FLORA AND FAUNA STUDY
PART LOT 28, DP 871790
SEASPRAY STREET, NARRAWALLEE
CITY OF SHOALHAVEN

April 1998

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1 INTRODUCTION

1.1 BACKGROUND

This flora and fauna study was undertaken by Kevin Mills & Associates Pty Limited, Ecological and Environmental Consultants. It is one of several studies commissioned by Shoalhaven City Council, who is undertaking an investigation to determine whether a parcel of land, known as part Lot 28, DP 871790, in Seaspray Street Narrawallee can be rezoned to allow for urban expansion. The land which is currently zoned Environmental Protection 7(d2) (special scenic), is owned by Hanson South Coast Pty Limited of Jannali, NSW.

1.2 THE SCOPE OF THIS STUDY

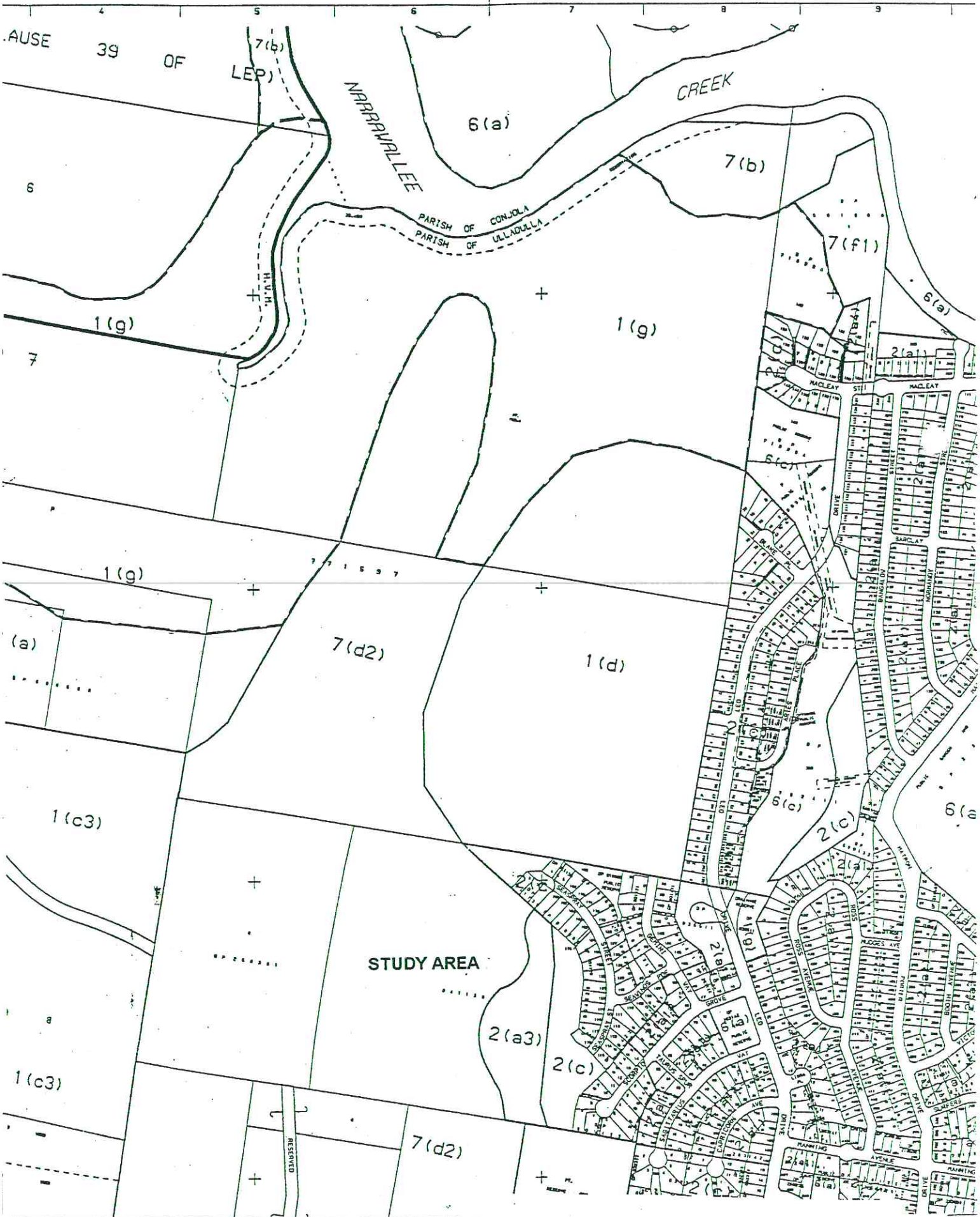
The principle aim of this study is to investigate the flora and fauna associated with the study area, to determine whether there are any environmental constraints to the proposal to rezone the land to enable residential subdivision. The report includes:

i. Flora

- an outline of the methodology;
- a description of the vegetation types found during the site survey;
- a map showing the distribution of the vegetation communities in the study area;
- a list of flora species recorded in the study area;
- threatened plant species recorded on the site, and a discussion of the significance of the species in a local, regional and state context;
- an assessment of the impact of the proposed rezoning on the vegetation, including threatened plant species;
- a statement as to whether on flora grounds the rezoning could or should not proceed and, if so, whether any special protection measures should be put in place to minimise the impact.

ii. Fauna

- an outline of the methodology;
- a description of the fauna habitats present;
- a list of the fauna species recorded in the study area;
- a description of the fauna expected to occur in the study area, based on the vegetation, fauna habitats and food trees available;
- threatened fauna species recorded on the site, and a discussion of the significance of the species in a local, regional and state context;
- a statement as to whether on fauna grounds the rezoning could or should not proceed and, if so, whether any special protection measures should be put in place to minimise the impact.



LOCAL ENVIRONMENTAL PLAN MAP

ENVIRONMENTAL PLANNING AND ASSESSMENT ACT, 1979

SHOALHAVEN L.E.P. 1985 – GAZ. 17 MAY 1985 AS AMENDED BY:

FIGURE 1
LOCATION AND LAND USE ZONING
IN THE VICINITY OF THE STUDY AREA

1.3 THE STUDY AREA

Narrawallee is a small coastal village that forms part of the Milton-Ulladulla urban area. The study area, known as part Lot 28 DP 871790, is approximately 13.71 hectares of land in Seaspray Street, on the western edge of the existing residential areas. The site is located on the western slope of a low ridge, about 20 to 45 metres above sea level, and in an adjacent small valley. Forest covers most of the study area. A concept plan for a proposed subdivision dated 11 April 1997 has been prepared by Watkinson, Apperley Pty Limited of Nowra.

1.4 INFORMATION ALREADY AVAILABLE

Kevin Mills & Associates carried out a brief flora and fauna study on land just north of the study area in 1994 (Kevin Mills & Associates 1994). The topography and vegetation are on both sites. The report described three vegetation communities, provided a brief list of the fauna observed and noted the threatened fauna species that likely to occur in the area.

In a major study of the flora and fauna in the Milton-Ulladulla district, which includes the Seaspray Street study area, Kevin Mills & Associates (1996) documented the flora and fauna of the district, prepared a vegetation map and identified the species of threatened and rare flora and fauna known to occur in the district. The vegetation in the present study area was described and mapped as PIL-SYN: Blackbutt Tall Forest; see Figure 2. The results of all previous studies of the flora and fauna in the Milton-Ulladulla area were summarised and/or incorporated into the project (Kevin Mills & Associates 1996).

