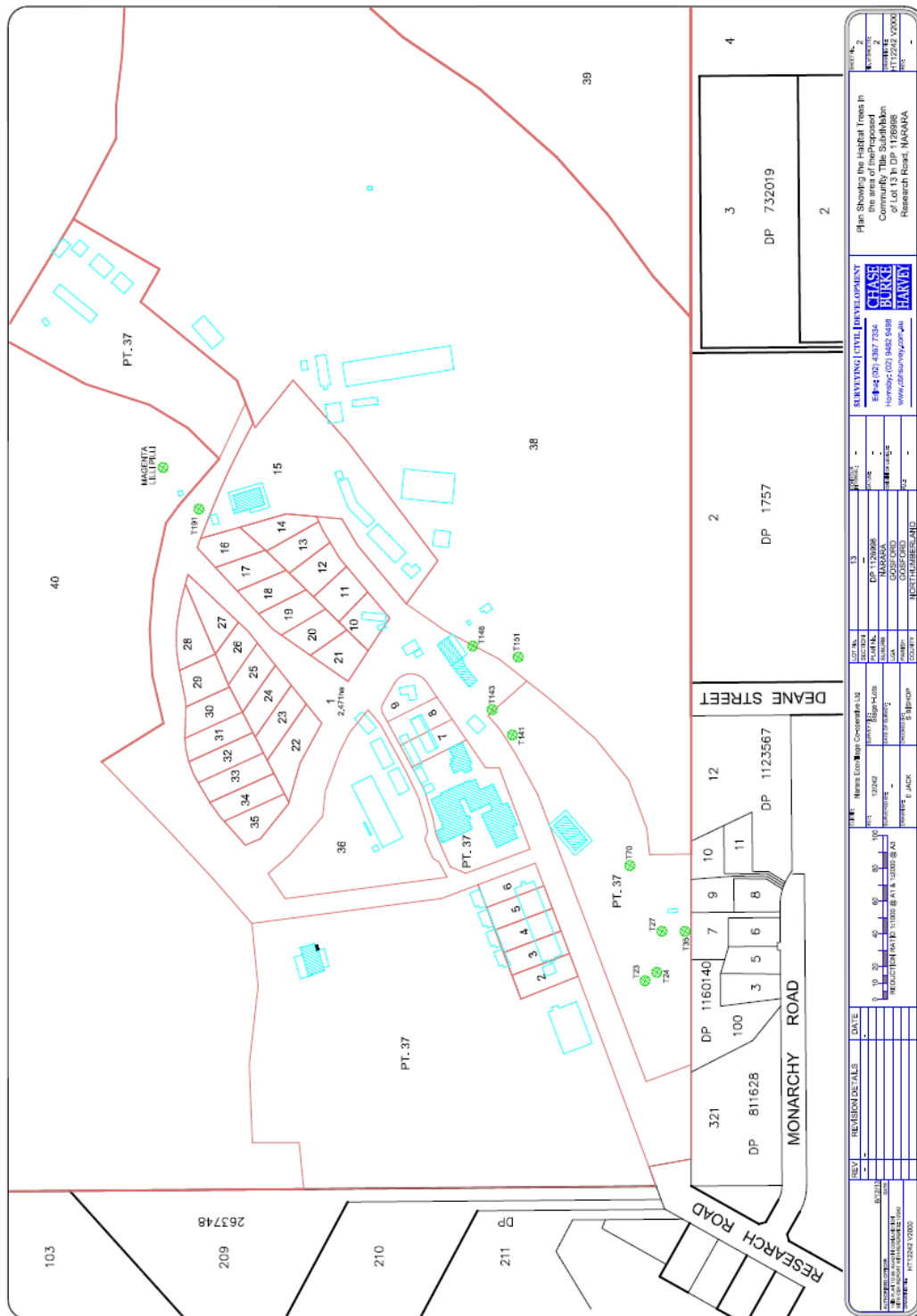
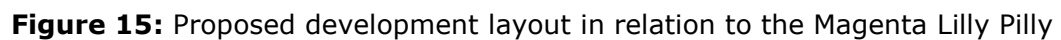


Figure 14: Layout plan showing trees with hollows near or within the development area.



12.0 DISCUSSION

Recent additional survey has increased the number of threatened and generalist species now known to be present throughout the site (Figures 4 and 6), although some data has come by way of colleagues and previous surveys of the nearby state forests (e.g. Wellington & Wells, 1995). Further field investigation of the lower slopes and ridgetops is the main reason for the resultant additional data for the previous investigations only covered riparian vegetation within the cleared floodplain and lower slopes. At this stage the information presented is adequate enough for the Authorities to make a decision based on flora and fauna impact, although further survey in part is still required to finalise it to a complete audit stage. Two endangered ecological communities have also been identified as being present, which are the remnant freshwater wetland and the lowland rainforests (Figure 5).

Of the vegetation recorded, the open forests and woodlands (MU6; Exposed Terrigal Formation Woodland), located at the top of the ridge and on the upper drier slopes are common at a local and regional scale and are all adequately represented in the local conservation reserves such as Brisbane Water National Park and the state forest areas. However, it is also recognized this forest has a significant old growth quality with the presence of numerous old trees with hollows. Alternatively, the gullies, that drain the Exposed Terrigal Formation Woodland through sandstone geology, are boulder strewn and as a consequence of this and the rock outcropping, the forest canopy is discontinuous because trees are unable to gain a foothold on the underlying rock strata. Thus, these gully forests (MU4) have a patchy structure with both closed and open canopies, but with a different flora to the vegetation on the adjoining moist slopes and lowland gallery rainforests (MU1) found on alluvium along the major drainage line of Narara Creek. Not in all cases do they fit the strict definition of rainforest but they conform to the rainforest terminology that was prepared in the late 1980's. Furthermore, this palm gully rainforest type (MU4) is not well represented in reserves on the Central Coast of New South Wales although small areas are now reserved in the Wambina Road and Palmgrove Nature Reserves and managed by the *NSW National Parks and Wildlife Service* (Gosford Office).

Overall, the rainforest vegetation on the Central Coast and recorded in these gullies is probably not strictly true rainforest. As explained in Harden, McDonald & Williams (2006; 2007) those rainforests found further north in coastal New South Wales have a closed canopy without the intrusion of eucalypts and other non-eucalypt hardwood species such as Turpentine and Sydney Blue Gum. Nevertheless, for the purposes of this exercise they do conform to the description of local rainforest prepared by Bell (2004) in the Gosford local government area mapping.

Gully Rainforest, which is the form of rainforest found at this site, is the vegetation type that really applies to Gosford City Council's Rainforest Policy. These gully rainforests at the Narara Ecovillage site are examples of the lowland rainforest endangered ecological community but at the low end of the scale. In contrast the main Narara Creek vegetation is a remnant lowland gallery rainforest on alluvial soils with emergent Sydney Blue Gum and Turpentine but Andrews-Neil (2006 b) have confirmed that the Lowland Rainforest Endangered Ecological Community definition does not apply to this riparian forest on alluvial flats. Gosford City Council has also advised that the previous rainforest policy does not apply.

The moist lower slope forest found partly in this property on the Terrigal Formations is also a form of rainforest, but has a more diverse canopy of *Eucalyptus spp.* with *Syncarpia glomulifera* Turpentine. Some researchers would also refer to this vegetation as closed

forest with a dense mesophyllous understorey, typically dominated by rainforest species. All of this vegetation will be adequately protected in the DCP 175 land under the PVP.

The presence of riparian grassland between the remnant palm gully rainforest (MU4) and paddock areas will require some difficult management decisions if they are to survive. At present the patches found are facing competition on either side, from paddock grasses or the Privet-infested edge. Whilst the Privet can be removed the species must be replaced with an alternate rainforest tree such as Red Ash or preferably Hard Quandong in some cases and that would comply with the priority actions for the rainforest pigeons. Eradicating the paddock grass may not be so easy and so trials may have to be undertaken first using "Roundup bioactive" and other methods and replanting the native species using cultivated plants. The native riparian grasslands only survive, as far as can be established, in narrow riparian bands. Further detailed information is presented in the ecological management plan (Payne & Inwood, 2013) but similar grassland habitats being protected can be observed at the Pioneer Dairy at Tuggerah.

One further point worthy of mention is the presence of a freshwater wetland EEC (MU2) on the floodplain of Narara Creek (Figure 5). Whilst this wetland lies outside of the proposed development area, it was not mentioned in the previous surveys (Andrews-Neil, 2006a, b). Given the fact that waterbirds (see Photo 4) are feeding and nesting and one threatened species, the Black Bittern, are utilizing this wetland and the associated drainage line its protection is warranted. Management of this resource will need to be considered and in doing so the current practices of mowing should continue to prevent the habitat from becoming dominated by Cumbungi and to allow waterbirds to continue utilizing the habitat for feeding.

It is too early at this stage to fine tune any drainage proposal but planning should not direct urban drainage into this wetland otherwise it will become degraded. All drainage should bypass this wetland.

Given the fact that all of the vegetated slope and ridge area is unlikely to be compromised by the development proposed by the proponent it would be difficult to conclude a significant impact would result on threatened species and endangered ecological communities. When all matters are considered together the resources required by the known threatened species to survive are mostly captured by the slope and ridge vegetation although it is somewhat disturbed. This current disturbance is not a function of the proposed development and following on from this, the likely impacts of the development on the DCP land are expected to be minimal because the impact zone is all downslope of the vegetated area. In addition any impact through the site would be by way of Narara Creek only.

A number of microbat species were recorded over the dam waters and by all accounts this area is an important habitat based on microbat call frequency. Some microbat species have been listed as vulnerable over recent years and to understand the reasons why, a basic understanding of bat ecology is important at a landscape scale (Haysom, et al., 2010). Microbats require suitable roosting sites within easy reach of foraging habitat. Different sites are utilized such as roost sites, maternity sites, mating roosts and even hibernation roost sites. The different roost sites are believed to be related to different temperature and humidity conditions. Maternity sites will have higher temperatures because the conditions are more suited to raising young. Hibernation sites are cooler and more humid and in this environment bats are able to conserve energy during torpor. Some male bat species will utilize a number of roosts over successive nights visiting a number of different females whilst others will move between roost types (switching behavior). Roosts are found in

trees, domestic homes, caves, culverts, bridges and other structures. Microclimatic conditions are a prime reason for the choice of roost sites as well as easy access to foraging habitat. Maternity sites in caves (for example, the Eastern Bent-wing Bat) may be found hundreds of kilometres away from other roosting sites.

Foraging niches vary as does the diet. Aerial insect and other aquatic mosquito larvae occur in their diet and one of the key foraging habitats for catching prey is over freshwater bodies. Thus, conservation measures to protect microbats needs to consider roosting, foraging and access to food resources by the protection of tree hollows and through the installation of artificially placed roost boxes, if this was found to be necessary.

The previous report prepared by Andrews-Neil (2006b) identified the need for consideration of a wildlife corridor in the planning stage, details of which have been presented in the Ecological Restoration Plan. Obviously, the Terrigal slopes and ridges (which will be protected by the PVP), including the dam, would satisfy these requirements but as an additional management issue these slopes and ridges have become the habitat to a proliferating population of the Bell Miner *Manorina melanophrys*.

The Bell Miners on the property are extremely numerous on the Terrigal Formation lower slopes where Lantana has been able to invade and furthermore, to a lesser extent on the ridges, where Lantana is absent. Bell-minor-associate-dieback (BMAD as it is known) has been addressed by researchers in recent years (see Wardell-Johnson et. al., 2005; Wardell-Johnson and Lynch, 2005) and appears to be an interaction associated with this bird species and lerp (secretions from psyllid insects) accumulation, nurturing and harvesting. The authors claim BMAD is a significant threat to the sustainability of moist eucalypt forests and biodiversity conservation in north-eastern New South Wales.

Canopy die-back increase or thinning is thought to be a result of Bell Miner increase and this is one of the main management issues to be addressed on this property. Bell Miners can have a sustained presence in a forest creating a mechanism that maintains elevated populations of psyllid insects. Although the tree canopy is damaged as a result of dieback in these circumstances there appears to be no direct link of an interrelationship that can show a cause and effect link between the birds and psyllid insects.

The Bell Miner requires tree crowns that support high densities of insects and a tree structure to maintain their nesting sites and defend their territories. Bell Miners will defend their territories to the point where they exclude all other avian insectivores. This results in an increase in insects in and die-back of the canopy. At the Narara Ecovillage the increase in Bell Miner populations appears to be associated with an increase in Lantana invasion with limited thinning of the canopy on the lower slopes only. The upper slope, where the Bell Minor also persists, is devoid of Lantana and canopy thinning. Research by the various authorities has so far resulted in showing no cause and affect between the increased density of Bell Miners and the proliferation of Lantana and thus no direct link with BMAD can be established. However, whilst Lantana may not be a primary causal factor initiating the BMAD problem it may contribute to crown opening (causing less re-generation to fill the gaps) which then may contribute to an increase in psyllid infestation.

It has been agreed between the researchers that where a dense shrubby understorey exists, a lower soil carbon-nitrogen ratio results and this then creates increased nitrogen mineralization of the soil. Such an increase then may result in higher concentrations of free amino acids in eucalypt foliage as the soil nutrients are taken up by the trees.

Therefore, any activity or process that increases foliar nitrogen will promote an expansion of psyllid outbreak.

At a large scale, where Lantana is dominant, such as at Narara, the plant species is suppressing the re-growth of native trees and shrubs and has done so mainly on the lower slopes (MU3) where there is increased moisture, but not the upper slopes where soils are drier (this is acknowledged as being the main secondary management issue). Thus, according to the research, whilst Lantana may not be a primary cause of the die-back, its presence may reflect decreased crown density, which can contribute to vigorous foliage re-growth which will support psyllid populations, but that which can be observed appears to be only minor. It is also noted at this point that Lantana increases the levels of organic carbon and nitrates in the soil, thus altering the natural nutrient cycle, especially given the degree of Lantana infestation at this site. This is believed by some researchers to be a contributing factor favoring the establishment of psyllids and Bell Miner colonies. Lantana is used by the Bell Miner for nesting activities. What is known though, if the Lantana is removed the forest will return an understorey that is structurally more diverse that will not favour Bell Miner colonization. However, this process will require the establishment of a dense shade producing canopy with regular systematic weed maintenance.

If the forest understorey is restored by eradicating the Lantana a return to natural forest conditions may result and given this type of forest in the local government area the upper Narara Valley is one of the most extensive and therefore is worthwhile restoring.

The land covered under DCP175, which will act as the wildlife corridor, has attributes that have been researched by others such as Recher (1991; 1996). Within the vegetation present on the slopes and ridges, eucalypt forest vertebrates can depend on tree hollows present (Photo 12) for shelter and nesting. These animals include microbats and arboreal marsupials, forest birds, reptiles and amphibians and in some cases the dependence on tree hollows can be considerable. In particular, tree hollows present on the ridges are prominent and maybe suited to owls for roosting purposes (Figure 12). Furthermore, with respect to some general bird species such as fantails, robins, cuckoo-shrikes, sittellas, thornbills, warblers and honeyeaters, spider web, which can be very common in this forest type vegetation, is the main source of nesting material (Recher, 1991).

Nest location is also important for such bird species because some bird species place nests on dead wood (both vertical and horizontal) whilst others place nests behind loose bark and the bark can be used as a nest substrate. Shedding bark, particularly from the *Symphyomyrtus* group of eucalypts found on this property (eg. *Eucalyptus saligna*), has loose decortivating bark along the main branches. Beneath this layer are bark invertebrates, including many insects. These insects produce exudates, which can be rich in sugars and complex carbohydrates. Mammals and birds exploit this insect resource together with manna (an 66ylindri from the plant caused by insect damage), lerps (secretions from psyllid insects) and honeydew (secretions from sap sucking insects). The latter is utilized by arboreal mammals such as the Sugar Glider, the Feather-tail Glider and the Yellow-bellied Glider all of which would be found on the property.

Decortivating bark found at the base of these trees is also utilized by invertebrate insects which then re-colonise the trunk as new bark is formed and then shed. Ground logs are also utilized by both ground dwelling and ground foraging mammals, birds, reptiles and frogs (Recher, 1996).

The most important outstanding question from the survey results would appear to be the uncertainty of the diggings and scatchings within the palm gully rainforests (MU4). If the evidence of the diggings does turn out to be the Long-nosed Potoroo, then management of another mycophagous species will need to be addressed in the Ecological Restoration Plan further down the track. By this, it is meant that fungul fruiting bodies, that are found well underground, are the main constituent of this animal's diet (Claridge et. al. 2007). This would also explain the deeper underground diggings and chewed sections of mycorrhiza, noted in several of the ground holes. To begin with, the fox and feral cat management will have to be employed simultaneously because both are predators to Potoroos as stated in the NSW OEH Priority Action Statements. This management process should complement the removal of Lantana and will have to be managed with a Potoroo conservation perspective, if this is the animal present. Only in this way will underground fungi survive in a relationship with the many mesophyllous plant species and any Potoroo population.

The Seven Part Test of Significance has been provided and from these added details only the possibility of the Long-nosed Potoroo and the Stuttering Frog causes some concern. It is not recommended a species impact statement be prepared but instead further survey be carried out with a surveillance camera for a one month period to try and determine the mycophagous mammal species present. In the meantime the planning for the project can be progressed by allowing an adequate buffer zone between any development area with the drainage line/gully areas on the moist lower slopes (ie EEC's as set out in Table 4) and an adequate buffer from the Magenta Lilly Pilly.

13.0 CONCLUSIONS AND RECOMMENDATIONS

The flora and fauna survey for Lot 13 DP1126998 has been re-visited and upgraded. An adequate number of flora quadrats and transects have now been surveyed to comply with the state *NSW DECC* (2004) guidelines. Fauna surveys have also been upgraded and included cage trapping, Elliott B trapping and hair-tube trapping. No arboreal trapping has been completed at this stage and these two components cannot be achieved until the weed infested slopes are rid of Lantana to allow access. Microbat surveys for the ridge, dam and freshwater wetland have been completed and further surveys for the Stuttering Frog indicated its likely presence along the edge of the dam based on distant calls. However, the survey report is adequate to progress the planning matter further.

Four threatened species, the Glossy Black Cockatoo, the Black Bittern, the Freckled Duck, the Red-crowned Toadlet, the Southern Myotis, the Eastern Freetail-bat and possibly the Little Bent-wing Bat were added to the fauna component, but no threatened species were added to the flora component.

Additional Seven Part Tests for threatened species have been provided and whilst there is unlikely to be any significant impact, a mycophagous mammal species (Long-nosed Potoroo) is present which was unable to be trapped and therefore its identification remains unknown. The diggings created by this species are most unlike bandicoot diggings and so further surveys have been recommended to try and solve this issue. Furthermore, as a result the seven part test of significance for the Long-nosed Potoroo was re-examined (Appendix 6).

It should also be noted the palm dominated rainforest gullies and the freshwater wetland (Photos 4 & 6) are examples of endangered ecological communities which have been addressed in the Ecological Restoration Plan (Payne & Inwood, 2013). All of the gullies (MU4) qualify as the Lowland Rainforest EEC except for the middle-western gully (see Table 4).