In the study for the West Ulladulla Sports Complex, Kevin Mills & Associates (1997) recorded a broad range of flora and fauna species. Although several kilometres from the Seaspray Street study area, this report provides significant information on the flora and fauna in the Ulladulla district.

2 FLORA

2.1 METHODOLOGY FOR THE FLORA STUDY

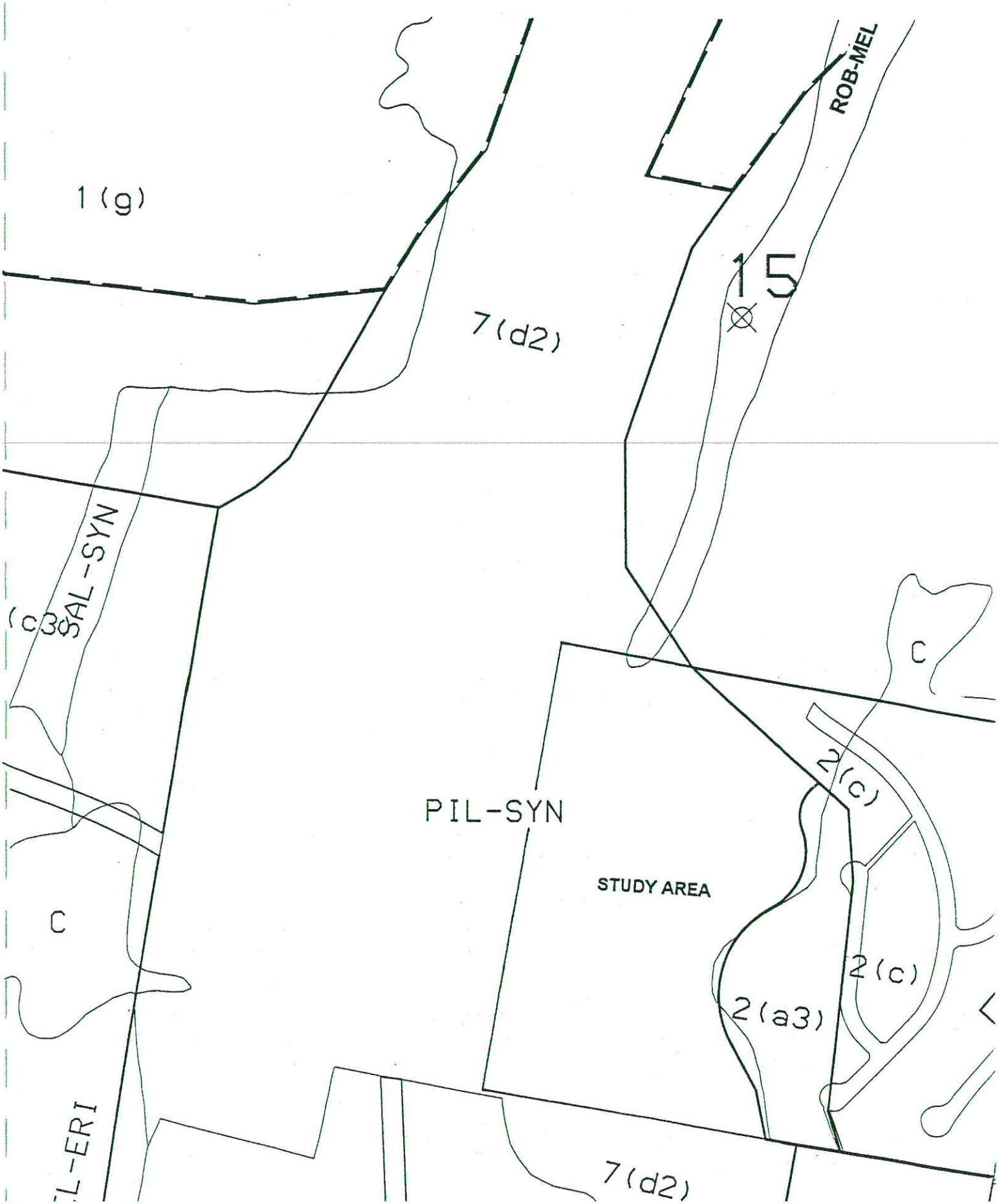
The vegetation survey was undertaken in February and March 1998. The survey methodology was designed to obtain a description of the plant communities in the study area and a comprehensive list of the native flora, including threatened species.

Vegetation Communities

The entire study area was traversed, in order to investigate the distribution and boundaries of the vegetation. The traverses were made on foot, and a good coverage of the study area was achieved. The boundaries of the plant communities were marked directly onto a map based on the subdivision plan prepared by Watkinson Apperley Pty Limited.

Vegetation survey sites were selected in locations considered to be typical of the local plant communities. Floristic data were recorded on a *pro forma* survey sheet at each survey site; these were about 30 metres by 30 metres in area. The vegetation was surveyed at four levels: the canopy (trees), middle canopy (trees), understorey (shrubs) and ground cover (plants less than one metre in height). The plant species in each stratum were recorded and an estimate was made of the height and proportional coverage of each stratum. The aim of the surveys was to describe the general character of the plant communities, so not every species on every site was recorded on the survey sheet. Notes were also made on the condition of the vegetation, the amount of disturbance, and evidence of logging, bushfire and weeds. The survey sheets (see Appendix 2) and notes taken during the field surveys form the basis of the

FIGURE 2
MAP OF THE EXISTING VEGETATION IN THE STUDY AREA



plant community descriptions in Section 2.2, which describe the floristic composition, structure, distribution and condition of the vegetation.

Australian vegetation classification systems are usually based on the name of the dominant species (the floristic association) and an expression of the growth form, height and cover of the vegetation (the structural formation). The classification system constructed by Walker and Hopkins (1984) is an example; see Appendix 1. In keeping with this practice, the names of the vegetation communities in this report are based on (i) the common name of the dominant species in the tallest stratum and (ii) the structure of the community.

Each plant community was given an identification code. The codes were developed by the consultant to standardize vegetation classification in the Shoalhaven local government area, and are specific to that area. More information on the vegetation survey methodology is available in "Vegetation Survey Methods and Natural Vegetation Types in the Coastal Parts of the City of Shoalhaven, New South Wales" (Mills 1996a).

Plant Species

A floristic audit was undertaken at the survey sites and during the traverses of the study area, for the purpose of identifying as many as possible of the plant species present. The resulting list of plant species is reasonably comprehensive, but not definitive. As this study is primarily concerned with the native vegetation, the plant list does not include non-native species.

Threatened Plants

The plant survey included a search for species listed on the *Threatened Species Conservation Act 1995.* Information on the distribution of threatened flora is obtainable from various botanical texts and from the Wildlife Atlas database of the National Parks and Wildlife Service.

The consultant also maintains a regional database of records of threatened and rare plant species. Because of personal experience and the availability of such resources, the consultant is familiar with the threatened and rare plant species occurring in the Milton-Ulladulla district and the habitats in which they usually occur. The study area was searched thoroughly for threatened plants during the survey.

Limitations of the Flora Study

The plant species list in this report is fairly comprehensive but additional species would no doubt be detected during a longer survey that included the different seasons. Some plant species are difficult to find and to identify for part of the year; for example, terrestrial orchids. Similarly, many grasses produce sufficient plant material to enable accurate identification for only part of the year. Many herbs are difficult to find until they produce fresh growth and flowers.

It follows, then, that survey results can be improved by conducting lengthy surveys. Generally, the longer the survey the more species will be recorded, until the collection of data reaches a plateau. Unfortunately, however, it is usually not feasible to delay or extend the duration of a survey to allow for seasonal variations. Most studies are subjected to budgetary and time constraints that determine the duration and the timing of the surveys. Many readers would be aware of these and similar methodological issues influencing the effectiveness of floristic surveys; the results of surveys should be considered in the light of these limitations.

Nomenclature

Most of the plant species names in this report are the current names published by the National Herbarium of New South Wales in the *Flora of New South Wales* (Harden 1990-1993). The taxonomic names are supplemented by common names obtained from various sources, such as the *Flora of New South Wales* (op. cit.) and *Australian Plant Genera* by Baines (1981).

2.2 PLANT COMMUNITIES

Most of the study area is covered in Blackbutt tall forest. A band of Woollybutt-Paperbark forest occurs along the creek. The vegetation on the site was previously mapped entirely as Blackbutt tall forest (Kevin Mills & Associates 1996); the scale of mapping was too broad to delineate the narrow band of Woollybutt-Paperbark forest. The vegetation from the 1996 study is provided in Figure 2.

The two vegetation communities in the study area are summarised in Table 1, and their structural and floristic characteristics are discussed below. Their distribution on the site is shown on Figure 3. The completed vegetation survey sheets are provided in Appendix 2 and the survey sites are shown on Figure 3.

Table 1
Plant Communities in the Study Area

Name	Dominant Species	Occurrence
PIL-SYN Blackbutt Tall Forest	*Eucalyptus pilularis* *Syncarpia glomulifera* *Eucalyptus gummifera* *Eucalyptus globoidea*	On the slopes in the eastern and western parts of the study area.
LON-MEL Woollybutt - Paperbark Forest	*Eucalyptus longifolia* *Melaleuca linariifolia* *Eucalyptus botryoides*	On the poorly drained flats at the base of the gully, in the western part of the study area.

PIL-SYN : Blackbutt Tall Forest
Eucalyptus pilularis - Syncarpia glomulifera - Eucalyptus gummifera - Eucalyptus globoidea

Structure: The Blackbutt tall forest is more than 30 metres in height, but shorter in some areas where it has been logged. Trees over 30 metres are still common in the lower part of the gully.

Occurrence: Blackbutt forest covers most of the study area; it occurs on the slopes on both sides of the gully, as well as on the adjacent ridges.

Description: The tall forest is dominated by Blackbutt *Eucalyptus pilularis* and the most commonly associated tree species are Turpentine *Syncarpia glomulifera* and Red Bloodwood *Eucalyptus gummifera*. Other trees in the community are Grey Ironbark *Eucalyptus paniculata*, Rough-barked Apple *Angophora floribunda* and White Stringybark *Eucalyptus globoidea*. A few Yertchuk *Eucalyptus consideniana* occur on the ridge on the eastern boundary of the study area. The medium-sized trees Black She-oak *Allocasuarina littoralis* and Old Man Banksia *Banksia serrata* are relatively common in some places. The shrubby understorey contains Hairpin Banksia *Banksia spinulosa*, Myrtle Wattle *Acacia myrtifolia*, Handsome Flat-pea *Platylobium formosum*, Giant Wedge Pea *Gompholobium latifolium*, Golden Wattle *Acacia longifolia* and Sunshine Wattle *Acacia terminalis*. The rather dense ground cover contains species such as Spiny-headed Mat-rush *Lomandra longifolia*, Rapier-sedge *Lepidosperma filiforme*, Common Bracken *Pteridium esculentum*, Native Sarsaparilla *Hardenbergia violacea*, Rough Guinea Flower *Hibbertia aspera* and Blady Grass *Imperata cylindrica*. Thickets of shrubs up to four metres in height occur along the lower slopes, containing species such as Blakely's Bush-pea *Pultenaea blakelyi*, Cheesetree *Glochidion ferdinandi*, Soft Geebung *Persoonia mollis* and Golden Wattle *Acacia longifolia*.

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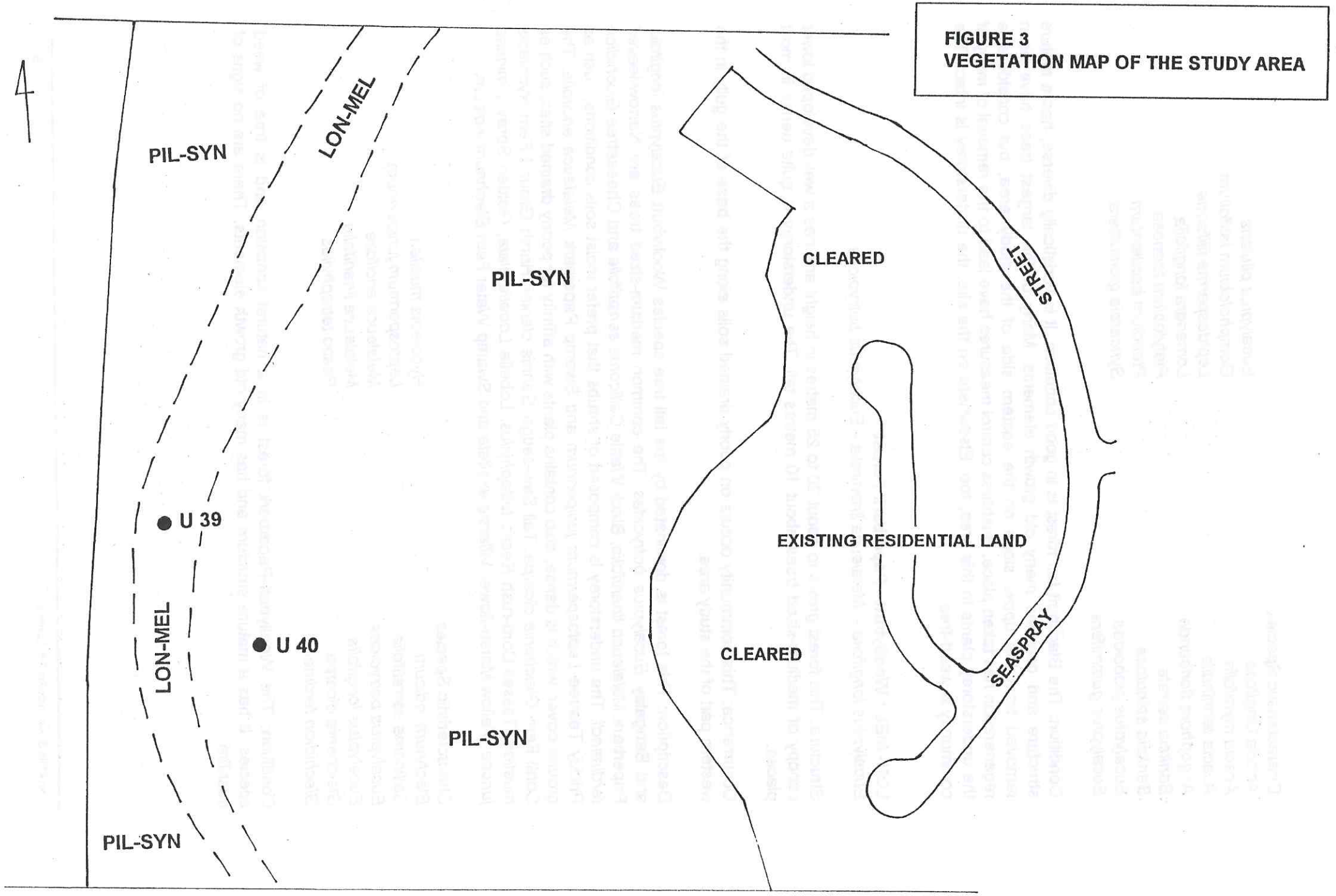
FIGURE 3
VEGETATION MAP OF THE STUDY AREA