It is recommended, under Development Control Plan 175, that the following actions should occur in respect of the maintenance and development planning for the site through the preparation of a property vegetation plan (PVP) and Ecological Restoration Plan. The PVP is already underway and the Ecological Restoration Plan finalised which has provided a prescriptive framework for the management of threatened species habitat, weed management and native grass re-establishment and other mitigation measures to minimise potential indirect impacts associated with any future subdivision and development. The PVP will also outline any other necessary strategies for the on-going management of the site.

It is recommended the following be addressed in conjunction with the development:

Stage 1 Development Application Requirements

1. Undertake weed removal around the tree of *Syzygium paniculatum* for a distance of 20 metres as set out in DCP175. Do not introduce any impure forms of *Acmena spp.* or *Syzygium spp.* into the site through the horticultural trade for landscaping purposes elsewhere throughout the property. Remove the unwanted intrusive *Pyrus calleryana* from the middle-western gully and any other gully in which it occurs.
2. Install only low level lighting against the forest edge and the dam because of the presence of foraging by threatened fauna species. Lighting should be designed to be consistent with human safety.
3. During the demolition of any old buildings care must be taken that no bat roosts are apparent behind batons and struts. Care should be taken during the demolition process and if any species are found the Ecologist should be contacted for further advice.
4. At least three months prior to construction install along the forest edge a number of microbat roost boxes, suitable for colonization by the Greater Broad-nosed, Southern Myotis and the other forest bats, equivalent to the number of hollow trees which will be removed. At this stage consider establishing four bat roosting boxes one of which is to replace the tree hollow in tree 191.
5. Removal of tree No. 191 is recommended because of its location with a proposed feeder road. A tree protection zone of an estimated radius of 4.8m under AS 4970-2009 is not possible. Recommendation 9 also applies to this tree.
6. Due to the fact that there is the potential for the Long-nosed Potoroo being present establish a condition through a section 88b instrument that all dogs shall be on a leash at all times and cats will only be allowed within a catrun. The latter must be in place prior to accommodation.
7. During construction implement best practice soil erosion and sediment control structures to protect the Freshwater Wetland EEC and Narara Creek.
8. If in the event an Aboriginal relic is found during work procedures the location and detail is to be reported immediately to NSW OEH and the Darkinjung Land Council.
9. The following tree pruning procedure will be applicable to any tree with a hollow to minimize environmental impacts to threatened fauna. With the aid of a "Cherry Picker" inspect any vertical and horizontal hollow for the presence of nocturnal animals with the aid of a spotlight or similar.
 - If no animals are found to be present then proceed to take off sections of the tree. This will be done according to best practice guidelines and with safety.
 - If an animal is found to be present in the vertical or horizontal hollow then at nightfall wait for the animal to exit the hollow. Then bag the entrance to the hollows ensuring that each bag is tied securely. This will prevent the animal re-entering any of the hollows just prior to dawn.

Next day proceed to take off sections of the tree up to a limit of three metres depth. This will be done with the supervision of an Arborist who will organize the removal of the hollow bearing stem with safety.

Longer term management of impacts associated with the Development Application

10. Regenerate the native riparian grassland alongside drainage lines within the 10m riparian buffer zone, where required by the *NSW Department of Water*.
11. Cultivate and propagate the riparian floodplain grasses, particularly *Ottochloa gracillimus* and take steps to re-introduce these grasses as a community within and beside the gully drainage lines or as part of the buffer/asset protection zone.
12. Remove the Narrow-leaved Carpet Grass from the Freshwater Wetland.
13. Recognise this wetland is an endangered ecological community (EEC) supporting threatened species and take steps to protect it from urban drainage. Maintain the mowing regime but install signage to recognize its location.
14. Carry out weed removal of the lower moist slopes and gullies to increase access and to allow the natural forest understorey to re-generate. Refer to the Ecological Restoration Plan. This may result in the reduction of the population of the Bell Minor.
15. Install a surveillance camera for one month to try and establish the mycophagous mammal species present in the gullies as it could possibly be the Long-nosed Potoroo.
16. Construct a narrow access track along the southern side of Narara Creek from the dam to allow access for determining accurately the presence of any Stuttering Frog population.
17. Take steps, through discussions with Government Authorities, to eradicate the European Fox, the European Rabbit and Feral Cat. Seek out one employee who is willing to undertake the course to supervise these tasks.
18. Eradicate the European Fox in consultation with the NSW Department of Primary Industries.
19. Eradicate the Feral Cat in consultation with the NSW Department of Primary Industries.
20. Eradicate the rabbit population in consultation with the NSW Department of Primary Industries.

Other Approvals that will or will not be required

1. Approval will be required through the *NSW Department of Water* because the subject development site is located within 40m of a drainage line.
2. Approval will be required under the *Native Vegetation Act, 2003* as a small area of riparian native vegetation is to be removed.
3. Concurrently, any native vegetation on this site would qualify as Urban Bushland under SEPP19 and therefore approval will be required through the *NSW Department of Planning*.
4. No approval is required through the commonwealth under the *EPBC Act, 1997*.
5. No approval is required through the *NSW Department of Planning* under SEPP44 Koala Habitat Protection because the vegetation does not constitute potential Koala habitat.
6. No approval will be required under AS-4970-2009.

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**APPENDIX 1: LETTER FROM NSW SCIENTIFIC COMMITTEE REGARDING PALM
DOMINATED GULLY STATUS**

NSW SCIENTIFIC COMMITTEE

Robert Payne
Wildlife Ecologist
Ecological Surveys & Management
15 Mountain-Ash Way
UMINA BEACH NSW 2257

Dear Mr Payne,

The Scientific Committee, established by the Threatened Species Conservation Act, has made a Final Determination to list Lowland Rainforest in the NSW North Coast and Sydney Basin bioregions as an ENDANGERED ECOLOGICAL COMMUNITY in Part 3 of Schedule 1 of the Act.

The Committee appreciates your advice on rainforests in the central coast area. Your report identifies five types of rainforest in the area, of which Gallery Rainforest, Gully Rainforest and Palm Gullies are potentially referable to the assemblage described in the Lowland Rainforest Determination, while Littoral Rainforest and Dry Forest are unlikely to be part of this community. 'Palm Gullies' are referable to Floyd's suballiance 6 (*Archontophoenix – Livistona*). 'Gallery Rainforest' and 'Gully Rainforest' are referable to Floyd's suballiance 37 (*Ceratopetalum apetalum – Schizomeria ovata – Acmena smithii – Doryphora sassafras*). Some rainforest stands display features of Floyd's suballiance 14 (*Doryphora sassafras – Daphnandra micranthus – Dendrocnide excelsa – Ficus-spp. – Toona*), notably their high frequencies of *Doryphora* and *Ficus* spp. However, *Daphnandra*, *Dendrocnide* and *Toona* are not common. Dominance of *Ceratopetalum* with *Sloanea* in several stands, and frequent occurrence of *Schizomeria*, also suggests affiliation with Floyd's suballiance 33 (*Ceratopetalum apetalum – Schizomeria – Argyrodendron* spp – *Sloanea*), which is more common on the north coast.

It would appear that the central coast district includes some areas that are part of the Lowland Rainforest community and others that are not. Floyd's suballiances 6 and 14 are part of Lowland Rainforest (paragraph 4 of Determination). The Determination also includes suballiance 33 within Lowland Rainforest where it occurs in conjunction with stands of any suballiance listed in paragraph 4 (including suballiance 6 and 14). Moreover, twelve of fifteen 'indicator species' listed for Gully Rainforest and Gallery Rainforest in Appendix 1 of your report are also listed in the Lowland Rainforest Final Determination (paragraph 2) as characteristic of the community. Consequently, many stands of rainforest within Gosford LGA may fall within Lowland Rainforest. However, suballiance 37, which you identify within the Gosford LGA, is not part of Lowland Rainforest. There may thus be uncertainty in the diagnosis of some stands. These marginal stands would need to be assessed by qualified practitioners on a case by case basis.

590subs.doc

ESTABLISHED BY THE THREATENED SPECIES CONSERVATION ACT 1995

Contact Address: C/o PO Box 1967 Hurstville NSW 2220

Telephone: (02) 9585 6940 Facsimile: (02) 9585 6606

NSW SCIENTIFIC COMMITTEE

Your submission also noted a gradual decline of rainforests in the Gosford LGA since your studies began in 1976 and cited various threats at particular sites.

Thank you for your submission to the Committee. A copy of the Final Determination is attached.

Yours sincerely,



Associate Professor Lesley Hughes
Chairperson
Scientific Committee

- 3 JAN 2007

APPENDIX 2: PLANT SPECIES LIST

Native Endemic Plant Species List

Family	Latin Name
Escalloniaceae	<i>Abrophyllum ornans</i>
Fabaceae (Mimosoideae)	<i>Acacia buxifolia</i> subsp. <i>buxifolia</i>
Fabaceae (Mimosoideae)	<i>Acacia decurrens</i>
Fabaceae (Mimosoideae)	<i>Acacia floribunda</i>
Fabaceae (Mimosoideae)	<i>Acacia irrorata</i> subsp. <i>irrorata</i>
Fabaceae (Mimosoideae)	<i>Acacia linifolia</i>
Fabaceae (Mimosoideae)	<i>Acacia longifolia</i> subsp. <i>longifolia</i>
Fabaceae (Mimosoideae)	<i>Acacia maidenii</i>
Fabaceae (Mimosoideae)	<i>Acacia prominens</i>
Fabaceae (Mimosoideae)	<i>Acacia ulicifolia</i>
Myrtaceae	<i>Acmena smithii</i>
Rutaceae	<i>Acronychia wilcoxiana</i>
Epacridaceae	<i>Acrotriche divaricata</i>
Apiaceae	<i>Actinotus helianthi</i>
Adiantaceae	<i>Adiantum formosum</i>
Adiantaceae	<i>Adiantum hispidulum</i>
Sapindaceae	<i>Alectryon subcinereus</i>
Casuarinaceae	<i>Allocasuarina littoralis</i>
Casuarinaceae	<i>Allocasuarina torulosa</i>
Rhamnaceae	<i>Alphitonia excelsa</i>
Myrtaceae	<i>Angophora costata</i>
Myrtaceae	<i>Angophora floribunda</i>
Fabaceae (Faboideae)	<i>Aotus ericoides</i>
Cunoniaceae	<i>Aphanopetalum resinosum</i>
Arecaceae	<i>Archontophoenix cunninghamiana</i>
Aspleniaceae	<i>Asplenium attenuatum</i>
Aspleniaceae	<i>Asplenium australasicum</i> forma <i>australasicum</i>
Aspleniaceae	<i>Asplenium flabellifolium</i>
Aspleniaceae	<i>Asplenium polyodon</i>
Araliaceae	<i>Astrotricha latifolia</i>
Myrtaceae	<i>Backhousia myrtifolia</i>
Proteaceae	<i>Banksia cunninghamii</i>
Proteaceae	<i>Banksia serrata</i>
Proteaceae	<i>Banksia spinulosa</i>
Pittosporaceae	<i>Billardiera scandens</i>
Blechnaceae	<i>Blechnum cartilagineum</i>
Blechnaceae	<i>Blechnum wattsii</i>
Rutaceae	<i>Boronia ledifolia</i>
Euphorbiaceae	<i>Breynia oblongifolia</i>

Family	Latin Name
Pittosporaceae	<i>Bursaria longisepala</i>
Cunoniaceae	<i>Caldcluvia paniculosa</i>
Cunoniaceae	<i>Callicoma serratifolia</i>
Myrtaceae	<i>Callistemon pinifolius</i>
Myrtaceae	<i>Callistemon salignus</i>
Myrtaceae	<i>Callistemon shiressii</i>
Dicksoniaceae	<i>Calochlaena dubia</i>
Rubiaceae	<i>Canthium coprosmoides</i>
Cyperaceae	<i>Carex appressa</i>
Cyperaceae	<i>Carex maculata</i>
Cyperaceae	<i>Carex spp.</i>
Cyperaceae	<i>Caustis flexuosa</i>
Vitaceae	<i>Cayratia clematidea</i>
Araliaceae	<i>Cephalalaria cephalobotrys</i>
Cunoniaceae	<i>Ceratopetalum apetalum</i>
Cunoniaceae	<i>Ceratopetalum gummiferum</i>
Adiantaceae	<i>Cheilanthes sieberi</i>
Adiantaceae	<i>Cheilanthes spp.</i>
Orchidaceae	<i>Chiloglottis spp.</i>
Thelypteridaceae	<i>Christella dentata</i>
Vitaceae	<i>Cissus antarctica</i>
Vitaceae	<i>Cissus hypoglauca</i>
Euphorbiaceae	<i>Claoxylon australe</i>
Ranunculaceae	<i>Clematis aristata</i>
Ranunculaceae	<i>Clematis glycinoides</i>
Ranunculaceae	<i>Clematis spp.</i>
Verbenaceae	<i>Clerodendrum tomentosum</i>
Commelinaceae	<i>Commelina cyanea</i>
Sterculiaceae	<i>Commersonia fraseri</i>
Proteaceae	<i>Conospermum longifolium</i>
Rutaceae	<i>Correa reflexa</i>
Rutaceae	<i>Correa reflexa var. reflexa</i>
Myrtaceae	<i>Corymbia gummifera</i>
Lauraceae	<i>Cryptocarya glaucescens</i>
Lauraceae	<i>Cryptocarya microneura</i>
Cyatheaceae	<i>Cyathea australis</i>
Cyatheaceae	<i>Cyathea leichhardtiana</i>
Poaceae	<i>Cymbopogon refractus</i>
Poaceae	<i>Cynodon dactylon</i>
Cyperaceae	<i>Cyperus imbecillis</i>
Cyperaceae	<i>Cyperus spp.</i>
Orchidaceae	<i>Dendrobium speciosum</i>

Family	Latin Name
Dennstaedtiaceae	<i>Dennstaedtia davallioides</i>
Fabaceae (Faboideae)	<i>Desmodium varians</i>
Phormiaceae	<i>Dianella caerulea</i>
Phormiaceae	<i>Dianella caerulea</i> var. <i>producta</i>
Phormiaceae	<i>Dianella prunina</i>
Poaceae	<i>Digitaria parviflora</i>
Dioscoreaceae	<i>Dioscorea transversa</i>
Ebenaceae	<i>Diospyros australis</i>
Sapindaceae	<i>Diploglottis cunninghamii</i>
Blechnaceae	<i>Doodia aspera</i>
Monimiaceae	<i>Doryphora sassafras</i>
Poaceae	<i>Echinopogon</i> spp.
Elaeocarpaceae	<i>Elaeocarpus reticulatus</i>
Celastraceae	<i>Elaeodendron australe</i>
Myrsinaceae	<i>Embelia australiana</i>
Lauraceae	<i>Endiandra discolor</i>
Lauraceae	<i>Endiandra sieberi</i>
Poaceae	<i>Entolasia marginata</i>
Poaceae	<i>Entolasia stricta</i>
Epacridaceae	<i>Epacris longiflora</i>
Myrtaceae	<i>Eucalyptus acmenoides</i>
Myrtaceae	<i>Eucalyptus agglomerata</i>
Myrtaceae	<i>Eucalyptus costata</i>
Myrtaceae	<i>Eucalyptus grandis</i>
Myrtaceae	<i>Eucalyptus paniculata</i>
Myrtaceae	<i>Eucalyptus piperita</i>
Myrtaceae	<i>Eucalyptus saligna</i>
Myrtaceae	<i>Eucalyptus scias</i>
Myrtaceae	<i>Eucalyptus siderophloia</i>
Myrtaceae	<i>Eucalyptus umbra</i>
Eupomatiaceae	<i>Eupomatia laurina</i>
Luzuriagaceae	<i>Eustrephus latifolius</i>
Santalaceae	<i>Exocarpos cupressiformis</i>
Moraceae	<i>Ficus coronata</i>
Moraceae	<i>Ficus rubiginosa</i>
Cyperaceae	<i>Gahnia aspera</i>
Cyperaceae	<i>Gahnia clarkei</i>
Cyperaceae	<i>Gahnia melanocarpa</i>
Luzuriagaceae	<i>Geitonoplesium cymosum</i>
Geraniaceae	<i>Geranium homeanum</i>
Euphorbiaceae	<i>Glochidion ferdinandi</i>
Euphorbiaceae	<i>Glochidion ferdinandi</i> var. <i>ferdinandi</i>

Family	Latin Name
Fabaceae (Faboideae)	<i>Glycine spp.</i>
Fabaceae (Faboideae)	<i>Glycine tabacina</i>
Verbenaceae	<i>Gmelina leichhardtii</i>
Fabaceae (Faboideae)	<i>Gompholobium huegelii</i>
Fabaceae (Faboideae)	<i>Gompholobium latifolium</i>
Fabaceae (Faboideae)	<i>Gompholobium virgatum</i>
Haloragaceae	<i>Gonocarpus teucroides</i>
Grammitaceae	<i>Grammitis billardiieri</i>
Proteaceae	<i>Grevillea buxifolia</i>
Proteaceae	<i>Grevillea speciosa</i>
Proteaceae	<i>Grevillea speciosa</i> x <i>G. oldei</i>
Sapindaceae	<i>Guioa semiglaucula</i>
Araceae	<i>Gymnostachys anceps</i>
Proteaceae	<i>Hakea gibbosa</i>
Fabaceae (Faboideae)	<i>Hardenbergia violacea</i>
Dilleniaceae	<i>Hibbertia dentata</i>
Dilleniaceae	<i>Hibbertia obtusifolia</i>
Dilleniaceae	<i>Hibbertia scandens</i>
Euphorbiaceae	<i>Homalanthus populifolius</i>
Violaceae	<i>Hybanthus monopetalus</i>
Apiaceae	<i>Hydrocotyle peduncularis</i>
Hymenophyllaceae	<i>Hymenophyllum cupressiforme</i>
Pittosporaceae	<i>Hymenosporum flavum</i>
Dennstaedtiaceae	<i>Hypolepis muelleri</i>
Poaceae	<i>Imperata 80ylindrical</i> var. <i>major</i>
Proteaceae	<i>Isopogon anemonifolius</i>
Fabaceae (Faboideae)	<i>Jacksonia scoparia</i>
Juncaceae	<i>Juncus planifolius</i>
Juncaceae	<i>Juncus spp.</i>
Fabaceae (Faboideae)	<i>Kennedia rubicunda</i>
Myrtaceae	<i>Kunzea ambigua</i>
Sterculiaceae	<i>Lasiopetalum ferrugineum</i>
Sterculiaceae	<i>Lasiopetalum ferrugineum</i> var. <i>cordatum</i>
Dryopteridaceae	<i>Lastreopsis decomposita</i>
Dryopteridaceae	<i>Lastreopsis microsora</i> subsp. <i>microsora</i>
Menispermaceae	<i>Legnephora moorei</i>
Cyperaceae	<i>Lepidosperma elatius</i>
Cyperaceae	<i>Lepidosperma laterale</i>
Myrtaceae	<i>Leptospermum polygalifolium</i>
Restionaceae	<i>Lepyrodia scariosa</i>
Epacridaceae	<i>Leucopogon esquamatus</i>
Orchidaceae	<i>Liparis reflexa</i>