Characteristic Species:

Acacia longifolia
Acacia myrtifolia
Acacia terminalis
Angophora floribunda
Banksia serrata
Banksia spinulosa
Eucalyptus globoidea
Eucalyptus gummifera
Eucalyptus pilularis
Gompholobium latifolium
Lepidosperma filiforme
Lomandra longifolia
Platylobium formosa
Pteridium esculentum
Syncarpia glomulifera

Condition: The Blackbutt tall forest is in good condition. It is floristically diverse, has a mature structure and contains many old growth elements. Many of the largest trees have been removed from the upper slope on the eastern side of the study area, but considerable regeneration has taken place. Bushfires control measures have lead to the removal of many of the understorey plants in this area, too. Elsewhere on the site, the understorey is intact. The community is weed-free.

LON- MEL : Woollybutt - Paperbark Forest
Eucalyptus longifolia - Melaleuca linariifolia - Eucalyptus botryoides

Structure: This forest grows to about 20 to 25 metres in height and has a well developed lower canopy of medium-sized trees about 10 metres tall. The understorey is quite dense in most places.

Occurrence: This community occurs on poorly drained soils along the base of the gully in the western part of the study area.

Description: This forest is dominated by the tall tree species Woollybutt *Eucalyptus longifolia* and Bangalay *Eucalyptus botryoides*. The common medium-sized trees are Narrow-leaved Paperbark *Melaleuca linariifolia*, Black Wattle *Callicoma serratifolia* and Cheesetree *Glochidion ferdinandi*. The understorey is composed of shrubs that prefer moist soils conditions, such as Prickly Teatree *Leptospermum juniperinum* and Swamp Paperbark *Melaleuca ericifolia*. The ground cover, which is dense, also contains plants with affinity for poorly drained sites, such as Coral Fern *Gleichenia dicarpa*, Tall Saw-sedge *Gahnia clarkei*, Harsh Ground Fern *Hypolepis muelleri*, Tassell Cord-rush *Restio tetraphyllus*, Lobelia *Lobelia alata*, Golden Spray *Viminaria juncea*, Yellow Marsh-flower *Villarsia exaltata* and Swamp Water Fern *Blechnum indicum*.

Characteristic Species:

Blechnum indicum
Callicoma serratifolia
Eucalyptus botryoides
Eucalyptus longifolia
Gleichenia dicarpa
Glochidion ferdinandi
Hypolepis muelleri
Leptospermum juniperinum
Melaleuca ericifolia
Melaleuca linariifolia
Restio tetraphyllus

Condition: The Woollybutt-Paperbark forest is in a natural condition and is free of weed species. It has a mature structure and has many old growth elements. There are no signs of bushfire.

2.3 PLANT SPECIES

The native plant species recorded in the study area are listed in Appendix 3; 110 native species were recorded and no doubt more would be found during a longer and more intensive study. Weed species were not recorded. The site is almost free of weeds; the only weeds found in the area were growing on the cleared land at the eastern edge of the study area.

2.4 THREATENED FLORA

The *Threatened Species Conservation Act 1995* conserves threatened species, populations and ecological communities in New South Wales. Threatened plant species are listed on the schedules attached to the Act and are classified either as "endangered" (Schedule 1 species), "vulnerable" (Schedule 2 species) or "presumed extinct" (Schedule 1, Part 4).

The CSIRO has undertaken extensive research into the conservation status of Australian plant species and has prepared a list of rare or threatened Australian plants, commonly known as ROTAP species, for each state (Briggs & Leigh 1996). All plant species listed under the *Threatened Species Conservation Act 1995* appear on the ROTAP list, so all plant species that are threatened in New South Wales are also considered to be vulnerable or endangered on a national basis. The ROTAP list is much larger, however, because it has an additional category, for "rare" plant species.

Plant species may also be uncommon, rare or important for conservation reasons in a regional context. For example, the species might be at or near the limit of its geographical range (latitude or altitude), it may be an outlying population or it may be rare in a specified region. Unfortunately, few regional assessments of plant species have been made. However, the conservation status of the coastal flora in the Shoalhaven region has been assessed (Mills 1996b). The study by Kevin Mills & Associates (1996) identified several rare and regionally significant plant species in the Ulladulla area and the study by Kevin Mills & Associates (1997) discussed those species of threatened flora that are known to occur or which could occur in the Ulladulla area.

No threatened plant species were found during the course of the field study; none of the species recorded in the study area are listed on the *Threatened Species Conservation Act 1995*. However, one species of interest is *Blechnum indicum*, a fern that occurs in a large population in the base of the gully in the study area, in the Woollybutt forest. This fern reaches its southern limit of distribution in the Milton-Ulladulla area; it is known to occur just south of the study area at Ulladulla, but not in such abundance.

3 FAUNA

3.1 METHODOLOGY FOR THE FAUNA STUDY

The fauna survey was undertaken in February and March 1998, during a drought. The weather was very hot and dry; there had been no substantial rain for several months.

Species Detection

The survey concentrated on mammals, avifauna, reptiles and amphibians. The aim of the survey was to detect as many as possible of the fauna species present. Several techniques were used to detect and identify the fauna in the study area. These methods included opportunistic or chance sightings of mammals during daylight and searches for scats, tracks, runways, diggings and other signs of mammal presence. Triggs (1996) discusses how these methods are used to identify mammals. Birds were identified in the field by observation and/or

call. Reptiles and amphibians were sought in suitable habitats. Habitat niches were targeted, and rocks and logs were removed and then carefully replaced in the search for fauna.

The ANABAT microchiropteran bat detection and identification system was used to identify the species of bats occurring in the study area. "Bandicoot" traps were used in an attempt to trap and identify which species of small and medium-sized mammals occur in the study area. Ten traps were set along a transect about 200 metres long. The traps were in the ecotone between the two forest communities near the base of the valley, in thick undergrowth where many bandicoot diggings were found. The traps were baited with a combination of peanut butter, honey, bread and/or apple, and were left in position for two consecutive nights.

Three bird counts were undertaken in the study area; this involved searching the whole study area and recording the numbers of each species seen or heard. Spotlighting was undertaken on two nights to locate mammals, particularly arboreal species, birds and frogs that are active at night.

Fauna Habitats

A description of the fauna habitats in the study area was prepared, because the types of habitats available in an area influence which fauna (including threatened species) occur there, as well as the diversity and abundance of fauna. The vegetation community descriptions provide a good source of information on the habitats present, but other data were also collected such as the presence/absence of rock outcrops, tree hollows, dams and streams, organic ground litter, habitat niches, prolific flowering and habitat features with the potential to attract threatened fauna. The fauna habitat study therefore has an important role in predicting threatened fauna likely to occur in the study area.

Threatened Species

Information on the distribution of threatened fauna is obtainable from various reports and publications, and from the Wildlife Atlas database of the National Parks and Wildlife Service. The consultant also maintains a regional database of records of threatened and uncommon fauna. Because of personal experience and the availability of such resources, the consultant is familiar with most threatened fauna occurring in the Milton-Ulladulla district. Threatened fauna were searched for by the methods already described.

Limitations of the Fauna Study

The results of fauna studies can be optimised by conducting the surveys over a long period, to compensate for the effect of unfavourable weather on survey results and to account for seasonal change and climatic variation. In principle, the longer the survey the more species will be recorded, until the recording of additional species peters out. Results can also be improved by utilising a wide range of species detection techniques, because some fauna are detected by particular methods. These methods may include the direct observation of animals, spotlight surveys, call identification, habitat analysis to predict species' presence, scat identification, scat analysis, the laying of box traps, pitfall traps and hair tubes, the use of harp nets, sonar detection devices and pre-recorded playback tapes.

However, as already discussed, flora and fauna studies are subject to budgetary and time constraints that determine the amount of time allocated, the timing of the surveys and the species detection methods used. Many readers would already be aware of these and similar issues influencing the effectiveness of fauna surveys. The results of the survey should be viewed in the light of these limitations.

Thus, the fauna survey results are only a guide to the native fauna present and are by no means a definitive list of the species occurring in the study area. A complete inventory of species can only be obtained by an intensive fauna survey program spanning all seasons.

Nomenclature
The nomenclature in this report is based on the Australian Museum's *The Mammals of Australia* edited by Strahan (1995), the Royal Australasian Ornithologists Union's *The Taxonomy and Species of Birds of Australia and its Territories* by Christidis and Boles (1994) and *Reptiles and Amphibians of Australia* by Cogger (1992).

3.2 FAUNA HABITATS

The fauna habitats in the study area are closely associated with the vegetation communities described in Section 2.2. The main habitat is forest with an understorey of dense shrubs and small trees. The forest contains large Blackbutt *Eucalyptus pilularis* trees with hollows, although many of the trees are smaller and have not developed hollows. The many large dead trees throughout the forest also have many hollows. Most of the large Blackbutt trees are down the slope near the base of the gully; many have large hollows. The ground cover is generally a dense growth of small plants. Organic litter is abundant, as well as fallen trees left from logging. The trees are more widely spaced on the poorly drained flat along the base of the small valley, the ground cover and shrub layer are very dense and grow to about two metres. A more detailed description of the vegetation of the area can be obtained from Section 2.2.

The creek which flows through the western part of the study area is not permanent, it mainly seeps through the ground. The vegetation along the creek is very dense. There are no pools along the creek. There are no rock outcrops in the study area. The soils are very sandy.

3.3 FAUNA SPECIES

Mammals
The mammals recorded in the study area are listed in Table 2, with notes on the method of detection. Fourteen mammal species were recorded, 12 native and two non-native species. Four species were recorded on adjacent land during a previous study (Kevin Mills & Associates 1994); these are indicated in the table by the letter "A". Several other mammals may also occur in the study area, such as the Grey-headed Flying-fox *Pteropus poliocephalus*, Dusky Antechinus *Antechinus swainsonii*, Red-necked Wallaby *Macropus rufogriseus* and other microchiropteran bat species.

Table 2
Mammal Species recorded in the Study Area

Species	Method of Detection: Day obs.	Night obs.	Trapped	Diggings/ burrows	Scats/ dung	Dreys (nests)	Calls
Brown Antechinus *Antechinus stuartii*	Remains found						
Bush Rat *Rattus fuscipes*			X		A		
Chocolate Wattled Bat *Chalinolobus morio*							X
Common Brushtail Possum *Trichosurus vulpecula*		X	X				
Common Ringtail Possum *Pseudocheirus peregrinus*					X, A	X	

Eastern Grey Kangaroo *Macropus giganteus*	X			X	
Fox* *Vulpes vulpes*	X			X, A	
Greater Glider *Petauroides volans*		X			
Large Forest Bat *Vespadelus darlingtoni*					?
Long-nosed Bandicoot *Perameles nasuta*	?		?		
Rabbit* *Oryctolagus cuniculus*			?		
Short-beaked Echidna *Tachyglossus aculeatus*			X		
Sugar Glider *Petaurus breviceps*					X
Swamp Wallaby *Wallabia bicolor*	X, A				

* Introduced species. A: Recorded on the adjacent site.

The results of the spotlight surveys, undertaken over a period of two nights, are provided in Table 3. Two arboreal mammal species were observed on the study area; these are the Greater Glider and Common Brushtail Possum. The Sugar Glider was heard and a fourth species, the Common Ringtail Possum, was recorded by the presence of dung and dreys (nests) in the study area. The survey results indicate that there is a good population of arboreal mammals in the forests in the study area, consistent with the quality of the forest and the abundance of tree hollows.

Table 3
Results of Spotlight Surveys in the Study Area

Species	No.	Notes
22 February 1998 8.15pm - 10.15pm		
Greater Glider	2	In *Eucalyptus pilularis*
Greater Glider	2	In *Syncarpia glomulifera*
Common Brushtail Possum	1	In *Angophora floribunda*
23 February 1998 8.30pm - 9.30pm		
Greater Glider	2	In *Eucalyptus botryoides*
Greater Glider	2	In *Eucalyptus pilularis*
Greater Glider	1	In *Syncarpia glomulifera*
Sugar Glider	1	Calls heard

Avifauna

The bird species recorded in and adjacent to the study area during the survey or during the 1994 survey on the adjacent land are listed in Table 4. Forty-nine species were observed and/or heard; all except one are native species. The information in Table 4 is supplemented in Appendix 4, by a list of all of the birds ever recorded in the Ulladulla district; the list was compiled from various sources, as indicated in the Appendix.