Family	Latin Name
Arecaceae	<i>Livistona australis</i>
Loganiaceae	<i>Logania albiflora</i>
Lomandraceae	<i>Lomandra confertifolia</i> subsp. <i>confertifolia</i>
Lomandraceae	<i>Lomandra confertifolia</i> subsp. <i>pallida</i>
Lomandraceae	<i>Lomandra confertifolia</i> subsp. <i>rubiginosa</i>
Lomandraceae	<i>Lomandra glauca</i>
Lomandraceae	<i>Lomandra longifolia</i>
Lomandraceae	<i>Lomandra obliqua</i>
Proteaceae	<i>Lomatia silaifolia</i>
Asclepiadaceae	<i>Marsdenia rostrata</i>
Celastraceae	<i>Maytenus silvestris</i>
Myrtaceae	<i>Melaleuca linariifolia</i>
Rutaceae	<i>Melicope micrococca</i>
Apocynaceae	<i>Melodinus australis</i>
Poaceae	<i>Microlaena stipoides</i> var. <i>stipoides</i>
Rubiaceae	<i>Morinda jasminoides</i>
Myrsinaceae	<i>Myrsine variabilis</i>
Lauraceae	<i>Neolitsea dealbata</i>
Davalliaceae	<i>Nephrolepis cordifolia</i>
Oleaceae	<i>Notelaea longifolia</i>
Oleaceae	<i>Notelaea longifolia</i> forma <i>longifolia</i>
Oleaceae	<i>Notelaea venosa</i>
Asteraceae	<i>Olearia phlogopappa</i>
Poaceae	<i>Oplismenus aemulus</i>
Poaceae	<i>Oplismenus imbecillis</i>
Poaceae	<i>Ottochloa gracillima</i>
Asteraceae	<i>Ozothamnus diosmifolius</i>
Monimiaceae	<i>Palmeria scandens</i>
Bignoniaceae	<i>Pandorea pandorana</i>
Poaceae	<i>Panicum</i> spp.
Apocynaceae	<i>Parsonsia straminea</i>
Apocynaceae	<i>Parsonsia velutina</i>
Poaceae	<i>Paspalidium distans</i>
Poaceae	<i>Paspalum distichum</i>
Adiantaceae	<i>Pellaea falcata</i>
Adiantaceae	<i>Pellaea nana</i>
Peperomiaceae	<i>Peperomia tetraphylla</i>
Polygonaceae	<i>Persicaria decipiens</i>
Proteaceae	<i>Persoonia levis</i>
Proteaceae	<i>Persoonia linearis</i>
Proteaceae	<i>Persoonia</i> spp.
Proteaceae	<i>Petrophile pulchella</i>

Family	Latin Name
Euphorbiaceae	<i>Phyllanthus hirtellus</i>
Thymelaeaceae	<i>Pimelea linifolia</i>
Pittosporaceae	<i>Pittosporum multiflorum</i>
Pittosporaceae	<i>Pittosporum revolutum</i>
Pittosporaceae	<i>Pittosporum undulatum</i>
Polypodiaceae	<i>Platynerium bifurcatum</i>
Apiaceae	<i>Platysace lanceolata</i>
Apiaceae	<i>Platysace linearifolia</i>
Fabaceae (Faboideae)	<i>Podolobium ilicifolium</i>
Escalloniaceae	<i>Polyosma cunninghamii</i>
Araliaceae	<i>Polyscias sambucifolia</i> subsp. A
Dryopteridaceae	<i>Polystichum australiense</i>
Dryopteridaceae	<i>Polystichum proliferum</i>
Rhamnaceae	<i>Pomaderris ferruginea</i>
Rhamnaceae	<i>Pomaderris lanigera</i>
Rhamnaceae	<i>Pomaderris</i> spp.
Rubiaceae	<i>Pomax umbellata</i>
Salicaceae	<i>Populus</i> spp.
Lobeliaceae	<i>Pratia purpurascens</i>
Lamiaceae	<i>Prostanthera linearis</i>
Acanthaceae	<i>Pseuderanthemum variabile</i>
Rubiaceae	<i>Psychotria loniceroides</i>
Dennstaedtiaceae	<i>Pteridium esculentum</i>
Pteridaceae	<i>Pteris tremula</i>
Fabaceae (Faboideae)	<i>Pultenaea daphnoides</i>
Fabaceae (Faboideae)	<i>Pultenaea flexilis</i>
Fabaceae (Faboideae)	<i>Pultenaea villosa</i>
Polypodiaceae	<i>Pyrrosia rupestris</i>
Myrtaceae	<i>Rhodamnia rubescens</i>
Ripogonaceae	<i>Ripogonum fawcettianum</i>
Rosaceae	<i>Rubus moluccanus</i> var. <i>moluccanus</i>
Rosaceae	<i>Rubus moluccanus</i> var. <i>trilobus</i>
Rosaceae	<i>Rubus nebulosus</i>
Rosaceae	<i>Rubus parvifolius</i>
Orchidaceae	<i>Sarcochilus falcatus</i>
Menispermaceae	<i>Sarcopetalum harveyanum</i>
Cunoniaceae	<i>Schizomeria ovata</i>
Cyperaceae	<i>Schoenus ericetorum</i>
Cyperaceae	<i>Schoenus melanostachys</i>
Flacourtiaceae	<i>Scolopia braunii</i>
Asteraceae	<i>Sigesbeckia orientalis</i> subsp. <i>orientalis</i>
Elaeocarpaceae	<i>Sloanea australis</i>

Family	Latin Name
Smilacaceae	<i>Smilax australis</i>
Smilacaceae	<i>Smilax glyciophylla</i>
Proteaceae	<i>Stenocarpus salignus</i>
Menispermaceae	<i>Stephania japonica</i> var. <i>discolor</i>
Epacridaceae	<i>Styphelia laeta</i> subsp. <i>latifolia</i>
Myrtaceae	<i>Syncarpia glomulifera</i>
Meliaceae	<i>Synoum glandulosum</i> subsp. <i>glandulosum</i>
Myrtaceae	<i>Syzygium oleosum</i>
Myrtaceae	<i>Syzygium paniculatum</i>
Vitaceae	<i>Tetrastigma nitens</i>
Poaceae	<i>Themeda australis</i>
Acanthaceae	<i>Thunbergia alata</i>
Ulmaceae	<i>Trema tomentosa</i> var. <i>viridis</i>
Myrtaceae	<i>Tristaniopsis laurina</i>
Epacridaceae	<i>Trochocarpa laurina</i>
Typhaceae	<i>Typha orientalis</i>
Violaceae	<i>Viola hederacea</i>
Lamiaceae	<i>Westringia fruticosa</i>
Monimiaceae	<i>Wilkiea huegeliana</i>
Xanthorrhoeaceae	<i>Xanthorrhoea resinifera</i>

Exotic Plant Species List

Family	Latin Name
Polygonaceae	<i>Acetosa sagittata</i>
Asteraceae	<i>Ageratina adenophora</i>
Poaceae	<i>Aira</i> spp.
Poaceae	<i>Andropogon virginicus</i>
Araucariaceae	<i>Araucaria heterophylla</i>
Asclepiadaceae	<i>Araujia sericifera</i>
Asparagaceae	<i>Asparagus aethiopicus</i>
Poaceae	<i>Axonopus fissifolius</i>
Asteraceae	<i>Bidens pilosa</i>
Poaceae	<i>Briza minor</i>
Callitrichaceae	<i>Callitriche stagnalis</i>
Poaceae	<i>Chloris gayana</i>
Lauraceae	<i>Cinnamomum camphora</i>
Asteraceae	<i>Conyza bonariensis</i>
Asteraceae	<i>Coreopsis lanceolata</i>
Poaceae	<i>Digitaria sanguinalis</i>
Poaceae	<i>Ehrharta erecta</i>
Zingiberaceae	<i>Hedychium gardnerianum</i>

Family	Latin Name
Cyperaceae	<i>Isolepis prolifera</i>
Juncaceae	<i>Juncus articulatus</i>
Verbenaceae	<i>Lantana camara</i>
Oleaceae	<i>Ligustrum sinense</i>
Caprifoliaceae	<i>Lonicera japonica</i>
Ochnaceae	<i>Ochna serrulata</i>
Poaceae	<i>Paspalum dilatatum</i>
Poaceae	<i>Paspalum urvillei</i>
Passifloraceae	<i>Passiflora edulis</i>
Poaceae	<i>Pennisetum clandestinum</i>
Solanaceae	<i>Physalis peruviana</i>
Pinaceae	<i>Pinus radiata</i>
Plantaginaceae	<i>Plantago lanceolata</i>
Poaceae	<i>Poa annua</i>
Rosaceae	<i>Rubus fruticosus</i> sp. agg.
Araliaceae	<i>Schefflera arboricola</i>
Fabaceae (Caesalpinioideae)	<i>Senna pendula</i> var. <i>glabrata</i>
Poaceae	<i>Setaria gracilis</i>
Poaceae	<i>Setaria italica</i>
Solanaceae	<i>Solanum mauritianum</i>
Solanaceae	<i>Solanum nigrum</i>
Asteraceae	<i>Tagetes minuta</i>
Commelinaceae	<i>Tradescantia fluminensis</i>
Verbenaceae	<i>Verbena rigida</i>

APPENDIX 3: FAUNA SPECIES LIST FOR THE CATCHMENT

COMMON NAME	LATIN NAME	REMARKS	A	S	T	O
AMPHIBIANS						
Common Eastern Froglet	<i>Crinia signifera</i>					
Giant Burrowing Frog	<i>Heleioporus australiacus</i>	TSC Act				
Red-crowned Toadlet	<i>Pseudophryne australis</i>	TSC Act				
	<i>Uperoleia fusca</i>					
Green Tree Frog	<i>Litoria caerulea</i>					
Bleating Tree Frog	<i>Litoria dentata</i>					
Eastern Dwarf Tree Frog	<i>Litoria fallax</i>					
Peron's Tree Frog	<i>Litoria peroni</i>					
	<i>Litoria tyleri</i>					
	<i>Litoria verreauxii</i>					
Stuttering Frog	<i>Mixophyes balbus ?</i>	TSC Act				
Long-necked Tortoise	<i>Chelodina longicollis</i>					
REPTILES						
	<i>Lampropholis delicata</i>					
	<i>Lampropholis guichenoti</i>					
Eastern Water Skink	<i>Eulamprus quoyii</i>					
Eastern Water Dragon	<i>Intellagama lesueurii</i>					
Lace Monitor	<i>Varanus varius</i>					
Diamond Python	<i>Morelia spilota</i>					
Brown Tree Snake	<i>Boiga irregularis</i>					
Common Death Adder	<i>Acanthophis antarcticus</i>					
Dwarf Crowned Snake	<i>Cacophis krefftii</i>					
Yellow-faced Whipsnake	<i>Demansia psammophis</i>					
Black-bellied Swamp Snake	<i>Hemiaspis signata</i>					
Red-bellied Black Snake	<i>Pseudechis porphyriacus</i>					
Eastern Brown Snake	<i>Pseudonaja textilis</i>					
BIRDS						
Australian Brush Turkey	<i>Alectura lathamii</i>					
Brown Quail	<i>Coturnix ypsilophora</i>					
Australian Wood Duck	<i>Chenonetta jubata</i>					
Freckled Duck	<i>Stictonetta naevosa</i>	(TSC Act)				
Pacific Black Duck	<i>Anas superciliosa</i>					
Chestnut Teal	<i>Anas castanea</i>					
Australasian Grebe	<i>Tachybaptus novaehollandiae</i>					
Darter	<i>Anhinga melanogaster</i>					
Little Black Cormorant	<i>Phalacrocorax sulcirostris</i>					
Little Pied Cormorant	<i>Phalacrocorax melanoleucos</i>					
Straw-necked Ibis	<i>Threskiornis spinicollis</i>					
Masked Lapwing	<i>Vanellus miles</i>					
White-necked Heron	<i>Ardea pacifica</i>					
White-faced Heron	<i>Egretta novaehollandiae</i>					
Striated Heron	<i>Butorides striatus</i>					
Black Bittern	<i>Ixobrychus flavicollis</i>	(TSC Act)				
Black-shouldered Kite	<i>Elanus axillaris</i>					
Collared Sparrowhawk	<i>Accipiter cirrhocephalus</i>					
Grey Goshawk	<i>Accipiter novaehollandiae</i>					

Osprey	<i>Pandion haliaetus</i>								
White-bellied Sea Eagle	<i>Haliaetus leucogaster</i>								
Wedge-tailed Eagle	<i>Aquila audax</i>								
Australian Hobby	<i>Falco longipennis</i>								
Lewin's Rail	<i>Rallus pectoralis</i>								
Dusky Moorhen	<i>Gallinula tenebrosa</i>								
Purple Swampphen	<i>Porphyrio porphyrio</i>								
Eurasian Coot	<i>Fulica atra</i>								
Painted Button-quail	<i>Turnis varius</i>								
Spotted Turtle-dove	<i>Streptopelia chinensis</i>								
Bar-shouldered Dove	<i>Elanus axillaris</i>								
Brown Cuckoo-dove	<i>Macropygia amboinensis</i>								
Topknot Pigeon	<i>Lopholaimus antarcticus</i>								
Emerald Dove	<i>Chalcophaps indica</i>								
Wonga Pigeon	<i>Leucosarcia melanoleuca</i>								
White-headed Pigeon	<i>Columba leucomela</i>								
Crested Pigeon	<i>Ocyphaps lophytes</i>								
Glossy Black-Cockatoo	<i>Calyptorhynchus lathami</i>	(TSC Act)							
Yellow-tailed Black-cockatoo	<i>Calyptorhynchus funereus</i>								
Galah	<i>Cacatua roseicapilla</i>								
Little Corella	<i>Cacatua sanguinea</i>								
Sulphur-crested Cockatoo	<i>Cacatua galerita</i>								
Rainbow Lorikeet	<i>Trichoglossus haematodus</i>								
Musk Lorikeet	<i>Glossopsitta concinna</i>								
Australian King Parrot	<i>Alisterus scapularis</i>								
Crimson Rosella	<i>Platycercus elegans</i>								
Eastern Rosella	<i>Platycercus eximius</i>								
Fan-tailed Cuckoo	<i>Cacomantis flabelliformis</i>								
Common Koel	<i>Eudynamis scolopacea</i>								
Channel-billed Cuckoo	<i>Scythrops novaehollandiae</i>								
Barn Owl	<i>Tyto alba</i>								
Powerful Owl	<i>Ninox strenua</i>	(TSC Act)							
Southern Boobook	<i>Ninox novaeseelandiae</i>								
Sooty Owl	<i>Tyto tenebricosa</i>	(TSC Act)							
Barn Owl	<i>Tyto alba</i>								
Tawny Frogmouth	<i>Podargus strigoides</i>								
White-throated Needletail	<i>Hirundapus caudacutus</i>								
White-throated Nightjar	<i>Eurostopodus mysticalis</i>								
Azure Kingfisher	<i>Alcedo azurea</i>								
Forest Kingfisher	<i>Todiramphus macleayii</i>								
Sacred Kingfisher	<i>Todiramphus sanctus</i>								
Laughing Kookaburra	<i>Dacelo novaeguineae</i>								
Dollarbird	<i>Eurystomus orientalis</i>								
Superb Lyrebird	<i>Menura novaehollandiae</i>								
Superb Fairy Wren	<i>Malurus cyaneus</i>								
Spotted Pardalote	<i>Pardalotus punctatus</i>								
White-browed Scrubwren	<i>Sericornis frontalis</i>								
Yellow-throated Scrubwren	<i>Sericornis citreohularis</i>								
Large-billed Scrubwren	<i>Sericornis magnirostris</i>								
Brown Gerygone	<i>Gerygone mouki</i>								

Brown Thornbill	<i>Acanthiza pusilla</i>					
Yellow Thornbill	<i>Acanthiza nana</i>					
Little Wattlebird	<i>Anthochaera chrysoptera</i>					
Red Wattlebird	<i>Anthochaera carunculata</i>					
Noisy Friarbird	<i>Philemon corniculatus</i>					
Bell Miner	<i>Manorina melanophrys</i>					
Noisy Miner	<i>Manorina melanocephala</i>					
Lewins Honeyeater	<i>Meliphaga lewinii</i>					
Yellow-faced Honeyeater	<i>Lichenostomu chrysopss</i>					
White-naped Honeyeater	<i>Melithreptus lunatus</i>					
New Holland Honeyeater	<i>Philylidonyris novaehollandiae</i>					
Eastern Spinbill	<i>Acanthorhynchus tenuirostris</i>					
Eastern Yellow Robin	<i>Eopsaltria australis</i>					
Eastern Whipbird	<i>Psophodes olivaceus</i>					
Red-whiskered Bulbul	<i>Pycnonotus jocosus</i>					
Rufous Whistler	<i>Pachycephala rufiventris</i>					
Golden Whistler	<i>Pachycephala pectoralis</i>					
Grey Shrike-thrush	<i>Colluricincla harmonica</i>					
Black-faced Monarch	<i>Monarcha melanopsis</i>					
Leaden Flycatcher	<i>Myiagra rubecula</i>					
Willie Wagtail	<i>Rhipidura leucophrys</i>					
Grey Fantail	<i>Rhipidura fuliginosa</i>					
Rufous Fantail	<i>Rhipidura rufifrons</i>					
Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>					
Olive-backed Oriole	<i>Oriolus sagittatus</i>					
Figbird	<i>Sphecotheres viridis</i>					
Grey Butcherbird	<i>Cracticus torquatus</i>					
Pied Butcherbird	<i>Cracticus nigrogularis</i>					
Magpie-lark	<i>Grallina cyanoleuca</i>					
Australian Magpie	<i>Gymnorhina tibicen</i>					
Pied Currawong	<i>Strepera graculina</i>					
Australian Raven	<i>Corvus coronoides</i>					
Green Catbird	<i>Ailuroedus cressirostris</i>					
Regent Bowerbird	<i>Sericulus chrysocephalus</i>					
Satin Bowerbird	<i>Ptilonorhynchus violaceus</i>					
Red-browed Finch	<i>Neochmia temporalis</i>					
Mistletoebird	<i>Diaceum hirundinaceum</i>					
Welcome Swallow	<i>Hirundo neoxena</i>					
Silvereye	<i>Zosterops lateralis</i>					
Bassian Thrush	<i>Zoothera lunulata</i>					
Common Mynah	<i>Acridotheres tristis</i>					
MAMMALS						
Brown Antechinus	<i>Antechinus stuartii</i>					
Long-nosed Bandicoot	<i>Parameles nasuta</i>					
Eastern Pigmy Possum	<i>Cercatus nanus</i>	(TSC Act)				
#Yellow-bellied Glider	<i>Petaurus australis</i>	(TSC Act)				
Sugar Glider	<i>Petaurus breviceps</i>					
Common Ringtail Possum	<i>Pseudochairs peregrinus</i>					
Mountain Brushtail Possum	<i>Trichosurus caninus</i>					
#Long-nosed Potoroo	<i>Potorous tridactylus</i>	(TSC Act)				