Table 4
Bird Species recorded in and near the Study Area

Common Name	Taxonomic Name	Study Area	Adjacent
Australian King-Parrot	*Alisterus scapularis*	X	A
Australian Magpie	*Gymnorhina tibicen*	X	A
Australian Raven	*Corvus coronoides*	X	A
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	X	A
Brown Gerygone	*Gerygone mouki*	X	A
Brown Thornbill	*Acanthiza pusilla*	X	A
Crested Pigeon	*Ocyphaps lophotes*		A
Crested Shrike-tit	*Falcunculus frontatus*		A
Crimson Rosella	*Platycercus elegans*	X	A
Eastern Spinebill	*Acanthorhynchus tenuirostris*	X	A
Eastern Whipbird	*Psophodes olivaceus*	X	A
Eastern Yellow Robin	*Eopsaltria australis*	X	
Galah	*Cacatua roseicapilla*		A
Gang-gang Cockatoo	*Callocephalon fimbriatum*	X	
Golden Whistler	*Pachycephala pectoralis*	X	A
Grey Butcherbird	*Cracticus torquatus*	X	A
Grey Fantail	*Rhipidura fuliginosa*	X	
Grey Shrike-thrush	*Colluricincla harmonica*	X	A
Laughing Kookaburra	*Dacelo novaeguineae*	X	A
Lewin's Honeyeater	*Meliphaga lewinii*		A
Little Wattlebird	*Anthochaera chrysoptera*	X	
Magpie-lark	*Grallina cyanoleuca*		A
Mistletoebird	*Dicaeum hirundinaceum*	X	A
Musk Lorikeet	*Glossopsitta concinna*	X	
New Holland Honeyeater	*Phylidonyris novaehollandiae*	X	A
Noisy Friarbird	*Philemon corniculatus*		A
Olive-backed Oriole	*Oriolus sagittatus*	X	
Peaceful Dove	*Geopelia striata*	X	
Pied Currawong	*Strepera graculina*	X	A
Powerful Owl	*Ninox strenua*	X	A
Rainbow Lorikeet	*Trichoglossus haematodus*	X	A
Red Wattlebird	*Anthochaera carunculata*	X	A
Red-browed Finch	*Neochmia temporalis*	X	A
Rufous Fantail	*Rhipidura rufifrons*	X	
Rufous Whistler	*Pachycephala rufiventris*	X	
Satin Bowerbird	*Ptilonorhynchus violaceus*	X	
Silvereye	*Zosterops lateralis*		A
Spotted Pardalote	*Pardalotus punctatus*	X	A
Spotted Turtle-Dove*	*Streptopelia chinensis*		A
Striated Thornbill	*Acanthiza lineata*	X	A
Sulphur-crested Cockatoo	*Cacatua galerita*		A
Superb Fairy-wren	*Malurus cyaneus*	X	
Variegated Fairy-wren	*Malurus lamberti*	X	
Whistling Kite	*Haliastur sphenurus*	X	
White-bellied Sea-Eagle	*Haliaeetus leucogaster*		A
White-browed Scrubwren	*Sericornis frontalis*	X	A
White-throated Treecreeper	*Cormobates leucophaeus*	X	A
Yellow-faced Honeyeater	*Lichenostomus chrysops*		A
Yellow-tailed Black-Cockatoo	*Calyptorhynchus funereus*		A

1. X: recorded in the study area; A: recorded on adjacent land, includes the species listed in the report by KMA (1994). * Introduced species.

The results of the bird counts in the study area are presented in Table 5; 34 species were recorded. The birds recorded are typical of this forest type in the Milton-Ulladulla district.

Table 5
Results of Bird Counts in the Study Area

Species[1]	23.2.98 8.30am-9.45am	23.2.98 5.00pm-6.15pm	24.2.98 6.45am-8.15am
Australian King-Parrot			5
Australian Magpie	1	3	1
Australian Raven	1		1
Black-faced Cuckoo-shrike		1	4
Brown Gerygone	1		
Brown Thornbill	7	7	6
Crimson Rosella	3	4	9
Eastern Spinebill	3		1
Eastern Whipbird			1
Eastern Yellow Robin		2	
Gang-gang Cockatoo			2
Golden Whistler	3	2	1
Grey Butcherbird			1
Grey Fantail	4	3	1
Grey Shrike-thrush	2	1	1
Laughing Kookaburra			1
Little Wattlebird		1	
Mistletoebird			1
Musk Lorikeet		1	4
New Holland Honeyeater	1		1
Olive-backed Oriole			2
Pied Currawong		1	
Rainbow Lorikeet	2	6	2
Red Wattlebird			2
Red-browed Finch	6	2	9
Rufous Fantail	1		1
Rufous Whistler	1		
Satin Bowerbird			1
Spotted Pardalote	2		2
Striated Thornbill	2		6
Superb Fairy-wren			
Variegated Fairy-wren			2
White-browed Scrubwren			3
White-throated Treecreeper	1	1	2
No. of Birds	41	35	73
No. of Species (total 34)	17	14	28

1. The taxonomic name of each species can be ascertained from Table 4.

Reptiles and Amphibians

Only three reptiles were recorded during the study, and no frogs were found; see Table 6. The low species diversity and abundance is no doubt attributable to the sustained period of drought. Two amphibian species were recorded nearby during the 1994 study; these species would also occur in the study area, where similar habitat is available. Additional species from these groups no doubt occur in the study area.

Table 6
Reptiles and Amphibians recorded in and near the Study Area

Species	Taxonomic Name	Method of Detection
Frogs		
Brown-striped Frog	*Limnodynastes peronii*	Recorded by KMA (1994)
Common Eastern Froglet	*Crinia signifera*	Recorded by KMA (1994)
Reptiles		
Eastern Water Skink	*Eulamprus quoyii*	Observed
Grass Skink	*Lampropholis guichenoti*	Observed
Jacky Lizard	*Amphibolurus muricatus*	Observed

3.4 THREATENED FAUNA

The *Threatened Species Conservation Act 1995* conserves threatened species, populations and ecological communities of animals and plants in New South Wales. Threatened fauna are listed on the schedules attached to the Act and are classified either as "endangered" (Schedule 1 species), "vulnerable" (Schedule 2 species) or "presumed extinct" (Schedule 1, Part 4).

One threatened fauna species, the Powerful Owl, was recorded in the study area and several other species are known to occur in the local area. The potential for these species to occur in the study area is discussed below. Threatened fauna species recorded within a five kilometre radius of the study area and species that may occur there because of the availability of apparently suitable habitat are listed below in Table 7. The table and subsequent discussion do not include threatened fauna species for which there is no suitable habitat in the study area; for example, wetland birds are not included because there are no wetlands on the site and coastal birds are not included because the site is inland.

The study area is within the general distributional range of many species of threatened fauna. Not all were formally assessed, however; the reasons for their not being assessed include one or more of the following:

- the species has not been recorded in the study area or in the locality;
- it is so long since the species was last recorded that it is considered to have become locally extinct;
- the study area does not contain suitable habitat for the species;
- the habitat to be affected does not have the features required by these ecological specialists;
- the home range of the species is so large and the habitat to be affected in the study area is so small that the species would not be at risk;
- some species, for example migrating forest birds, are recorded so rarely in the locality that their occurrence is considered to be incidental.

Table 7
Threatened Fauna that may occur in the Study Area

Schedule 1 - Endangered Species	
Amphibians	
Litoria aurea	Green and Golden Bell Frog
Birds	
Xanthomyza phrygia	Regent Honeyeater
Mammals	
Isoodon obesulus	Southern Brown Bandicoot
Schedule 2 - Vulnerable Species	
Amphibians	
Heleioporus australiacus	Giant Burrowing Frog
Birds	
Calyptorhynchus lathami	Glossy Black-Cockatoo
Lathamus discolor	Swift Parrot
Ninox strenua	Powerful Owl
Mammals	
Miniopterus schreibersii	Common Bentwing-bat
Petaurus norfolcensis	Squirrel Glider

Threatened Species recorded in the Study Area

Powerful Owl

Class Aves
Order Strigiformes
Family Strigidae
Species *Ninox strenua* (Gould 1838)
Threatened Species Conservation Act 1995 (Schedule 2): threatened species (vulnerable)

Description
The Powerful Owl is a large dark hawk-owl with yellow eyes, dark grey above and whitish underneath, with coarse V-shaped bars on its underside and broad bars on its upperparts. The male is larger than the female; the mature male is generally about 55cm in length and up to about 1.75kg in weight.