#Eastern Grey-Kangaroo	<i>Macropus giganteus</i>					
Swamp Wallaby	<i>Macropus bicolor</i>					
Grey-headed Flying Fox	<i>Pteropus poliocephalus</i>	(TSC, EPBC Acts)				
Eastern Horseshoe-bat	<i>Rhinolophus megaphyllus</i>					
Eastern Free-tail Bat	<i>Mormopterus norfolkensis</i>	(TSC Act)				
A Freetail Bat	<i>Mormopterus sp. 2</i>					
White-striped Free-tail Bat	<i>Tadarida australis</i>					
Eastern Bent-wing Bat	<i>Miniopterus schreibersii oceanensis</i>	(TSC Act)				
Little Bent-wing Bat	<i>Miniopterus australis</i>	(TSC Act)				
Gould's Wattled Bat	<i>Chalinolobus gouldii</i>					
Chocolate Wattled Bat	<i>Chalinolobus morio</i>					
Southern Myotis	<i>Myotis macropus</i>	(TSC Act)				
Greater Broad-nosed Bat	<i>Scoteanax rueppellii</i>	(TSC Act)				
Eastern Broad-nosed Bat	<i>Scotorepens orion</i>					
Large Forest Bat	<i>Vespandalus darlingtoni</i>					
Little Eastern Forest Bat	<i>Vespandalus pumilus</i>					
Little Forest Bat	<i>Vespandalus vulturnis</i>					
Bush Rat	<i>Rattus fuscipes</i>					
Fox	<i>Vulpes vulpes</i>					
Cat	<i>Felis catus</i>					
Rabbit	<i>Oryctolagus cuniculus</i>					

Stratification Units

A= Alluvium

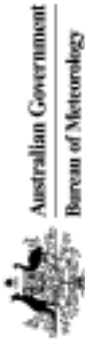
S=Narrabeen slopes

T=Narrabeen summit

O = Other eg. Dam or overhead

=Anecdotal evidence

**APPENDIX 4: WEATHER DETAILS FROM GOSFORD WEATHER STATION
(January, February & March 2013)**



Gosford, New South Wales
March 2013 Daily Weather Observations

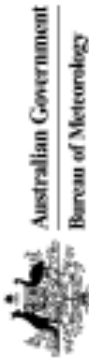
Date	Day	Temps		Rain	Evap	Sun	Max wind gust			9am			3pm		
		Min	Max	mm	mm	hours	Dir	Spd	Time	Temp	RH	Dir	Temp	RH	Dir
1	Fr	16.9	19.5	59.2				8	14:37	17.2	100	SE	18.8	99	SE
2	Sa	16.5	19.9	49.8			SE	35	23:03	17.2	100	SE	20.2	88	SE
3	Su	17.1	24.1	64.4			SE	35	14:27	19.0	100	SE	24.0	63	SE
4	Mo	14.6	25.1	6.0			SE	28	09:30	19.0	100	NNE	24.0	63	SE
5	Tu	15.8	26.2	0			ENE	28	13:18	22.2	98	ENE	26.3	63	E
6	We	16.8	26.4	0.6			E	24	15:50	20.7	100	ENE	26.4	57	ENE
7	Th	14.4	27.2	0			ENE	30	12:52	20.0	100	NE	25.7	54	E
8	Fr	14.5	26.9	0.2			NE	24	14:00	19.8	100	ENE	25.6	62	ENE
9	Sa	17.3	27.1	0.2			ENE	24	12:17	22.6	99	ENE	26.3	57	NE
10	Su	14.6	27.2	0			ENE	22	09:51	19.6	100	Cal	26.1	62	NE
11	Mo	15.9	26.7	0.6			SE	24	16:48	20.8	100	Cal	26.0	58	ENE
12	Tu	16.8	26.7	0			SE	22	14:21	20.8	100	Cal	26.6	56	ENE
13	We	13.7	27.8	0			NE	28	15:15	19.0	100	Cal	24.6	96	SE
14	Th	15.0	26.1	0			ENE	22	09:11	21.8	100	SSW	21.6	100	SE
15	Fr	19.9	22.3	0			SE	46	14:32	20.7	99	SSW	22.2	43	SE
16	Sa	16.7	28.7	1.6			NNW	20	12:04	19.4	62	SSW	20.8	54	SE
17	Su	16.3	22.7	0			S	43	14:35	16.9	69	SW	22.7	51	SE
18	Mo	11.0	22.0	4.6			SE	26	12:23	16.9	99	Cal	24.4	54	NE
19	Tu	12.6	23.4	3.2			NE	24	13:40	17.0	99	Cal	25.8	7	NE
20	We	11.8	24.8	0.2			ENE	28	14:15	17.2	100	Cal	26.0	7	ENE
21	Th	12.4	27.0	0.2			NE	39	09:25	25.5	25.5	Cal	26.0	7	ENE
22	Fr	16.6	31.1	0			N	26	11:19	23.0	23.0	Cal	26.0	7	ENE
23	Sa	18.8	30.0	0			N	20	13:24	22.6	22.6	Cal	26.4	64	ENE
24	Su	19.4	31.1	0			N	20	13:24	22.6	22.6	Cal	26.4	64	ENE
25	Mo	15.2	27.6	0			ENE	22	13:42	21.3	21.3	Cal	26.4	64	ENE
26	Tu	18.1	28.3	0			NE	22	14:40	22.5	22.5	Cal	26.8	9	ENE
27	We	15.9	29.5	0			NNE	22	14:34	20.3	20.3	Cal	28.2	9	ENE
28	Th	16.9	32.4	0			N	33	14:12	21.3	21.3	Cal	32.1	13	NNW
29	Fr	14.0	21.6	3.0			SE	28	12:38	18.9	18.9	Cal	21.1	13	SE
30	Sa	10.0	23.9	0			ENE	20	13:54	14.8	14.8	Cal	22.7	11	E
31	Su	14.2	25.1	0			NNW	24	09:09	17.3	17.3	Cal	23.6	9	SE

Station for March 2013

Mean	15.5	26.1	19.9	94	26.3	65	10
Lowest	10.0	19.5	14.8	62	18.8	43	8
Highest	19.9	32.4	25.5	100	32.1	100	19
Total							

Observations were taken from Gosford (New South Wales Research Station), AWS station 011007.
The closest station with pressure observations is at about 27 km to the northeast. The closest station with cloud and evaporation data is at Potts Ridge about 15 km to the northeast. The closest station with sunrise observations is at Sydney Airport about 59 km to the south.

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Gosford, New South Wales
February 2013 Daily Weather Observations

Date	Day	Temps		Rain	Evap	Sun	Max wind gust				Gsm				Qsm							
		Min	Max				Dirn	Spd	Time	Temp	RH	Cld	Dirn	Spd	MSLP	Temp	RH	Cld	Dirn	Spd	MSLP	Wx
1	Fr	16.7	27.0	0		100%	SSE	44	11:20	20.1	100		SSE	4		20.1	99		SE	15		
2	Sa	14.5	18.5	46.4			SSE	33	14:05	14.9	100		SSE	4		18.0	98		SE	9		
3	Su	14.8	22.8	11.0			SSE	31	15:57	17.8	98		NIE	6		21.3	63		SSE	9		
4	Mo	15.8	24.8	0			SSE	31	10:54	21.2	82		S	9		23.6	63		SE	17		
5	Tu	14.9	24.9	0			SSE	24	14:13	20.9	81		E	2		23.8	59		ENE	9		
6	We	15.2	26.1	0			SE	26	13:36	22.4	81		E	2		25.5	50		NE	9		
7	Th	13.3	27.9	0			SSE	28	15:50	21.6	82		ESE	2		26.6	53		E	13		
8	Fr	14.0	25.8	0			NNE	24	15:15	22.5	90		NNE	4		26.7	55		ENE	11		
9	Sa	15.9	26.4	0			NE	22	14:01	23.3	90		NIE	4		26.4	49		ENE	11		
10	Su	16.2	31.8	0			SSE	37	13:45	25.9			SSE	2		24.0			SE	19		
11	Mo	18.9	21.4	30.4			S	26	20:05	20.1	96		S	4		19.7	100		SE	7		
12	Tu	18.7	22.4	66.0			SE	20	10:48	19.0			NIE	2		21.3	99		SSE	6		
13	We	17.6	24.5	3.6			SSE	20	15:20							22.6	73		SE	11		
14	Th	12.8	26.6	0.2			NNE	22	16:43	17.8						25.0	51		ESE	11		
15	Fr	15.8	25.7	1.6			SSE	24	16:14	20.4						24.4	58		ESE	11		
16	Sa	13.9	25.9	1.4			E	24	11:48	21.1			SE	7		25.2	63		SE	11		
17	Su	14.4	26.0	3.8			SE	26	12:28	20.4						24.2	56		SE	11		
18	Mo	13.2	26.7	0			NNE	30	14:42	20.9						25.8	52		E	13		
19	Tu	15.5	28.1	0			NE	28	15:28	21.5						27.5	58		E	7		
20	We	17.0	27.3	0			SSE	30	14:20	23.3	96		SE	7		26.6	56		SE	13		
21	Th	17.7	26.7	1.0			SSE	31	16:12	23.7			SE	6		24.1	92		SE	13		
22	Fr	18.2	25.5	21.8			E	43	20:08				S	7		20.7			ESE	13		
23	Sa	18.5	23.3	42.0			SSE	30	15:30				SE	13		22.2			SE	17		
24	Su	20.8	25.3	64.8			E	30	15:30				NNW	6		26.9			NE	15		
25	Mo	19.7	25.1	0			ENE	24	15:08	24.5			N	7		27.9	83		NE	13		
26	Tu	18.9	26.8	0			NE	30	15:30	22.9			NNW	7		25.7	88		ENE	11		
27	We	17.6	26.7	0			NE	24	13:51	21.8			N	6		26.1	58		ENE	11		
28	Th	17.4	28.0	0			SSE	37	15:34							26.7			Calm			
Statistics for February 2013																						
Mean		16.6	26.2							21.3	86			3		24.5	68				11	
Lowest		12.8	18.5							14.9	96			Calm		18.0	49				Calm	
Highest		20.8	31.8	64.8			SSE	50		25.9	100		SE	13		26.7	100		SE	19		
Total				257.0																		

Observations were drawn from Gosford (Marine Research Station) AWS station (01002)
The closest station with pressure observations is at North Head about 27 km to the northwest. The closest station with cloud and evaporation data is at Port Stephens about 15 km to the northwest. The closest station with sunrise observations is at Sydney Airport about 59 km to the south.
ECI:EW000201302 Prepared at 16:00 UTC on 2 Apr 2013
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Gosford, New South Wales January 2013 Daily Weather Observations

Date	Day	Temps		Rain	Evap	Sun	Max wind gust				9am				3pm						
		Min °C	Max °C				Dirn	Spd hr/h	Time local	Temp °C	RH %	Cld alpha	Dirn	Spd hr/h	MSLP hPa	Temp °C	RH %	Cld alpha	Dirn	Spd hr/h	MSLP hPa
1	Tu	17.2	30.4	0			SE	22	00:36	25.2			ESE	6	26.5			ENE	9		
2	We	17.8	24.1	0			SSE	36	01:36	22.4			SE	13	21.6			ESE	13		
3	Th	17.8	25.4	0			S	24	12:07	20.8			ESE	7	24.5			ENE	9		
4	Fr	13.8	27.3	0			NE	28	16:29	22.8			NNW	11	26.4			ENE	11		
5	Sa	14.6	31.2	0			NE	26	14:31	23.6			N	7	26.7			ENE	9		
6	Su	16.2	28.8	0			NE	28	15:32	24.8			NNE	9	27.7			ENE	9		
7	Mo	18.6	41.5	0			ESE	24	13:42	23.5			SE	7	27.6			SE	7		
8	Tu	15.8	41.5	0			NNW	43	10:31	21.4			SE	15	21.0	60	13	NW	17		
9	We	21.3	22.3	0.4			SSE	37	05:22	21.4	88		SE	4	23.4	62		SSE	13		
10	Th	18.0	25.5	0			NE	26	14:36	22.3	70		ESE	4	23.4	62		E	11		
11	Fr	16.9	31.9	0			NNE	26	15:14	24.8	68		NNE	7	31.0	53		ENE	11		
12	Sa	17.9	42.3	0			NNW	35	12:49	30.6	56		SE	4	32.0	46		SE	11		
13	Su	18.6	24.4	0			SSE	35	22:37	22.3			SE	7	22.5			SE	9		
14	Mo	16.5	21.9	15.4			SSE	44	09:36	18.5	96		SE	13	21.4	49		SE	20		
15	Tu	15.1	25.1	0			E	28	16:54	20.3	70		SSE	4	24.4	48		ENE	13		
16	We	13.4	30.0	0			SE	24	11:17	23.4	80		SE	4	28.7	50		E	11		
17	Th	16.7	30.2	0			N	31	16:41	24.2			SSE	6	28.7	67		ENE	11		
18	Fr	16.7	44.8	0			N	40	10:14	29.3	70		SSE	2	43.9	15		NW	11		
19	Sa	21.3	24.2	0.4			SW	33	23:45	21.9	83		SE	7	21.2	79		SE	11		
20	Su	17.8	23.8	7.2			NNW	22	20:57				SE	7	21.6	98		SE	7		
21	Mo	18.8	26.7	2.6			NE	22	18:10	20.6			NNE	4	26.7	62		E	9		
22	Tu	16.5	32.4	0			SE	26	11:45	25.0	96		ENE	7	28.6	64		ENE	7		
23	We	19.3	23.2	0.6			SSE	33	15:36	21.2			SSE	7	22.2			SE	11		
24	Th	19.4	27.7	0			SE	26	13:24	21.6	98		SSE	7	26.4	69		SSE	13		
25	Fr	19.2	31.1	0			NE	31	18:32	24.9			N	6	29.5	59		NE	13		
26	Sa	21.2	30.6	0			NE	48	13:42	26.3	90		NE	9	27.5	78		ENE	13		
27	Su	20.3	22.3	31.8			N	19	23:10				Calm					Calm			
28	Mo	20.4	22.6	51.2			NE	43	21:26				Calm					ENE	11		
29	Tu	19.9	26.1	197.2			SE	39	12:17	22.4			N	4	21.1			SE	13		
30	We	16.7	26.8	5.2			SE	19	15:06	20.9			SE	6	24.5	68		SSE	9		
31	Th	18.1	29.2	0			ENE	35	13:15	24.4			NNE	4	27.7	73		NE	11		
Statistics for January 2013																					
Mean		18.0	26.5							23.4	80			6		26.9	58			10	
Lowest		13.4	21.9							18.5	56			Calm		21.0	13			Calm	
Highest		21.3	44.8	197.2			NE	48		30.6	98		SE	15		43.9	98		SE	20	
Total				312.0																	

Observations were collected from Gosford (Marine Research Station) (2013) (Station 011001).
The closest station with pressure observations is at Narara Head about 27 km to the northeast. The closest station with cloud and evaporation data is at Port Stephens about 15 km to the northwest. The closest station with satellite observations is at Sydney Airport about 150 km to the south.
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APPENDIX 5: HAIR TUBE ANALYSIS FROM DR. B. TRIGGS

Narara Ecovillage Hair tube survey 26/3/2013

No.	Mammal ID - definite	Mammal ID - probable
1	no hairs	
2	no hairs	
3	two fine hairs	rodent
4	no hairs	
5	no hairs	
6	no hairs	
7	one rodent hair	Mus musculus
8	Wallabia bicolor	
9	Rattus fuscipes	
10	no hairs	
11	no hairs	
12	one rodent hair	Rattus sp.
13	one fine hair	rodent
14	no hairs	
15	one rodent hair	M. musculus
16	few fine hairs	rodent
17	few fine hairs	rodent
18	few fine hairs	rodent
19	no hairs	
20	no hairs	
21	R. fuscipes	
22	no hairs	
23	no hairs	
24	few fine hairs	rodent
25	R. fuscipes	
26	no hairs	
27	one rodent hair	Rattus sp.
28	no hairs	
29	Rattus sp.	R. fuscipes
30	no hairs	
31	no hairs	
32	R. fuscipes	
33	no hairs	
34	no hairs	
35	no hairs	
36	no hairs	
37	R. fuscipes	
38	R. fuscipes	
39	no hairs	
40	one rodent hair	Rattus sp.

Skull ID: Wallabia bicolor

APPENDIX 6: SEVEN PART TESTS OF SIGNIFICANCE

Not all seven part tests of significance for individual species have been shown because they have previously been shown in Andrews-Neil (2006a; b). Those species included are additional species found during this survey and some species which have been re-addressed due to changes in circumstances.

The Dam

The Freckled Duck *Stictonetta naevosa*

The Freckled Duck is listed on schedule 2 of the *TSC Act, 1995* and is a dark grey-brown heavy bodied duck with a long neck and a distinctive bill. The head is large and crested and the whole body is speckled and vermiculated. In the breeding season the species will occur in terrestrial wetlands and feeds by filtering and dabbling in shallow productive waters and soft mud at wetland edges. Also found in fresh densely vegetated waters or those creeks and swamps with dense vegetation. The species, in the dry season, will move to large permanent open waters such as lakes and reservoirs where no vegetative cover exists, where they feed along the muddy margins. It is a very wide dispersive species moving from south west Queensland, western New South Wales, northern South Australia and south western Western Australia.

The Freckled Duck is a specialist filter feeder of seeds and aquatic plants.

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

Two birds were seen on the large railway dam near some tall sedgeland during the flora survey and are likely to be only transient individuals. The dam will not constitute part of the constructed accommodation development and therefore there is unlikely to be any adverse impact on this species such that a viable population is likely to be placed at the risk of extinction.

(b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the lifecycle 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.

This question is not applicable.

(c) In the case of an endangered ecological community, whether the action proposed:

- 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
- 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

This question is not applicable.

(d) In relation to the habitat of a threatened species, population or ecological community:

- **the extent to which habitat is likely to be removed or modified as a result of the action proposed, and**
- **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**
- **the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.**

The proposal will incur no physical loss or change of the dam habitat as a result of the action and therefore is unlikely to be any fragmentation of that habitat.

The dam has become a refuge for ducks and waterbirds and if threatened species come to utilize the area its importance will increase. The dam will not become fragmented or isolated as a result of the works.

The dam would be very important to this species in drought times because it is the only large freshwater body in the area. However, as no such works will involve the dam the long term survival of the Freckled Duck will not be affected.

(f) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

There has been no critical habitat declared for the Freckled Duck.

(g) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan.

There are ten priority action statements prepared for the Freckled Duck and none of these will be contravened. One PAS is being implemented which is to control feral animals on the site.

(h) Whether the action proposed constitutes or is part of a 'Key Threatening Process' or is likely to result in the operation of, or increase the impact of a key threatening process.

The proposal will not incur removal any physical change to the dam and as a result no currently listed 'Key Threatening Processes' will result.

The Large-footed Myotis, *Myotis macropus*
(prepared by R. Williams Ecotone Environmental Consultants)

The Large-footed Myotis is listed on Schedule 2 of the *TSC Act, 1995* and is known to occur in a wide coastal band from northern Western Australia, Northern Territory, Queensland, New South Wales, Victoria, and into far south-eastern South Australia. The distribution of this species extends inland from coastal South Australia, along the Murray River (Churchill 2008). The species is considered to be common over its limited national range (Richards *et al.* 2008).

The Large-footed Myotis has a strong affinity to open water, including farm dams, where it flies low over the water, feeding on flying insects as well insect larvae and small fish, raked from the water surface (Robson 1984). Within the locality, there are many large water bodies (Myall River and its tributaries, wetlands, farm dams and pools within ephemeral creek lines) and these provide ideal foraging habitat for this species. Long movements between the roost site and foraging area have been recorded. In Victoria, Caddle and Lumsden (1999) found that the large-footed myotis travelled up to 20 km from the roost site to a feeding site despite both locations being over water. In southern Queensland, Barclay *et al.* (2000) found that individual myotis travelled up to 10 km from the roost site in a disused railway tunnel to the foraging area over a man made lake and that two journeys were often made in one night. Roost sites are often over or near water within caves and man made structures, such as tunnels, buildings, culverts and bridges, as well as tree hollows (Churchill 2008). The use of man made structures gives the potential for a high incidence of disturbance, particularly where maternity roosts are involved.

Colonies usually number between 10 and 30 individuals, but up to several hundred individuals have been reported in a single roost (Richards *et al.* 2008). Small breeding clusters form within colonies, consisting of a male and a harem of females. This territory is defended from other males by the dominant male (Dwyer, 1970), however, banding studies have shown that both individual male and female members of the colony frequently change indicating that more than one roost is used by the local population at any one time (Ecotone 2001). In NSW, births occur between October and February and from limited information, it appears that each female may produce only a single young per year. Births within the colony appear to be staggered through the breeding season, with peaks in late October and early February. It is possible that young from the previous year give birth later in the breeding season (Ray Williams, *Ecotone Ecological Consultants*, pers. obs.). When not breeding, dominant males roost alone, defending their territory, whereas, surplus males may form predominantly all male groups of up to 50 individuals. Lactation lasts some eight weeks and after weaning the young forms a strong bond with its mother for at least four weeks, when it is probably taught how to catch food (Richards *et al.* 2008). In the cool southern latitudes, individuals may enter extended torpor to survive adverse winter weather conditions, however, in warmer coastal areas this species is active on most nights throughout the year, although they appear to return to the roost earlier in the night during winter.

The Large-footed Myotis can be relatively common where suitable habitat and roost sites occur and it was found foraging over the dam.

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

The Large-footed Myotis was detected feeding over the large dam and may roost in tree hollows nearby. The dam does not constitute part of the physical constructed development and therefore the proposal is unlikely to cause any adverse impact on this species such that a viable population is likely to be placed at the risk of extinction.

(b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the lifecycle 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.

This question is not applicable.

(c) In the case of an endangered ecological community, whether the action proposed:

- 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
- 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

This question is not applicable.

(d) In relation to the habitat of a threatened species, population or ecological community:

- the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
- 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
- the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

The proposal will incur no loss or physical change of the dam or tree hollow as a result of the action and therefore there will be no modification or removal of that habitat.

The railway dam is a favoured foraging habitat for this species but the habitat will not be fragmented or isolated as a result of this proposal. No tree hollows will be removed. However, as no such works will involve the dam the long term survival of the Large-footed Myotis will not be affected.

(f) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

There has been no critical habitat declared for the Large-footed Myotis.

(g) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan.

The proposal does not violate any of the priority action statements set down for the species. However, according to the PAS's all trees with hollows should be protected and artificial roost boxes should be established if infrastructure allows.

(h) Whether the action proposed constitutes or is part of a 'Key Threatening Process' or is likely to result in the operation of, or increase the impact of a key threatening process.

The proposal will not incur removal or any change to the dam or tree hollows and as a result no currently listed 'Key Threatening Processes' will impact on this species.

The Eastern Free-tail Bat, *Mormopterus norfolkensis*
(prepared by R. Williams Ecotone Environmental Consultants)

This bat has been recorded from the coast and adjacent ranges of south-eastern New South Wales, north from Pambula, to south-eastern Queensland. Although the habitat preferences are unclear, most records of this species have been reported from dry eucalypt forest and woodland on the eastern side of the Great Dividing Range. Individuals have, however, been recorded flying low over a rocky river in rainforest and wet sclerophyll forest and foraging in clearings at forest edges (Hoye *et al.* 2008). The species has also been recorded foraging over open paddocks and wetlands in the Hunter River catchment and north coast of NSW (Ray Williams, Ecotone pers. obs.) and a study of habitat use on a landscape scale found higher activity levels in cleared and semi-cleared landscapes than within forested and urban landscapes (McConville 2010).

It is a predominantly tree-dwelling species (roosting in hollows or behind loose bark in mature eucalypts), but one individual has been recorded roosting in the roof of a hut, together with a number of Gould's wattled bats and an eastern broad-nosed bat (Hoye *et al.* 2008). This species has also recently been found roosting and breeding in hollow mangrove trees (Anna McConville pers. comm.). Females give birth in late November to early December and flying young enter the population in January (Hoye *et al.* 2008). The diet is thought to consist of small insects including leafhoppers, chafers, weevils and other beetles.

The main threat to this species is believed to be the loss of tree hollows which are used as roost sites through clearing or apiary (honey bees taking over suitable hollows). Habitat modification through inappropriate burning regimes and grazing, and clearing for agriculture or urban development may reduce foraging habitat and insect prey availability. However, given the apparent preference for more open environments some habitat modification may be an advantage to this species.

Although few records occur for the study locality, the Eastern Free-tail Bat appears to be widespread across the coastal plains of the north coast of NSW.

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

This bat species was detected on the large dam and on the ridge near during the fauna surveys. The dam and the ridge does not constitute part of the physical constructed development and therefore there is unlikely to be any adverse impact on this species such that a viable population is likely to be placed at the risk of extinction.

(b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the lifecycle 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.

This question is not applicable.

(c) In the case of an endangered ecological community, whether the action proposed:

- **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**

- **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**

This question is not applicable.

(d) In relation to the habitat of a threatened species, population or ecological community:

- **the extent to which habitat is likely to be removed or modified as a result of the action proposed, and**
- **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**
- **the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.**

The proposal will incur no loss or physical change of the dam and ridge habitat as a result of the action and therefore there is unlikely to be any fragmentation or removal of that habitat. No areas will become isolated or fragmented which will impact the foraging activities of this species.

The dam and the forest edge is a feeding habitat for this species. However, as no such works will involve the dam and the ridge the long term survival of the Eastern Free-tail Bat will not be affected.

(f) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

There has been no critical habitat declared for the Eastern Free-tail Bat.

(g) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan.

The proposal does not violate any of the 18 priority action statements set down for the species. However, according to the PAS's, all trees with hollows will be protected in the DCP 175 land and the lowland area (see Figure 14).

(h) Whether the action proposed constitutes or is part of a 'Key Threatening Process' or is likely to result in the operation of, or increase the impact of a key threatening process.

The proposal will not incur removal any change to the dam or the ridge and as a result no currently listed 'Key Threatening Processes' will result.

The Eastern Bent-wing-bat, *Miniopterus schreibersii oceanensis*

(prepared by R. Williams Ecotone Environmental Consultants)

This species is widely distributed from the coast and ranges of eastern Australia, extending from Cape York Peninsula, through eastern Queensland, New South Wales and Victoria. Other subspecies occur in a) western Victoria and south-eastern South Australia and b) north Western Australia and the Northern Territory. In New South Wales, it is found from the coast to the western slopes of the Great Dividing Range. This species is widespread and can be locally common where suitable caves or tunnels are available as roost sites. However, the major threat to this species is the loss of roost sites, particularly nursery caves. Their dependence upon relatively few nursery caves suggests that threats to the existence or structural integrity of these may place regional populations in jeopardy. Frequent disturbance of roosts used for winter hibernation or periods of torpor is known to significantly increase winter mortality (Hoye and Hall, 2008a). Toxic accumulation of agricultural chemicals in body fat used during winter torpor may also reduce populations. Habitat loss through clearing for development or agriculture and subsequent reductions in insect prey availability may also adversely affect this species. The eastern bent-wing bat is reportedly preyed upon by feral cats and occasionally foxes (Churchill 2008).

Eastern Bent-wing bats are known to forage within a variety of habitat types adjoining roost sites. Dwyer (1995) regarded typical habitat as well-timbered valleys, however this species is often recorded utilising bushland remnants as well as developed land in urban areas where it often forages around street lights (Ray Williams, Ecotone pers. obs.). Eastern bent-wing bats are known to feed mainly on moths as well as cockroaches, beetles and flies and forages above the tree canopy (Churchill 2008). This is a mobile species and is estimated to forage within a 20 km radius of the roost site with a known distance of 65km recorded in a single night (Churchill 2008).

The limiting factor for this species is availability of roost sites. Suitable caves, mines, tunnels, road culverts and buildings are essential. Maternity roosts are particularly important and are known from limestone and sandstone caves, disused gold mines, concrete bunkers and lava tubes (Hoye and Hall 2008a). Long migrations between roost sites, according to seasonal needs or reproductive status, have been recorded (Hoye and Hall 2008a). Recorded nursery caves are few in number and widespread, which leaves this species vulnerable should any of these areas be destroyed. Within nursery caves, large populations of females, numbering up to 100,000 individuals gather prior to the birth of their young in December (Churchill 2008). In New South Wales mating occurs in late May and early June, just prior to winter. Delayed implantation occurs and development of the young does not commence until late August. A single young is born in December and juveniles are independent between February and March when nursery colonies disband and individuals disperse over long distances. They are sexually mature in their second year and may live to over 17 years of age (Hoye and Hall 2008a).

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

This bat species was detected foraging over the large dam and on the ridge. The dam and the ridge does not constitute part of the constructed development and therefore there is unlikely to be any adverse impact on this species such that a viable population is likely to be placed at the risk of extinction.

(b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the lifecycle 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.

This question is not applicable.

(c) In the case of an endangered ecological community, whether the action proposed:

- **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**
- **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**

This question is not applicable.

(d) In relation to the habitat of a threatened species, population or ecological community:

- **the extent to which habitat is likely to be removed or modified as a result of the action proposed, and**
- **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**
- **the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.**

The proposal will incur no loss or physical change of the dam or ridge habitat as a result of the action and therefore there is unlikely to be any fragmentation or modification of that habitat. These two habitats will not be fragmented or isolated as a result of the proposal.

The dam and the forest edge on the ridge is a feeding habitat for this species. However, as no such works will involve the dam and the ridge the long term survival of the Eastern Bent-wing Bat will not be affected.

(f) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

There has been no critical habitat declared for the Eastern Bent-wing Bat.

(g) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan.

The proposal does not violate any of the 18 priority action statements set down for the species. However, according this species could be found roosting in any of the old buildings.

(h) Whether the action proposed constitutes or is part of a 'Key Threatening Process' or is likely to result in the operation of, or increase the impact of a key threatening process.

The proposal will not incur the removal or any change to the dam or the ridge and as a result no currently listed 'Key Threatening Processes' will result.

The Little Bent-wing-bat, *Miniopterus australis*
(prepared by R. Williams Ecotone Environmental Consultants)

The national distribution of this species occurs along the coast and ranges of eastern Australia from Cape York to near Wollongong in New South Wales. Populations in the south of the range are predominantly limited to coastal areas. The Little Bent-wing Bat roosts in caves, stormwater drains and tunnels, with populations sometimes numbering into the thousands. Roosts are often shared with the larger Eastern Bent-wing Bat (Hoye & Hall 2008b). This species has also been observed roosting in the base of a hollowed out tree and within dense foliage (Schulz 1997), thereby increasing the significance of large mature trees in forest situations. This species has been reported to feed on small insects beneath the canopy in well timbered forest, but has also been reported utilising coastal swamps and rainforest. A nightly foraging range of 20 km from roost sites has been reported.

The ecology of this species is very similar to the Eastern Bent-wing Bat except that it is a more tropical species with the southerly range generally limited to the central coast of New South Wales, possibly because of the need for access to hot breeding caves. It is interesting to note that the southerly extent of the distribution was given as Kempsey in 1968 (Dwyer 1968) and that the range of the species has now extended to near Wollongong by 2009 (Martin Schulz pers. comm.). Whether this range expansion is a recent occurrence or the result of limited bat surveys is unclear however the southerly range of the species by 2000 was estimated to be just north of the Hawkesbury River (Williams and Hoye 2000). Over the last few years this species has been recorded at locations in the northern beaches of Sydney (Ray Williams, Ecotone pers. obs.).

Males are sexually active over winter with mating taking place in July and August. There is no delayed implantation, and births occur in December. Only a few maternity caves are known for this species and most are shared with the Eastern Bent-wing Bat. The life span of this species probably exceeds five years and green tree frogs, pythons, owls and foxes are known predators. The major threat arises from the disturbance of roost sites, particularly nursery caves.

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

This bat species was detected on the large dam. The dam does not constitute part of the physical constructed development and therefore there is unlikely to be any adverse impact on this species such that a viable population is likely to be placed at the risk of extinction.

(b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the lifecycle 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.

This question is not applicable.

(c) In the case of an endangered ecological community, whether the action proposed:

- **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**

- **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**

This question is not applicable.

(d) In relation to the habitat of a threatened species, population or ecological community:

- **the extent to which habitat is likely to be removed or modified as a result of the action proposed, and**
- **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**
- **the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.**

The proposal will incur no loss or change of the dam habitat as a result of the action and therefore there is unlikely to be any fragmentation or modification of that habitat.

The dam is a feeding habitat for this species. However, as no such works will involve the dam and thus the long term survival of the Eastern Bent-wing Bat will not be affected.

(f) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

There has been no critical habitat declared for the Little Bent-wing Bat.

(g) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan.

The proposal does not violate any of the 28 priority action statements set down for the species.

(h) Whether the action proposed constitutes or is part of a 'Key Threatening Process' or is likely to result in the operation of, or increase the impact of a key threatening process.

The proposal will not incur removal any change to the dam and as a result no currently listed 'Key Threatening Processes' will result.

Gully Rainforests and lower moist slopes

The Long-nosed Potoroo *Potorous tridactylus*

A Seven Part Test has already been prepared for the Long-nosed Potoroo (Andrews-Neil 2009b), but the impact is entirely based on minimal habitat destruction. For that reason and the fact that the European Fox and a Feral Cat occur at the site and the fact that domestic dogs and cats would pose a threat to this species and given that there maybe evidence to support the Potoroo's presence, the seven part test is being rewritten.

The Long-nosed Potoroo is listed as vulnerable on Schedule 2 of the *TSC Act, 1995* and as vulnerable on the *EPBC Act, 1997*.

It is nocturnal emerging from its nest an sunset and returning at dawn. Populations remain fairly constant with equal sex ratios with a density of 0.06 animals/ hectare. Animals have home ranges between 2-34 hectares but may only move 900m in a single night. Male offspring will disperse but females remain close to their site of birth.

Perhaps the most significant feature of thise species is that it is mycophageous and hypogeous (is they dig for fungi beneath the ground). Fungal matter (over 50 species) is the primary diet whilst other foods include grasses, sedges and *Lomandra spp.* in drier times. Some classes of insects are also eaten. Fungal spores pass through the gut of the Potoroo intact but are not known at this stage whether this enhances spore germination. Their habitat includes ridge top sclerophyll forests, moist sclerophyll forests, gully rainforests with the latter being preferred (Claridge et. al., 2007).

This Seven Part Test of Significance will only apply if the there is a commitment to eradicate the European Fox and Feral Cat and if community title is considered so that domestic dogs and cats do not become part of the development.

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

Diggings have been found in the gully rainforests which maybe from the Long-nosed Potoroo. The gully rainforests do not constitute part of the constructed development and will be protected by their EEC classification and therefore there is unlikely to be any adverse impact on this species such that a viable population is likely to be placed at the risk of extinction. However, this answer is primarily based on the fact that the European Fox and Feral Cat will be eliminated and no domestic dogs and cats will be allowed. If this management issue cannot be achieved then a further specialist survey using hidden cameras must be undertaken to validate if the Long-nosed Potoroo is present.

(b)In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the lifecycle 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.

This question is not applicable.

(c) In the case of an endangered ecological community, whether the action proposed:

- 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
- 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

This question is not applicable.

(d) In relation to the habitat of a threatened species, population or ecological community:

- the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
- 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
- the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

The proposal will incur no loss or change of the gully rainforest or moist lower slope forest habitat as a result of the action and there is unlikely to be any fragmentation of that habitat.

The gully rainforest may have become a refuge for the Potoroo based on the type of diggings. If this threatened species can be substantiated to utilize this habitat area its importance will increase. However, as no such works will involve the gully rainforests and moist lower slopes the long term survival of the any Long-nosed Potoroo will remain positive. Therefore, there will be no isolation and fragmentation of the gully rainforest areas.

Nevertheless, dogs and cats must be dealt with as must the European Fox and wild dogs. Recommendations are in place for eradication of the European Fox and wilddogs. Recommendations will be put in place so that no domestic dogs and cats will be allowed.

It should be noted that if the Long-nosed Potoroo is present the Palm Gully Rainforest become very important habitat for this species.

(f) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

There has been no critical habitat declared for the Long-nosed Potoroo.

(g) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan.

The action proposed will not contravene the 19 recovery actions and in particular threat abatement control of feral animals will be implemented. A domestic dog and cat control policy will be implemented.

(h) Whether the action proposed constitutes or is part of a 'Key Threatening Process' or is likely to result in the operation of, or increase the impact of a key threatening process.

The proposal will not incur removal or any change to the gully rainforests. However, if the Long-nosed Potoroo is found to be present the Lantana, European Fox and Feral Cat will need to be eradicated and it will need to be shown how the development will address the prevention of domestic cats and dogs (eg by community title).

Wompoo Fruit-dove *Ptilinopus magnificus*, the Rose-crowned Fruit-dove *Ptilinopus regina* and the Superb Fruit-dove *Ptilinopus superbus*.

The Wompoo Fruit-dove, the Rose-crowned Fruit-dove and the Superb Fruit-dove are listed as vulnerable on the *TSC Act, 1995*.

The Wompoo Fruit-dove is the largest of Australia's Fruit-dove's, whilst the Rose-crowned Fruit-dove is a much smaller bird with a shorter tail. Historically, the former species was found in the Illawarra district south of Sydney to the tip of Cape York Peninsula, but these populations south of Sydney have now disappeared. The species is currently only found between the Queensland border and the Hunter River, but breeding pairs are only confined from the Queensland border and south to Coffs Harbour and the Dorrigo Plateau. Core breeding areas are restricted only to high elevation sites around Mount Warning and the focal Peak volcanoes and the Washpool-Chaelundi areas. The areas that have been identified as breeding habitat are Washpool, New England-Dorrigo, Mount Warning and Nightcap National Parks.