Distribution and Abundance
The Powerful Owl occurs along the coast and ranges of eastern Australia, from near Rockhampton in Queensland, southwards throughout eastern New South Wales and Victoria. It mainly occurs on the coastal side of the Great Dividing Range but in some places its distribution extends inland to the western slopes. The size of the population remains unknown, but the species is thinly distributed across this range. In New South Wales the species is considered to be "uncommon" (Morris, McGill & Holmes 1981), a term referring to species with an estimated population of 1,000-10,000 birds. Garnett (1992) rated it as nationally rare. In a review of the species' distribution, habitat, biology and status in New South Wales, Debus and Chafer (1994) collated and analysed 516 records of the Powerful Owl from 267 locations and concluded that, although the species is more numerous than previously thought, it is "probably uncommon in New South Wales (as assessed by Morris et al. 1981)".

Habitat
The Powerful Owl prefers tall moist open eucalypt forests on hilly terrain, sometimes with a rainforest component, but is known to occur in a wider range of forest types such as drier forest and woodland, and urban bushland. Debus and Chafer (1994) found that, in New South Wales, "tall open and open forest appear to be its most important habitat types, [but] it also uses woodland and riparian habitats". Debus and Chafer (1994) described the species' roosting habitat as "a variety of sites [ranging] from dense canopy and substorey trees within rainforest and open forest, often in gullies, to canopy trees in woodland. Commonly recorded roost sites in coastal areas [of southern New South Wales] are Red Turpentine *Syncarpia glomulifera* in tall open forest, and Black She-oak *Allocasuarina littoralis* in open forest . . . [with] dense crowns". At Kioloa, Davey (1993) recorded the Powerful Owl in mid and late successional forest and in uneven-aged forest, but not in forest with a development age of less than 70 years.

Estimates of the species' home range vary from 400-600 hectares per family group (Davey 1993) to 800-1,000 hectares (Schodde & Mason 1980), and neighbouring pairs have been recorded 3-10 kilometres apart (Fleay 1968) and, in one location, as close as 400 metres apart (Quinn 1993). Obviously, the quality of the habitat and the abundance of prey influence the size of the home range.

Behaviour
The Powerful Owl is a reclusive and quite sedentary species that occupies a permanent territory, either singly or in pairs. It roosts on the branches of trees in gullies by day and hunts at night, mainly in forests with an open structure and along the edge of forests.

Breeding

Debus and Chafer (1994) found that the nest trees of Powerful Owls are in tall open forest or open forest, "in live eucalypts, often the largest in a stand and probably among the oldest within a patch of forest". The nesting sites are usually large vertical hollows in tree trunks in gullies in hilly or mountainous country (Beruldsen 1980); large tree hollows are required for nesting, at least 0.5m deep (Schodde & Mason 1980). The species is long lived, and is a seasonal breeder; it breeds only once a year and produces only one or two fledglings. Breeding occurs from late autumn to mid winter. Nest failures are common and the species has a low breeding recruitment rate (Debus & Chafer 1994).

Diet

The Powerful Owl mainly eats arboreal mammals such as the Common Ringtail Possum *Pseudocheirus peregrinus*, Greater Glider *Petauroides volans*, Sugar Glider *Petaurus breviceps*, other arboreal mammals, and birds. The species' diet varies from region to region, depending on the local availability of prey. In southern coastal New South Wales, its main prey species is the Common Ringtail Possum (Debus & Chafer 1994).

Conservation Status

The Powerful Owl is listed on Schedule 2 of the *Threatened Species Conservation Act 1995*; it is vulnerable in New South Wales. The species was listed because its population is suspected to have been reduced, its distribution has been reduced, the potential for recovery is poor, the threatening processes are moderate and it is an ecological specialist (NPWS 1992). Although the species has traditionally been regarded as rare or uncommon, some recent studies have shown that it is more common than once thought.

Debus and Chafer (1994) analysed the distribution of 267 sites at which the species has been recorded in New South Wales and found that, "in NSW the Powerful Owl has been recorded at 73 sites in 46 state forests, and 52 sites in 32 conservation reserves. . . . Many of the sites in conservation reserves (and about half of these reserves) are on the infertile Hawkesbury-Shoalhaven Plateaux, in poorer quality habitat unwanted for wood production. In other words, there is little high quality owl habitat specifically reserved for conservation." The adequacy of reservation in the Shoalhaven region is unknown for, as Debus and Chafer (1994) pointed out, "conservation reserves have been poorly surveyed for owls relative to state forests, and there are ameliorative effects from conservation efforts within state forests".

Threats

Historically, the main threat to the Powerful Owl was the loss of habitat when forests were cleared on a large scale for farming purposes. The species is still adversely affected by the clearing of habitat and inappropriate forest management practices. Intensive logging leads to the loss of old growth elements and nesting hollows, and a reduction in the availability of prey. Several authors (e.g. Kavanagh 1991, Tanton 1994, Debus & Chafer 1994), provide a summary of recent research into the impact of logging practices on Powerful Owls and their prey species.

Debus and Chafer (1994) made the following assessment of the threats to the Powerful Owl: "Given that about 20% of the tall open forest and 50% of the open forest in NSW has been cleared (from Lunney 1991), populations of the Powerful Owl may have declined by up to 50% through habitat loss; its remaining habitat is fragmented and subjected to logging, grazing, burning etc. However, Owls may be more abundant in high site-quality (tall open forest) than in lower site-quality (open) forest, meaning that populations may have declined by somewhat less than 50%. The concern is whether it can survive in forest that is converted from old growth to regrowth or plantations (exotic or native), because intensive forestry practices removed many hollows which are potential nest sites for the Owls or den sites for their prey. Intensive logging also causes a decline in arboreal hollow-dependent marsupials, particularly the Greater Glider."

Occurrence in the Shoalhaven Region and in the Milton-Ulladulla Area
The Powerful Owl has been recorded throughout the Shoalhaven region, and is exptected to occur wherever there is well developed forest. There has apparently been one record of the Powerful Owl in the Milton-Ulladulla area; it was sighted at "Milton" in August 1994, as reported by Morris and Burton (1996). Other records in the district are from north of Lake Conjola and southwest of Burrill Lake (NPWS Wildlife Atlas).

Habitat in the Study Area
The forest in the study area is ideal habitat for the Powerful Owl. Several very large eucalypts provide potential nest sites for the owls, and arboreal mammals are common on the site, four species were recorded. The forest in the study area is contiguous with a large area of forest extending to the north and south; see Figure 4.

Results of Surveys in the Study Area
A Powerful Owl was heard calling in the southern part of the study area on the night of 23 February 1998. The owl called for about half an hour and then was quiet. Two owls were heard about 20 minutes later, calling from trees just south of the study area. The study area is within the territory of a pair of owls that appear to range throughout the forests in the Narrawallee area; see Figure 5.

Threatened Species that may occur in the Study Area
In addition to the Powerful Owl, another eight threatened species are likely to occur in the Narrawallee area. These species are discussed below because of their potential to occur in the study area, although none were recorded there during this study.