The Wompoo Fruit-dove is found in remnant sub-tropical rainforest and adjoining wet sclerophyll habitats and occasionally in isolated trees amongst farmland. The Wompoo Fruit-dove makes an important contribution to seed dispersal in rainforests. This is because of their relatively large gape which enables it to feed on rainforest fruit which is otherwise too large for other rainforest pigeons and flying foxes.

The Wompoo Fruit-dove is partially territorial as it moves around within a small area in response to food availability and nesting requirements. However, it does have a seasonal altitudinal migration inhabiting upland forests during summer and moving to low elevations in winter. It is estimated that its home range is approximately 20Ha.

Due to the limited occurrence of its food resources in the southern part of its range it has become locally extinct.

The Rose-crowned Fruit-dove has a core range in the North Coast of New South Wales and the eastern escarpment of the New England Tablelands and sometimes south to Port Stephens. Breeding has only been recorded as far south as the lower Clarence Valley, but vagrants are sometimes recorded much further south on the Central Coast and in Sydney. The species is currently widespread and moderately common to common in the Richmond Valley, but comparable data from other regions is not available.

As for the Wompoo Fruit-dove, the Rose-crowned Fruit-dove inhabits rainforest and nearby sclerophyll forests and coastal scrub which supports abundant trees with fleshy fruits. It is also found in remnant patches and regrowth forests and furthermore within pockets of Camphor Laurel and Privet regrowth. Its habitat requirements are wider than the Wompoo Fruit-dove and it occurs in moist forest and woodland with abundant fruiting trees as well as ornamental parks and gardens.

The Rose-crowned Fruit-dove will feed on fleshy fruits of rainforest trees, palms and vines, especially native figs and introduced weed trees that as Camphor Laurel, Inkweed, Wild Tobacco Bush and Lantana.

The Wompoo Fruit-dove similarly inhabits rainforest but it forages high in the canopy where it will feed on figs and palms. It is known to be partly nomadic.

The Superb Fruit-dove between North Queensland and Moruya in New South Wales. It inhabits rainforests, mangroves, riparian habitats and isolated food trees. As for tall the fruit-doves it is arboreal and feeds almost exclusively on rainforest fruit. For nesting it build a flimsy nest 5-30m above the ground.

On the subject site feeding habitat exists only for all species along Narara Creek, the gully rainforests and the lower moist slopes where there is an abundance of *Acmena smithii*, Lilly Pilly which produces fleshy fruits in late spring and summer. These trees would be a food source for these vagrant birds (*NSW Scientific Committee*, 2008; 2010).

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

Neither of the fruit-doves was recorded on the lower slopes or gullies where no development will take place. As these rainforest habitats will not constitute part of the constructed development there is unlikely to be any adverse impact on this species such that a viable population is likely to be placed at the risk of extinction.

(b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the lifecycle 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.

This question is not applicable.

(c) In the case of an endangered ecological community, whether the action proposed:

- 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
- 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

This question is not applicable.

(d) In relation to the habitat of a threatened species, population or ecological community:

- the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
- 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
- the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

The proposal will incur no loss or change of the gully rainforest or moist lower slope forest habitat as a result of the action and there is unlikely to be any fragmentation or removal of that habitat.

The gully or moist lower slope habitats will not become fragmented or isolated as a result of the development.

However, the lower slope and gully could become important to the fruit-doves if they are found feeding at that location.

(f) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

There has been no critical habitat declared for the three fruit-doves.

(g) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan.

There are 19 priority actions and this development does not contravene any of these. In particular, the rainforests will be restored and their known feed trees will be embellished.

(h) Whether the action proposed constitutes or is part of a 'Key Threatening Process' or is likely to result in the operation of, or increase the impact of a key threatening process.

The proposal will not incur removal or any change to the gully rainforests or lower slope moist forests and therefore none of the key threatening processes, except for the Bell Miner which is already present and now listed as a key threatening process. This KTP has the potential of reducing foliage in trees by harvesting insects and if the process is applicable to rainforest species it may impact on feeding resources for the three fruit-doves.

The Stuttering Frog *Mixophyes balbus*

The Stuttering Frog *Mixophyes balbus* is listed as an endangered species under Schedule 1 of the NSW TSC Act. It is also listed as a vulnerable Species under the Commonwealth EPBC Act.

The Stuttering Frog is a large frog that inhabits running streams and belongs to the ground frog family Myobatrachidae. They have been recorded from north eastern NSW to north east Victoria in eastern flowing streams along the Great Dividing Range (Hunter & Gillespie, 2006).

Being rainforest-dwelling frogs that are highly camouflaged in the wet ground forest leaf-litter and are almost exclusively occupy the banks of these streams although do forage in nearby riparian zone vegetation. The species breeds in summer after heavy rains, during which males can be detected by their call and at night using headlamps with a pronounced soft pink reflective eyeshine.

Previously the species has been detected in the Gosford Local Government Area (LGA) to the north along Stoney Creek within Strickland State Forest and further north again within Ourimbah State Forest and adjoining lands as well as the Watagan Range (Wellington and Wells, 1995) and near Mardi Dam at Tuggerah.

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

The Stuttering Frog is likely to be found in the gully rainforests and along the margins of the dam. The gully rainforests do not constitute part of the physical constructed development and therefore there is unlikely to be any adverse impact on this species such that a viable population is likely to be placed at the risk of extinction. However, this answer is primarily based on the fact that the European Fox and Feral Cat will be eliminated and no domestic dogs and cats will be allowed.

(b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the lifecycle 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.

This question is not applicable.

(c) In the case of an endangered ecological community, whether the action proposed:

- **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**
- **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**

This question is not applicable.

(d) In relation to the habitat of a threatened species, population or ecological community:

- **the extent to which habitat is likely to be removed or modified as a result of the action proposed, and**
- **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**
- **the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.**

The proposal will incur no loss or physical change of the gully rainforest or moist lower slope forest habitat as a result of the action and there is unlikely to be any fragmentation of that habitat.

The gully rainforests are regarded as refuges with specialist species. If this threatened species can be substantiated to utilize this habitat area its importance will increase. However, as no such works will involve the gully rainforests and moist lower slopes the long term survival of the any Stuttering Frog will remain positive.

(f) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

There has been no critical habitat declared for the Stuttering Frog.

(g) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan.

There is a recovery and threat abatement plan prepared for the Stuttering Frog at the commonwealth level. The document will require the landholder to undertake more work to substantiate the presence of the species and if present target and eradicate the relevant key threatening processes. The NSW OEH has also formulated a series of Priority Actions in its Priority Action Statement for the species. These largely mirror the Recovery Plan actions for the species.

(h) Whether the action proposed constitutes or is part of a 'Key Threatening Process' or is likely to result in the operation of, or increase the impact of a key threatening process.

The proposal will not incur removal or any change to the gully rainforests. However, if the Stuttering Frog is found to be present the Lantana, European Fox and Feral Cat will need to be eradicated and it will need to be shown how the development will address the prevention of domestic cats and dogs (eg by community title).

The Giant Barred River Frog *Mixophyes iteratus*

The Giant Barred Frog *Mixophyes iteratus* is listed as an endangered species under Schedule 1 of the *NSW TSC Act*. It is also listed as an endangered species under the Commonwealth *EPBC Act*.

The Giant Barred Frog is a large frog that inhabits running streams and belongs to the ground frog family Myobatrachidae. They have been recorded from north eastern NSW to somewhere near Narooma in eastern flowing streams along the Great Dividing Range.

Being rainforest-dwelling frogs that are highly camouflaged in the wet ground forest leaf-litter and are almost exclusively occupy the banks of these streams although do forage in nearby riparian zone vegetation. The species breeds in summer after heavy rains, during which males can be detected by their call and at night using headlamps.

Previously the species has been detected in the Gosford Local Government Area (LGA) to the north along Stoney Creek within Strickland State Forest.

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

The Giant Barred Frog is likely to be found in the gully rainforests and along the margins of the dam. The gully rainforests do not constitute part of the physical constructed development and therefore there is unlikely to be any adverse impact on this species such that a viable population is likely to be placed at the risk of extinction. However, this answer is primarily based on the fact that the European Fox and Feral Cat will be eliminated and no domestic dogs and cats will be allowed.

(b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the lifecycle 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.

This question is not applicable.

(c) In the case of an endangered ecological community, whether the action proposed:

- 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
- 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

This question is not applicable.

(d) In relation to the habitat of a threatened species, population or ecological community:

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

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

The proposal will incur no loss or physical change of the gully rainforest or moist lower slope forest habitat as a result of the action and there is unlikely to be any fragmentation of that habitat.

The gully rainforests are regarded as refuges with specialist species. If this threatened species can be substantiated to utilize this habitat area its importance will increase. However, as no such works will involve the gully rainforests and moist lower slopes the long term survival of the any Giant Barred Frog will remain positive.

(f) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

There has been no critical habitat declared for the Stuttering Frog.

(g) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan.

There is no recovery and threat abatement plan prepared for the Stuttering Frog at the state commonwealth level and the recovery actions are currently being prepared by NSW OEH.

(h) Whether the action proposed constitutes or is part of a 'Key Threatening Process' or is likely to result in the operation of, or increase the impact of a key threatening process.

The proposal will not incur removal or any change to the gully rainforests. However, if the Giant Barred Frog is found to be present the Lantana, European Fox and Feral Cat will need to be eradicated and it will need to be shown how the development will address the prevention of domestic cats and dogs (eg by community title).

The Green-thighed Frog *Litoria brevipalmata*

The Green-thighed Frog *Litoria brevipalmata* is listed as a vulnerable species under Schedule 2 of the *NSW TSC Act*.

The Green-thighed Frog is a medium sized frog that inhabits wet forest besides running streams and belongs to the ground frog family Hylidae. They have been recorded from southern Queensland to Gosford in NSW beside streams around oxbows and ponds in isolated areas of the Great Dividing Range (Cogger, 2014).

Being generally regarded as a rainforest-dwelling frog they can be found along the banks of these streams although they do forage in nearby riparian zone vegetation. The species breeds in summer after heavy rains, during which males can be detected by their call and at night using headlamps.

Previously the species has been detected in the Wyong Local Government Area (LGA) in the major eastward draining valleys near Ourimbah State Forest and could be found on this property.

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

The Green-thighed Frog is likely to be found in the swampy floodplain of Narara Creek beside rainforests and along the margins of the dam. The gully rainforests, the dam margins and the swampy floodplain do not constitute part of the physical constructed development and therefore there is unlikely to be any adverse impact on this species, if it is present such that a viable population is likely to be placed at the risk of extinction. However, this answer is primarily based on the fact that the European Fox and Feral Cat will be eliminated and no domestic dogs and cats will be allowed.

(b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the lifecycle 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.

This question is not applicable.

(c) In the case of an endangered ecological community, whether the action proposed:

- 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
- 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

This question is not applicable.

(d) In relation to the habitat of a threatened species, population or ecological community:

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

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

The proposal will incur no loss or physical change of the gully rainforest, the dam margins or moist lower slope forest habitats as a result of the action and there is unlikely to be any fragmentation of that habitat.

The gully rainforests are regarded as refuges with specialist species. If this threatened species can be substantiated to utilize this habitat area its importance will increase. However, as no such works will involve the gully rainforests and moist lower slopes the long term survival of the any Green-thighed Frog will remain positive.

(f) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

There has been no critical habitat declared for the Green-thighed Frog.

(g) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan.

There is no recovery and threat abatement plan prepared for the Green-thighed Frog and it has been assigned to the "data deficient" collection of species. More work will be required by the landholder if the species presence or absence requires to be substantiated.

(h) Whether the action proposed constitutes or is part of a 'Key Threatening Process' or is likely to result in the operation of, or increase the impact of a key threatening process.

The proposal will not incur removal or any change to the gully rainforests, floodplain forests and dam margins. However, if the Green-thighed Frog is found to be present the Lantana, European Fox and Feral Cat will need to be eradicated and it will need to be shown how the development will address the prevention of domestic cats and dogs (eg by community title).

Ridgetops**The Glossy Black-Cockatoo *Calyptorhynchus lathami***

The Glossy Black-cockatoo is listed on Schedule 2 of the *TSC Act 1995*.

The distribution of the Glossy Black Cockatoo is patchy between eastern Victoria and central Queensland on the coast and inland to the tablelands with a small population in the Riverina area of NSW. It is found in woodlands and forests in these areas where there is an abundance of *Allocasuarina littoralis* Black she-oak, *A. torulosa* Forest she-oak and *A. verticillata*, Drooping She-oak. The birds extract the seeds from the casuarina cones for food and are dependant upon large eucalypts with hollows for breeding and raising young.

The species breeds in tree hollows or large limbs with hollows. It appears the birds have specific feed trees which are mature but sparsely foliated and between 2-10 metres tall. Sometimes these trees may occur amongst dense undergrowth. Roosting is known to occur in the canopy of live leafy trees, usually eucalypts, which are located 30m from the hollow bearing tree. Their movements are poorly known (Higgins, 1999).

NSW DEC lists nine recovery actions for the species and those that apply to this property include the reduction of burning practices to promote the longevity of she-oak trees, protect existing and future hollow bearing trees, protect the areas where the she-oaks grow and establish corridors for movement.

Infrequent sightings of the species during each of the fauna surveys suggest the Glossy Black Cockatoo irregularly visits parts of the subject site for foraging resources. The area of high quality foraging habitat for the Glossy Black Cockatoo occurs on the mid to upper slopes of the ridge where mature *Allocasuarina littoralis* and *A. torulosa* trees to a height of 15-20 metres occur. The Glossy Black Cockatoo also utilises large to very large tree hollows for nesting and potential nesting sites (large to very large tree hollows) are widespread across the ridge.

No evidence of breeding behaviour was noted during fauna investigations over the short period and observations of habitat trees with large to very large size hollows indicate several trees may be suitable.

Potential development of the subject site will not remove foraging and nesting resources for the species.

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

The Glossy Black Cockatoo was recorded on the ridge where no development will take place. As the ridge will not constitute part of the constructed development there is unlikely to be any adverse impact on this species such that a viable population is likely to be placed at the risk of extinction.

(b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the lifecycle 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.

This question is not applicable.

(c) In the case of an endangered ecological community, whether the action proposed:

- 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
- 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

This question is not applicable.

(d) In relation to the habitat of a threatened species, population or ecological community:

- the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
- 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
- the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

The proposal will incur no loss or change of the ridge top forest habitat as a result of the action and there is unlikely to be any fragmentation of that habitat.

The ridge top habitat will not become fragmented or isolated as a result of the development.

However, the ridgetop is important to the Glossy Black Cockatoo as it feeds at that location.

(f) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

There has been no critical habitat declared for the Glossy Black Cockatoo.

(g) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan.

The proposed development does not violate the ten recovery actions for this species.

(h) Whether the action proposed constitutes or is part of a 'Key Threatening Process' or is likely to result in the operation of, or increase the impact of a key threatening process.

The proposal will not incur removal or any change to the ridge top forest. However, the Bell Miner is present which is now listed as a key threatening process. This Key Threatening Process has the potential of reducing foliage in trees by harvesting insects and if the process

is applicable to *Allocuarina spp.* it may impact on feeding resources for the Glossy Black Cockatoo.

The Giant Burrowing Frog *Heleioporous australiacus* and Red-crowned Toadlet *Pseudophryne australis*

The Giant Burrowing Frog and Red-crowned Toadlet are listed on Schedule 2 of the *TSC Act 1995* and the former is listed as vulnerable on the *EPBC Act, 1997*.

There will not be any impact on any Red-crowned Toadlet or Giant Burrowing Frogs populations that may be present. Although no Giant Burrowing Frogs were recorded, the former species utilise local streams and soaks to deposit their eggs and the tadpoles are often seen in the breeding ponds of these streams. On the other hand Red-crowned Toadlets utilise soaks and ephemeral re-entrants associated with these streams and are present in the moist ground layers of the sandstone hanging swamps. A population of the latter was recorded on the ridge.

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

Both the Giant Burrowing Frog and Red-crowned Toadlet are likely to occur on the ridge where no development will take place. As the ridge will not constitute part of the constructed development there is unlikely to be any adverse impact on these species such that a viable population is likely to be placed at the risk of extinction.

(b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the lifecycle 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.

This question is not applicable.

(c) In the case of an endangered ecological community, whether the action proposed:

- 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
- 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

This question is not applicable.

(d) In relation to the habitat of a threatened species, population or ecological community:

- the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
- 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
- the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

The proposal will incur no loss or change of the ridge top forest habitat as a result of the action and there is unlikely to be any fragmentation of that habitat.

The ridge top habitat will not become fragmented or isolated as a result of the development.

However, the ridgetop is important to the Giant Burrowing Frog and Red-crowned Toadlet as they occur at that location.

(f) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

There has been no critical habitat declared for the Giant Burrowing Frog and Red-crowned Toadlet.

(g) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan.

There priority action statements prepared for the Giant Burrowing Frog and Red-crowned Toadlet and the development will not complement any of the recommendations in these statements.

(h) Whether the action proposed constitutes or is part of a 'Key Threatening Process' or is likely to result in the operation of, or increase the impact of a key threatening process.

The proposal will not incur removal or any change to the ridge top forest. No Key Threatening Process will result.

The Eastern Pigmy Possum *Cercaetetus nanus*

From surveys in Brisbane Water National Park over successive years (Payne, 2009; 2010) the Eastern Pigmy Possum has been found to gradually colonise nest boxes that have been installed in various habitats. The main habitat that it appears to prefer is low shrubland dominated by a mixture of winter flowering *Banksia* spp. such as *Banksia spinulosa*, *Banksia oblongifolia* and *Banksia robur*. Nesting material which is required for warmth and has been examined from within the nest boxes is *Leptospermum polygalifolium* and *Petrophile pulchella*.

It is also known that the extent of potential habitat for the Eastern Pigmy Possum is quite extensive on the property but the highest quality habitat is considered to occur in the ridgetop areas where there is more abundant pollen and nectar, particularly from post fire Myrtaceae and Proteaceae species such as *Banksia* spp. This area also has quite abundant tree hollows that may be utilised by the species. Also, the upper slopes of the subject site support abundant arboreal *Xanthorrhoea resinifera* which may provide further foraging and nesting sites for the species.

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

No surveys were undertaken on the ridge because it is known they are present (Alf Britton pers. com.) No development will take place at this location. As the ridge will not constitute part of the constructed development there is unlikely to be any adverse impact on this species such that a viable population is likely to be placed at the risk of extinction.

(b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the lifecycle 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.

This question is not applicable.

(c) In the case of an endangered ecological community, whether the action proposed:

- 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
- 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

This question is not applicable.

(d) In relation to the habitat of a threatened species, population or ecological community:

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

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

The proposal will incur no loss or change of the ridge top forest habitat as a result of the action and there is unlikely to be any fragmentation of that habitat.

The ridge top habitat will not become fragmented or isolated as a result of the development.

However, the ridgetop is important to the Eastern Pigmy Possum as it feeds at that location.

(f) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

There has been no critical habitat declared for the Eastern Pigmy Possum.

(g) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan.

The development will not contravene the seven recovery actions for this species and in particular it has been recommended the Feral Cat be eradicated and no domestic cats be allowed.

(h) Whether the action proposed constitutes or is part of a 'Key Threatening Process' or is likely to result in the operation of, or increase the impact of a key threatening process.

The proposal will not incur removal or any change to the ridge top forest. However, the Bell Miner is present which is now listed as a key threatening process. This Key Threatening Process has the potential of reducing foliage in trees by harvesting insects which may impact on feeding resources for the Eastern Pigmy Possum. *Phytophthora cinnamomi* is also evident in the grass trees on the ridge but this is a very difficult problem to address.

Stephens' Banded Snake *Hoplocephalus stephensii*

Stephens' Banded Snake is a medium-sized partly tree-dwelling snake up to about 1.2 metres in length. It is listed as Vulnerable on Schedule 2 of the *NSW TSC Act*.

It may be brown or yellow-brown to greyish white above, with a series of irregular, broad, dark crossbands. The head is black with a brown crown and a brown to creamish patch on either side of the nape. The lips are barred with black and cream. The belly is cream to grey. Midbody scale rows 21; ventrals 220–250; anal single; subcaudals single 50–70.

This species is dangerously venomous with an aggressive disposition. Its venom affects blood clotting.

The species is distributed from the coast and ranges in Southern Queensland south to about Gosford in NSW. It inhabits rainforest, moist eucalypt forests, heaths and vine thickets as well as including rocky areas up to about 950m in altitude. It has an apparent preference at least in the northern part of its range for Turpentine Trees *Syncarpia glommulifera* within which it shelters and forages.

Stephen's Banded Snake is nocturnal, and shelters in tree hollows, beneath the loose decorticating bark of trees, amongst vines or in hollow limbs as well as rock crevices or under slabs during the day. The species forages at night for frogs, lizards, birds and small mammals.

This species gives birth to live young (up to 9 per litter) between December and February. The new born snakes are around 25 cm from the tip of the snout to the base of the tail (snout-vent length).

Factors identified as likely to be significantly impacting on the species include: Clearing and fragmentation of habitat; forestry practices which result in loss of old or dead trees; too frequent burning for fuel reduction or silvicultural purposes which destroys old and dead trees and removes understorey vegetation; and illegal collection of snakes from the wild.

Actions considered likely to benefit the species include: fire management to protect old and dead trees and maintain understorey vegetation; the retention and protection of stands of native vegetation, especially those with old and dead trees; retention of hollow bearing trees as well as large mature trees which are incipient hollow bearing trees; management of grazing to protect and maintain understorey vegetation in areas of known habitat.

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

Stephens' Banded Snake is likely to occur on the ridge where no development will take place and where hollow trees are prevalent. As the ridge will not constitute part of the constructed development there is unlikely to be any adverse impact on these species such that a viable population is likely to be placed at the risk of extinction.

(b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the lifecycle 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.

This question is not applicable.

(c) In the case of an endangered ecological community, whether the action proposed:

- 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
- 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

This question is not applicable.

(d) In relation to the habitat of a threatened species, population or ecological community:

- the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
- 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
- the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

The proposal will incur no loss or change of the ridge top forest habitat as a result of the action and there is unlikely to be any fragmentation of that habitat.

The ridge top habitat will not become fragmented or isolated as a result of the development.

However, the ridgetop maybe important to Stephens' Banded Snake as the species may occur at this location.

(f) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

There has been no critical habitat declared for Stephens' Banded-snake.

(g) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan.

There are no priority action statements prepared for Stephens' Banded Snake but it is not expected the development will contravene any of the recommendations in these statements.

(h) Whether the action proposed constitutes or is part of a 'Key Threatening Process' or is likely to result in the operation of, or increase the impact of a key threatening process.

The proposal will not incur removal or any change to the ridge top forest. No Key Threatening Process will result.

Rosenberg's Heath Goanna *Varanus rosenbergi*

Rosenberg's Goanna *Varanus rosenbergi* is listed as a vulnerable species under Schedule 2 of the *NSW TSC Act*. It is a medium sized member of the Monitor Family of lizards Varanidae reaching about 1.5m in length. It is one of three members of the family recorded from the Sydney Basin and is the rarest of the three *Varanus* species overall.

Rosenberg's Goanna (also called Heath Goanna or Heath Monitor) is perhaps one of the rarest reptiles in the Sydney Basin. It generally occupies ridgetop locations in areas of Hawkesbury Sandstone geology and has large home range/territories. They are an active predator feeding predominantly on lizards but will also eat small mammals and carrion. They shelter in burrows, within rock ledges and ground logs and often nest in ground termitaria. They suffer a high incidence of road mortality and are suspected to be detrimentally impacted by changes to fire regime which likely impacts directly on the species as well as indirectly via impacts on prey items. Heath Goanna occupy heath and woodland vegetation communities and utilise ledges and crevices among sandstone outcrops as over wintering refugia where they aestivate/hibernate. At other times they actively forage across relatively large areas/territories. They have a patchy distribution and are not always present in areas that appear to contain suitable habitat. This may be a consequence of previous fire impacts and an inability to recolonise areas that have become isolated or fragmented. Little is known regarding carrying capacity or the area of land that is required to make up a viable territory.

The species is often notoriously difficult to detect when in low numbers as they are generally active during high temperature days during which time they are elusive and almost impossible to catch. Consequently, little is known about the ecology of the species and what is known is largely based on populations from Kangaroos Island, SA which is likely a different species.

Its distribution extends from the Sydney Sandstone to the north west of Sydney in Wollemi National Park and to the south it extends beyond the sandstone of the Sydney Basin with small disjunct populations recorded from the vicinity of Goulburn, the ACT and near Cooma. The species, as currently recognized, is also recorded from near Khancoban and Tooma River on the south west slopes and also occurs in South Australia and Western Australia. It occurs with a patchy distribution of 'hotspots' across this area that includes the Hornsby plateau, Blue Mountains, Central Coast and the Woronora plateau.

The preferred habitat is heath, woodland and open forest and in the Sydney Basin is recorded from elevated sandstone ridges where it can be detected using rocky sandstone ledges and crevices in which to shelter and over-winter. They may also shelter in or under ground logs and suitable large rocks.

Breeding is often associated with terrestrial termitaria which are used as incubation chambers for the eggs and from which hatchlings emerge, through their own excavation, after incubation is completed. Individuals require large areas of habitat over which to range whilst foraging and are most frequently detected when active during extremely hot weather. They actively pursue and feed on diurnally active lizards but also feed on small ground mammals and carrion.

Primary threats to the species are considered to be:

- Habitat loss and fragmentation as land is cleared for residential, agricultural and industrial developments;
- Removal of habitat elements, such as termite mounds, fallen timber and large rocks and destruction of ledges used for shelter;
- They are particularly prone to road mortality which is exacerbated by the upgrading of dirt roads to bitumen, which increases the speed of through traffic.
- Predation by cats and dogs is also considered to be a significant threat to the species.
- Changes to fire regime

On the Central Coast this species has been recorded from Brisbane Water NP; Popran NP; Dharug NP; Parr SRA; Yengo NP and within the State Forests of the Central Coast.

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

Rosenberg's Heath Goanna is likely to occur on the ridge where no development will take place and where hollow trees are prevalent. As the ridge will not constitute part of the constructed development there is unlikely to be any adverse impact on these species such that a viable population is likely to be placed at the risk of extinction.

(b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the lifecycle 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.

This question is not applicable.

(c) In the case of an endangered ecological community, whether the action proposed:

- 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
- 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

This question is not applicable.

(d) In relation to the habitat of a threatened species, population or ecological community:

- the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
- 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
- the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

The proposal will incur no loss or change of the ridge top forest habitat as a result of the action and there is unlikely to be any fragmentation of that habitat.

The ridge top habitat will not become fragmented or isolated as a result of the development.

However, the ridgetop maybe important to Rosenberg's Heath Goanna as the species may occur at this location.

(f) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

There has been no critical habitat declared for Rosenberg's Heath Goanna.

(g) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan.

There are no priority action statements prepared for Rosenberg's Heath Goanna but it is not expected the development will contravene any of the recommendations in these statements.

(h) Whether the action proposed constitutes or is part of a 'Key Threatening Process' or is likely to result in the operation of, or increase the impact of a key threatening process.

The proposal will not incur removal or any change to the ridge top forest. No Key Threatening Process will result.

The Narara Creek Floodplain

The Black Bittern

The Black Bittern was recorded during the survey in the freshwater wetland on the alluvial floodplain. This species occurs in terrestrial wetlands, estuarine and littoral habitats at the edges of running or still water. Vegetation is generally dense but can be narrow. The species will breed in dense vegetated wetlands which are secluded and nesting can also occur in leafy trees overhanging water. The Black Bittern will feed on small fish and freshwater crayfish and will stalk this prey by walking with retracted shoulders.

The call is described as a loud boom and the breeding cycle is poorly known. Nests are made of sticks, reeds and twigs with a shallow depression at the top (Marchant & Higgins, 1990)

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

The habitat of the Black Bittern is along the floodplain of Narara Creek and outside of the development area. As the floodplain will not constitute part of the physical constructed development there is unlikely to be any adverse impact on this species such that a viable population is likely to be placed at the risk of extinction.

(b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the lifecycle 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.

This question is not applicable.

(c) In the case of an endangered ecological community, whether the action proposed:

- 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
- 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

This question is not applicable.

(d) In relation to the habitat of a threatened species, population or ecological community:

- the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
- 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
- the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

The proposal will incur no loss or change of the floodplain wetland habitat as a result of the action and there is unlikely to be any fragmentation of that habitat.

The floodplain habitat will not become fragmented or isolated as a result of the development.

However, the floodplain habitat would be important to the Black Bittern as it feeds, and possibly nests, at that location.

(f) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

There has been no critical habitat declared for the Black Bittern.

(g) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan.

There are two priority action statements prepared for the Black Bittern and the proposal will not compromise these recovery actions.

(h) Whether the action proposed constitutes or is part of a 'Key Threatening Process' or is likely to result in the operation of, or increase the impact of a key threatening process.

The proposal will not incur removal or any change to the floodplain wetland. Clearing of vegetation and predation by the European Fox would be the two key threatening processes that would be applicable.

The Greater Broad-nosed Bat, *Scoteanax reuppelli*
(prepared by R. Williams Ecotone Environmental Consultants)

This species is most common in the gullies and river systems draining the Great Dividing Range, from north-eastern Victoria to the Atherton Tableland in tropical Queensland, but it extends to the coast over much of its range (Hoye & Richards 2008). It is regarded as sparse in abundance (Hoye & Richards 2008) but may prove to be more widespread than currently indicated (Parnaby 1992).

This species has been recorded in a variety of habitat types including rainforest, moist and dry eucalypt forest and woodland. Favoured foraging areas for this species appear to be tree-lined creeks and the junction of woodland and cleared paddocks (Churchill 2008). Large emergent trees with hollows, including dead trees and isolated paddock trees, are known to be used as roost sites (Law *et al.* 2000).

The greater broad-nosed bat feeds on moths, beetles and other large slow-flying insects and is also known to prey on bats captured in the same trap. A low, slow-flying species which utilises a large foraging area, the open nature of eucalypt woodland suits its direct flight pattern. Within denser vegetation types, use is made of natural and man-made openings such as roads, creeks and small rivers, where it hawks backwards and forwards for prey (Hoye & Richards 2008).

The reproductive cycle is poorly known, but it has been reported that a single young is produced in January and prior to birth, females congregate at maternity sites, which are located in suitable trees. Males are excluded during birth and rearing of the young (Hoye & Richards 2008).

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

This bat species was detected over the freshwater wetland. The freshwater wetland does not constitute part of the physical constructed development and therefore there is unlikely to be any adverse impact on this species such that a viable population is likely to be placed at the risk of extinction.

(b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the lifecycle 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.

This question is not applicable.

(c) In the case of an endangered ecological community, whether the action proposed:

- **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**
- **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**

This question is not applicable.

(d) In relation to the habitat of a threatened species, population or ecological community:

- the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
- 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
- the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

The proposal will incur no loss or change of the freshwater wetland habitat as a result of the action and therefore there is unlikely to be any fragmentation or modification of that habitat.

The freshwater wetland is a feeding habitat for this species and is likely to roost in tree hollows on the property. However, as no such works will involve the freshwater wetland or tree hollows the long term survival of the Greater Broad-nosed Bat will not be affected.

(f) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

There has been no critical habitat declared for the Greater Broad-nosed Bat.

(g) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan.

The proposal does not violate any of the 19 priority action statements set down for the species.

(h) Whether the action proposed constitutes or is part of a 'Key Threatening Process' or is likely to result in the operation of, or increase the impact of a key threatening process.

The proposal will not incur removal any change to the freshwater wetland or hollow bearing trees and as a result no currently listed 'Key Threatening Processes' will result.

Endangered Ecological Communities**Lowland Rainforest in the NSW North Coast and Sydney Basin bioregion**

The lowland rainforest endangered ecological community classification as applied to the palm dominated gully forests has some affinities with the lowland rainforest in the NSW north coast and Sydney Basin bioregion. The presence of this EEC is associated with the richer nutrient soils of the Narrabeen Group of rocks and is found on the coastal foothills. The vegetation associated with the gullies is patchy because of the presence of boulders and weed disturbance and only partly has a closed canopy. A diversity of canopy trees is present and the stratum occurs in three layers. Buttressed roots, palms, vines and vascular epiphytes are present.

The main tree species of the plotless sampling survey show an affinity to the warm temperate *Archotophoenix cunninghamiana*–*Livistona australis* and *Ceratopetalum-Diploglottis-Acmena* suballiances. For consideration of the seven part test the gullies have been adopted as being part of the lowland rainforest EEC.

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

This question is not applicable.

(b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the lifecycle 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.

This question is not applicable.

(c) In the case of an endangered ecological community, whether the action proposed:

- **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**
- **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**

From the plans supplied by the Architect most of the palm gully areas will be protected within the DCP175 land and that gully area shown to be located adjacent to the access road does not qualify as the EEC. It is doubtful if the development would have an adverse effect on the EEC habitat such that the habitat is likely to be placed at the risk of extinction. The proposal will not modify the composition of the EEC such that its local occurrence will be placed at the risk of extinction because most of the habitat has been captured by DCP175, which will be maintained through a weeding program.

(d) In relation to the habitat of a threatened species, population or ecological community:

- the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
- 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
- the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

The palm dominated gully forest habitat will not become fragmented or isolated as a result of the development.

However, the palm dominated gully forest is important because it supports a unique epiphytic and lithophytic flora.

(f) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

There has been no critical habitat declared for the lowland rainforest EEC.

(g) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan.

There are six recovery actions prepared for the lowland rainforest EEC, but the proposal will not compromise any recovery actions. Most of the areas will be protected and in particular weeding has been recommended which is one of the recovery actions.

(h) 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.

Continued invasion by *Lantana camara* would be the main key threatening processes that would be applicable but there is no additional key threatening process expected from the proposed development.

Freshwater Wetland on coastal floodplains in the NSW North Coast, Sydney Basin and south-east corner bioregions

The Freshwater Wetland endangered ecological community classification as applied to the floodplain of Narara Creek is a permanent or periodic habitat that is regularly inundated. It is found on a flat beside Narara Creek and is a coastal floodplain. The main grassland species is *Paspalum distichum* and the main rushland species *Typha orientalis* both of which are specifically listed in the determination. The wetland, of course, is highly modified from years of mowing. It occurs within the Gosford LGA as mentioned in the determination. Furthermore, there is the complete absence of woody plant species as also stated in the determination.

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

This question is not applicable.

(b) In the case of an endangered population, whether the action proposed is likely to have an adverse effect on the lifecycle 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.

This question is not applicable.

(c) In the case of an endangered ecological community, whether the action proposed:

- **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**
- **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**

From the plans supplied by the Architect the freshwater wetland area will not be part of the development. It is doubtful if the development would have an adverse affect on the EEC habitat such that the habitat is likely to be placed at the risk of extinction. The proposal will not modify the composition of the EEC such that its local occurrence will be placed at the risk of extinction because most of the habitat will be maintained through a future weeding and mowing program.

(d) In relation to the habitat of a threatened species, population or ecological community:

- **the extent to which habitat is likely to be removed or modified as a result of the action proposed, and**
- **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**
- **the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.**

The proposal will incur no modification of the freshwater wetland as a result of the development. The Freshwater Wetland habitat will not become fragmented or isolated as a result of the development.

However, the Freshwater Wetland is important because it supports a unique flora and supports insects, fish, frogs, larvae etc for a number of water bird species including the Black Bittern.

(f) Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

There has been no critical habitat declared for the freshwater wetland EEC.

(g) Whether the action proposed is consistent with the objectives or actions of a Recovery Plan or Threat Abatement Plan.

There are 13 recovery actions that apply to this EEC which will not be contravened. In particular management has been recommended for this EEC but its location should be identified by signage because it is not part of the development area.

(h) Whether the action proposed constitutes or is part of a 'Key Threatening Process' or is likely to result in the operation of, or increase the impact of a key threatening process.

The proposal will not incur part removal or change to the freshwater wetland habitat unless damage occurs from urban runoff. There appear to be no key threatening processes.

SUMMARY OF THE SEVEN PART TESTS

Overall the seven part test shows the development to be satisfactory at this point in time but the development must consider urban drainage run-off and the presence of the Freshwater Wetland which supports the Black Bittern. Drainage must bypass this wetland or be treated prior to disposal.

APPENDIX 7: KEY THREATENING PROCESSES

The Key Threatening Processes's listed in Schedule 3 of the *TSC Act* that appear most applicable to this species (both directly and indirectly) could be:

Key Threatening Process - KTP	
Alteration of habitat following subsidence due to longwall mining	
Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands	
Anthropogenic climate change	
Bushrock removal	
Clearing of native vegetation	
Competition and grazing by the feral European rabbit (<i>Oryctolagus cuniculus</i>)	
Competition and habitat degradation by feral goats (<i>Capra hircus</i>)	
Competition from feral honey bees (<i>Apis mellifera</i>)	
Death or injury to marine species following capture in shark control programs on ocean beaches	
Entanglement in or ingestion of anthropogenic debris in marine and estuarine environments	
Forest Eucalypt dieback associated with over-abundant psyllids and bell miners	
High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition	
Herbivory and environmental degradation caused by feral deer	
Importation of red imported fire ants (<i>Solenopsis invicta</i>)	
Infection by psittacine circoviral (beak and feather) disease affecting endangered psittacine species and populations	
Infection of frogs by amphibian chytrid causing the disease chytridiomycosis	
Infection of native plants by <i>Phytophthora cinnamomi</i>	
Introduction and Establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae	
Introduction of the large earth bumblebee (<i>Bombus terrestris</i>)	
Invasion and establishment of exotic vines and scramblers	
Invasion and establishment of Scotch broom (<i>Cytisus scoparius</i>)	
Invasion and establishment of the cane toad (<i>Bufo marinus</i>)	
Invasion of native plant communities by African Olive <i>Olea europaea</i> L. subsp. <i>cuspidata</i>	
Invasion, establishment and spread of <i>Lantana camara</i>	
Invasion of native plant communities by <i>Chrysanthemoides monilifera</i> (bitou bush and boneseed)	
Invasion of native plant communities by exotic perennial grasses	
Invasion of the yellow crazy ant (<i>Anoplolepis gracilipes</i> (Fr. Smith)) into NSW	
Loss of hollow-bearing trees	
Loss or degradation (or both) of sites used for hill-topping by butterflies	

Predation and hybridisation of feral dogs (<i>Canis lupus familiaris</i>)	
Predation by the European red fox (<i>Vulpes vulpes</i>)	
Predation by the feral cat (<i>Felis catus</i>)	
Predation by <i>Gambusia holbrooki</i> Girard, 1859 (plague minnow or mosquito fish)	
Predation by the ship rat (<i>Rattus rattus</i>) on Lord Howe Island	
Predation, habitat degradation, competition and disease transmission by feral pigs (<i>Sus scrofa</i>)	
Removal of dead wood and dead trees	

The implication of this data is that they should be reduced to maintain populations of threatened species on site.

APPENDIX 8: COMMONWEALTH ASSESSMENT UNDER THE EPBC ACT

VULNERABLE SPECIES

1. Assessment of the Giant Burrowing Frog.

Will the proposal lead to a long term decrease in the size of an important population of the species?

The Giant Burrowing Frog has found in the catchment on the ridges. The proposal, will not lead to a long term decrease in the size of an important population of this species.

Will the proposal reduce area of occupancy of an important population;

The proposal will not reduce the area of occupancy of an important population of the Giant Burrowing Frog.

Will the proposal fragment an existing important population into two or more populations;

The proposal will not fragment an existing important population of the Giant Burrowing Frog into two or more populations.

Will the proposal adversely affect habitat critical to the survival of a species;

The proposal will not adversely affect habitat critical to the survival of the Giant Burrowing Frog.

Will the proposal disrupt the breeding cycle of an important population;

The proposal will not disrupt the breeding cycle of an important population of the Giant Burrowing Frog.

Will the proposal modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;

The proposal will not modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the Giant Burrowing Frog is likely to decline;

Will the proposal result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;

The proposal will not result in invasive species that are harmful to the Giant Burrowing Frog becoming established in the vulnerable species' habitat.

Will the proposal introduced disease that may cause the species to decline; or

The proposal will not introduced disease that may cause the Giant Burrowing Frog to decline.

Will the proposal interfere substantially with the recovery of the species

The proposal will not interfere substantially with the recovery of the Giant Burrowing Frog.

2. Assessment of the Stuttering Frog and the Giant Barred River Frog.

Will the proposal lead to a long term decrease in the size of an important population of the species?

The Stuttering Frog and Giant Barred River Frog maybe found along the fringes of the dam, in the gullies and on the Narara Creek floodplain. The proposal, will not lead to a long term decrease in the size of an important population of this species.

Will the proposal reduce area of occupancy of an important population;

The proposal will not reduce the area of occupancy of an important population of the Stuttering Frog and the Giant Barred River Frog.

Will the proposal fragment an existing important population into two or more populations;

The proposal will not fragment an existing important population of the Stuttering Frog and Giant Barred River Frog into two or more populations.

Will the proposal adversely affect habitat critical to the survival of a species;

The proposal will not adversely affect habitat critical to the survival of the Stuttering Frog and the Giant Barred River Frog.

Will the proposal disrupt the breeding cycle of an important population;

The proposal will not disrupt the breeding cycle of an important population of the Stuttering Frog and the Giant Barred River Frog.

Will the proposal modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;

The proposal will not modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the Stuttering Frog and the Giant Barred River Frog are likely to decline;

Will the proposal result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;

The proposal will not result in invasive species that are harmful to the Stuttering Frog and the Giant Barred River Frog becoming established in the endangered species' habitat.

Will the proposal introduced disease that may cause the species to decline; or

The proposal will not introduced disease that may cause the Stuttering Frog and the Giant Barred River Frog to decline.

Will the proposal interfere substantially with the recovery of the species.

The proposal will not interfere substantially with the recovery of the Stuttering Frog and the Giant Barred River Frog.

3. Assessment of the Long-nosed Potoroo.

Will the proposal lead to a long term decrease in the size of an important population of the species?

The Long-nosed Potoroo maybe found in the palm gully rainforests on the slopes. The proposal, will not lead to a long term decrease in the size of an important population of this species.

Will the proposal reduce area of occupancy of an important population;

The proposal will not reduce the area of occupancy of an important population of the Long-nosed Potoroo.

Will the proposal fragment an existing important population into two or more populations;

The proposal will not fragment an existing important population of the Long-nosed Potoroo into two or more populations.

Will the proposal adversely affect habitat critical to the survival of a species;

The proposal will not adversely affect habitat critical to the survival of the Long-nosed Potoroo.

Will the proposal disrupt the breeding cycle of an important population;

The proposal will not disrupt the breeding cycle of an important population of the Long-nosed Potoroo.

Will the proposal modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;

The proposal will not modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the Long-nosed Potoroo is likely to decline;

Will the proposal result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat;

The proposal will not result in invasive species that are harmful to the Long-nosed Potoroo becoming established in the vulnerable species' habitat.

Will the proposal introduced disease that may cause the species to decline; or

The proposal will not introduced disease that may cause the Long-nosed Potoroo to decline.

Will the proposal interfere substantially with the recovery of the species.

The proposal will not interfere substantially with the recovery of the Long-nosed Potoroo.

4. Assessment of migratory/marine species; Fork-tailed Swift, White-throated Needletail, Black-faced Monarch, Satin Flycatcher, Rufous, Fantail and Latham's Snipe.

Will the proposal substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species;

The proposal will not substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for the migratory species listed above.

Will the proposal result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species; or

The proposal will not result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species listed above.

Will the proposal disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species;

The proposal will not disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of most of the migratory species listed.

SUMMARY OF THE COMMONWEALTH ASSESSMENT

The commonwealth assessment reveals that the project has little impact on commonwealth listed and migratory species.

APPENDIX 9 – GREVILLEA SPECIOSA X G. OLDEI



Photos showing the red, dome shaped, pendant and pubescent perianth typical of *Grevillea speciosa* and the triangular, recurved, three veined and pungent pointed leaves which are loosely villous on the undersurface, sometimes typical in *Grevillea oldei*. The conflorescence in *G. oldei* also exceeds the leaves and the perianth has two branched and simple erect hairs. Branchlets are also villous in the latter as seen in the photo.

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APPENDIX 10 – POTENTIAL REPTILE AND FROG SPECIES THAT MAY OCCUR

Group	Family	Scientific Name	Common Name	NSW Status	EPBC Act Status	Previous detection in vicinity of the property	Comment
Amphibia	<i>Myobatrachidae</i>	<i>Adelotus brevis</i>	Tusked Frog	P			Not known south of the Ridgeway; Strickland and Ourimbah SF's.
		<i>Crinia signifera</i>	Common Eastern Froglet	P			
		<i>Crinia tinnula</i>	Wallum Froglet	V,P			Unlikely to be present; habitat required (Wallum Swamp) absent from the study site
		<i>Heleioporus australiacus</i>	Giant Burrowing Frog	V,P	V		
		<i>Lechriodus fletcheri</i>	Fletcher's Frog	P			Not known south of Ourimbah which is currently southern most extent of the species
		<i>Limnodynastes dumerilii grayi</i>	Eastern Banjo Frog	P			Known from Somersby just outside Strickland SF
		<i>Limnodynastes peronii</i>	Brown-striped Marsh Frog	P			
		<i>Limnodynastes tasmaniensis</i>	Spotted Marsh Frog	P			Potentially present in Strickland SF plateau areas
		<i>Mixophyes balbus</i>	Stuttering Frog	E1,P,2	V		Potential habitat present; nearest confirmed record

Group	Family	Scientific Name	Common Name	NSW Status	EPBC Act Status	Previous detection in vicinity of the property	Comment
							Strickland SF
		<i>Mixophyes fasciolatus</i>	Giant Barred Frog	P			Not known south of Ourimbah SF but with some potential for occurring in Strickland SF.
		<i>Mixophyes iteratus</i>	Giant Barred River Frog	E1,P,2	E		Erroneously recorded from Strickland SF; nearest currently known locality Mangrove Dam/McPherson SF and Ourimbah Creek Road.
		<i>Pseudophryne australis</i>	Red-crowned Toadlet	V,P			Known from plateau areas of Strickland SF
		<i>Uperoleia laevigata</i>	Smooth Toadlet	P			
	<i>Pelodyadidae</i>	<i>Litoria aurea</i>	Green and Golden Bell Frog	E1,P	V		May have been historically present in Strickland SF and on lower parts of Narara Creek floodplain.
		<i>Litoria brevipalmata</i>	Green-thighed Frog	V,P			Not definitely known south of Ourimbah Creek and Chittaway; nearest likely habitat known is at Lisarow wetland.
		<i>Litoria caerulea</i>	Green Tree Frog	P			Likely present; recorded patchily across the Central Coast; once regularly recorded across much of the Somersby plateau area but

Group	Family	Scientific Name	Common Name	NSW Status	EPBC Act Status	Previous detection in vicinity of the property	Comment
							it has undergone at least a local decline.
		<i>Litoria chloris</i>	Red-eyed Green Tree Frog	P			Likely present, regularly recorded from lower slopes adjacent to Strickland SF and at Niagara Park and west Gosford escarpment.
		<i>Litoria dentata</i>	Bleating Tree Frog	P			Likely Present in swampy paperbark areas of lower sections of Strickland and adjacent areas.
		<i>Litoria fallax</i>	Eastern Dwarf Tree Frog	P			Commonly detected in agricultural areas and dams at Narara and Niagara Park.
		<i>Litoria freycineti</i>	Freycinet's Frog	P			Recorded from ridgetop habitat areas associated with temporary ridgetop pools and drainage lines.
		<i>Litoria latopalmata</i>	Broad-palmed Frog	P			Likely Present
		<i>Litoria littlejohni</i>	Littlejohn's Tree Frog	V,P	V		Potential habitat present but not definitely known south of Ourimbah SF or east of McPherson SF.
		<i>Litoria peronii</i>	Peron's Tree Frog	P			Commonly recorded from rural properties and farm dams with fringing vegetation.

Group	Family	Scientific Name	Common Name	NSW Status	EPBC Act Status	Previous detection in vicinity of the property	Comment
		<i>Litoria phyllochroa</i>	Leaf-green Tree Frog	P			Confirmed to be present
		<i>Litoria verreauxii</i>	Verreaux's Frog	P			Not detected; Winter caller; equivocally present; <i>L. 'revelata'</i> replaces this species north at around Wyong.
	<i>Bufonidae</i>	<i>Rhinella marina</i>	Cane Toad				Introduced species; no resident breeding population known south of Port Macquarie.
Reptilia	<i>Cheloniidae</i>	<i>Caretta caretta</i>	Loggerhead Turtle	E1,P	E		Marine only detected from within Brisbane Water estuary, though potentially occurring in tidal sections of Narara Creek.
		<i>Chelonia mydas</i>	Green Turtle	V,P	V		Marine only detected from within Brisbane Water estuary, though potentially occurring in tidal sections of Narara Creek.
	<i>Dermochelyidae</i>	<i>Dermochelys coriacea</i>	Leatherback Turtle	E1,P	E		Marine only.
	<i>Chelidae</i>	<i>Chelodina longicollis</i>	Long Necked Turtle	P			Known from farm dams and billabongs in the West Gosford and Narara areas.
		<i>Emydura signata</i>	Short-necked Turtle	P			Previously detected from within Ettymalong Creek

Group	Family	Scientific Name	Common Name	NSW Status	EPBC Act Status	Previous detection in vicinity of the property	Comment
							system Umina Beach.
	<i>Emydidae</i>	<i>Trachemys scripta elegans</i>	Red-eared Slider				Introduced; previously recorded as a feral population at Woy Woy.
	<i>Gekkonidae</i>	<i>Amalosia lesueurii</i>	Lesueur's Velvet Gecko	P			Detected from beneath sandstone slabs and exfoliations on benched sandstone outcrops adjacent to the study area.
		<i>Phyllurus platurus</i>	Broad-tailed Gecko	P		Strickland SF	Detected from rock crevices in benched sandstone outcrops within Strickland.
	<i>Pygopodidae</i>	<i>Lialis burtonis</i>	Burton's Snake-lizard	P			Undergone serious declines and has not been detected recently; nearest records from vicinity of McPherson and Olney SFs.
		<i>Pygopus lepidopus</i>	Common Scaly-foot	P		Strickland SF	Likely still present in heath areas of Brisbane Water NP and elevated components of Strickland.
	<i>Scincidae</i>	<i>Acritoscincus platynota</i>	Red-throated Skink	P			Detected on near ridgetop slopes/benches beneath surface rock.
		<i>Concinnia tenuis</i>	Barred-sided Skink	P			Arboreal specialist; cryptic and difficult to detect, likely present in Strickland but unconfirmed;

Group	Family	Scientific Name	Common Name	NSW Status	EPBC Act Status	Previous detection in vicinity of the property	Comment
		<i>Cryptoblepharus pulcher</i>	Elegant snake-eyed skink	P			Forages on sandstone outcrops and ground logs.
		<i>Ctenotus robustus</i>	Robust Ctenotus	P			Known from areas to the north and east of Strickland; Potentially present on lower sections of Strickland SF.
		<i>Ctenotus taeniolatus</i>	Copper-tailed Skink	P			Common and abundant on ridgetops.
		<i>Egernia cunninghami krefftii</i>	Cunningham's Skink	P			Likely occurs on ridgetop outcrops.
		<i>Eulamprus quoyii</i>	Eastern Water-skink	P			Common along all creek lines.
		<i>Hemisphaeriodon gerrardii</i>	Pink-tongued Skink	P			Not positively identified from Strickland.
		<i>Lampropholis delicata</i>	Dark-flecked Garden Sunskink	P			Ubiquitous species across most areas of the study site.
		<i>Lampropholis guichenoti</i>	Pale-flecked Garden Sunskink	P			Ubiquitous species across the study area particularly across the drier and more elevated ridge areas.
		<i>Liopholis whitii</i>	White's Skink	P			Detected beneath slabs of sandstone towards the top of ridges.

Group	Family	Scientific Name	Common Name	NSW Status	EPBC Act Status	Previous detection in vicinity of the property	Comment
		<i>Lygisaurus foliorum</i>	Tree-base Litter-skink	P			Not positively detected; generally found on more lateritic ridge tops.
		<i>Saiphos equalis</i>	Three-toed Skink	P			Detected beneath litter around the bases of trees in wetter lower slope areas and beneath rotting timbers.
		<i>Saproscincus mustelinus</i>	Weasel Skink	P			Crepuscular in habit, previously detected amongst litter on lower slopes.
		<i>Tiliqua scincoides</i>	Eastern Blue-tongue	P			Detected beneath rubbish and in residential areas; previously detected as road kill on roadways surrounding Strickland SF.
	Agamidae	<i>Amphibolurus muricatus</i>	Jacky Lizard	P			Has undergone obvious declines away from the more coastal heaths; habitat present along ridges.
		<i>Hypsilurus spinipes</i>	Angle-headed Dragon	P			Recorded from Katandra Reserve and likely present in moist forest and rainforest areas of Strickland.
		<i>Intellagama lesueurii</i>	Eastern Water Dragon	P			Common along streamlines where basking is possible.
		<i>Pogona barbata</i>	Bearded Dragon	P			Not positively detected but previously recorded from ridge top locations.
		<i>Rankinia diemensis boylani</i>	Mountain Dragon	P			Detected on the upper 'pavement' exposed ridge

Group	Family	Scientific Name	Common Name	NSW Status	EPBC Act Status	Previous detection in vicinity of the property	Comment
							areas.
	<i>Varanidae</i>	<i>Varanus rosenbergi</i>	Rosenberg's Goanna	V,P			Detected in benched sandstone outcrop areas from Kariong to Somersby and north to Ourimbah.
		<i>Varanus varius</i>	Lace Monitor	P			Reportedly regularly seen within Strickland SF and surrounding areas.
	<i>Typhlopidae</i>	<i>Ramphotyphlops nigrescens</i>	Blackish Blind Snake	P			Only opportunistically detected when conditions prevail that result in the species seeking shelter under surface cover rather than its more regular subterranean burrows. Likely present in Strickland SF.
	<i>Boidae</i>	<i>Morelia spilota</i>	Diamond Pythons	P			Detected previously within Strickland SF.
	<i>Colubridae</i>	<i>Boiga irregularis</i>	Brown Tree Snake	P			Regularly detected within Bouddi NP and present on.
		<i>Dendrelaphis punctulatus</i>	Common Tree Snake	P			Regularly detected across much of the vegetated areas of Gosford and Narara. Likely present in Strickland SF.
	<i>Elapidae</i>	<i>Acanthophis antarcticus</i>	Common Death Adder	P			Previously detected in elevated areas of Strickland SF.

Group	Family	Scientific Name	Common Name	NSW Status	EPBC Act Status	Previous detection in vicinity of the property	Comment
		<i>Cryptophis nigrescens</i>	Eastern Small-eyed Snake	P			Recorded previously to the north and likely present in Strickland SF.
		<i>Demansia psammophis</i>	Yellow-faced Whip Snake	P			Previously detected in ridgetop areas of Strickland SF.
		<i>Hoplocephalus bungaroides</i>	Broad-headed Snake	E1,P,2	V		There are no confirmed recent records of this species from coastal locations north of southern Sydney.
		<i>Hoplocephalus stephensii</i>	Stephens' Banded Snake	V,P			More recent records are from Ourimbah SF and Niagara Park/Narara areas west and north of Gosford. The species is therefore likely still present within Strickland SF.
		<i>Notechis scutatus</i>	Tiger Snake	P			This species is now very rare, with few recent records; recent observations are from the more elevated areas to the west of Strickland SF site within Popran NP.
		<i>Pseudechis porphyriacus</i>	Red-bellied Black Snake	P			Common along all the Creek lines within Strickland SF and surrounding agricultural/rural lands.
		<i>Pseudonaja textilis</i>	Eastern Brown Snake	P			Likely still present within Strickland SF.

Group	Family	Scientific Name	Common Name	NSW Status	EPBC Act Status	Previous detection in vicinity of the property	Comment
		<i>Vermicella annulata</i>	Bandy-bandy	P			Records of this species are very scarce; its highly cryptic nature and very patchy and somewhat enigmatic distribution makes its presence in Strickland uncertain.