Green and Golden Bell Frog
Status in New South Wales: Endangered; the species was listed on Schedule 1 of the *Threatened Species Conservation Act 1995* because its population has been severely reduced over the entire range and the threatening processes are severe (NPWS 1992).

Distribution and Abundance: The Green and Golden Bell Frog *Litoria aurea* occurs in eastern and southeastern New South Wales and in eastern Victoria. Its northern limit is at Byron Bay. It usually occurs at low altitudes but, in the southern part if its range, it is also found on the southern tablelands.

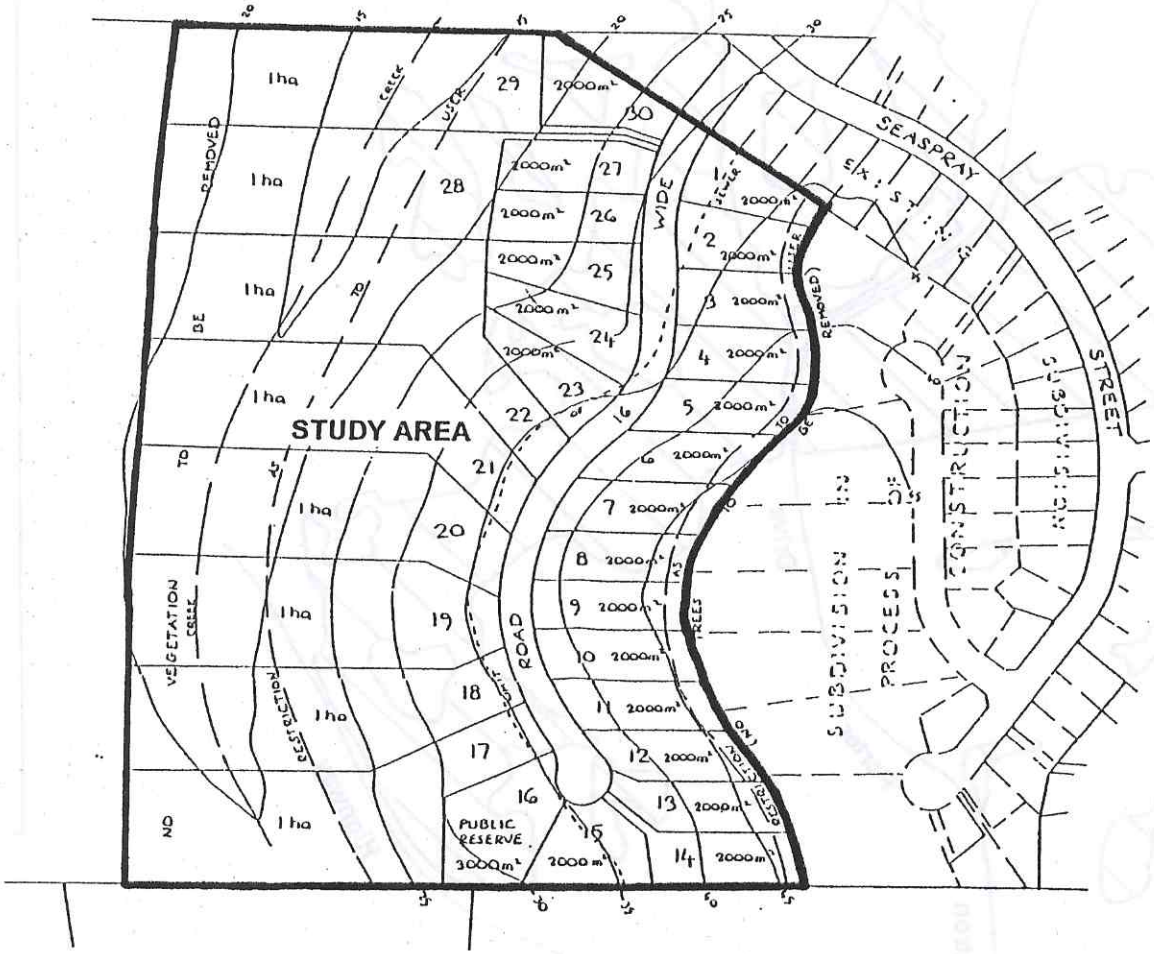
Habitat, etc.: Cogger (1992) described the habitat of this species as "vegetation within or at the edge of permanent water - streams, swamps, lagoons, farm dams and ornamental ponds. [It is] often found under debris on low, oft-flooded river flats." However, Pyke and White (1995) found populations associated with wetlands of a more ephemeral nature. Although such habitat is abundant throughout eastern New South Wales, the species is still uncommon, probably because of the presence of the Mosquitofish *Gambusia affinis*. Green and Golden Bell Frogs are very mobile; they move over long distances and readily inhabit highly disturbed sites and unstable environments (White & Pyke 1995). However, if the site becomes more stable, for example by the growth of emergent reeds in previously barren waterbodies or by the growth of fringing vegetation, the Green and Golden Bell Frog's competitors also occupy the site, perhaps to its detriment.

Threats: The Green and Golden Bell Frog has declined markedly in abundance in the past decade. The presence of predatory fish influences the species' use of a site, by causing it to abandon the area or by preventing breeding. The Green and Golden Bell Frog does not defend its egg mass or protect its tadpoles, and *Gambusia* are known to eat the spawn as well as recently hatched tadpoles (White 1995). The frogs breed successfully in fish-free waters, such as temporary pools and stormwater overflows.

SKETCH PLAN
OF PROPOSED SUBDIVISION OF
PART LOT 10 D.P.
OFF SEASPRAY STREET, NARRAWALLEE
FOR: HANSON SOUTH COAST PTY. LTD.
REDUCTION RATIO 1:2000

N

NOTE LOTS 1 - 15 INCL. TO BE CONNECTED TO SEWER
LOTS 16 - 30 INCL. SEWER BY INDIVIDUAL PUMPS



LOCALITY SKETCH

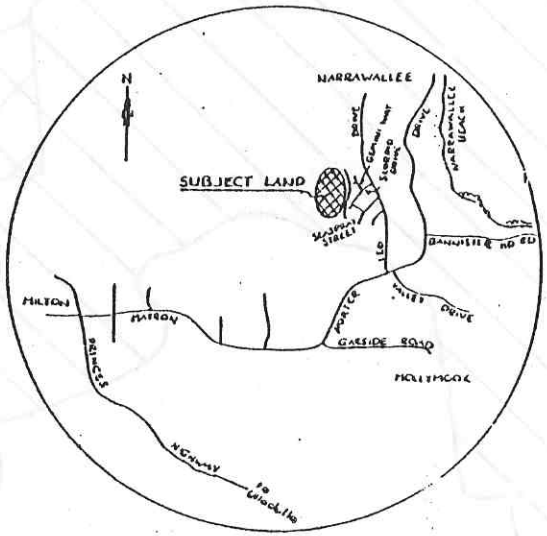


FIGURE 4 CONCEPT SUBDIVISION PLAN

WATKINSON, APPERLEY PTY. LTD.
SURVEYORS & ENGINEERS
51 GRAHAM STREET, NOWRA, 2541
PHONE: (044) 21 4500
FAX: (044) 231498

DATE 11 APRIL 1997

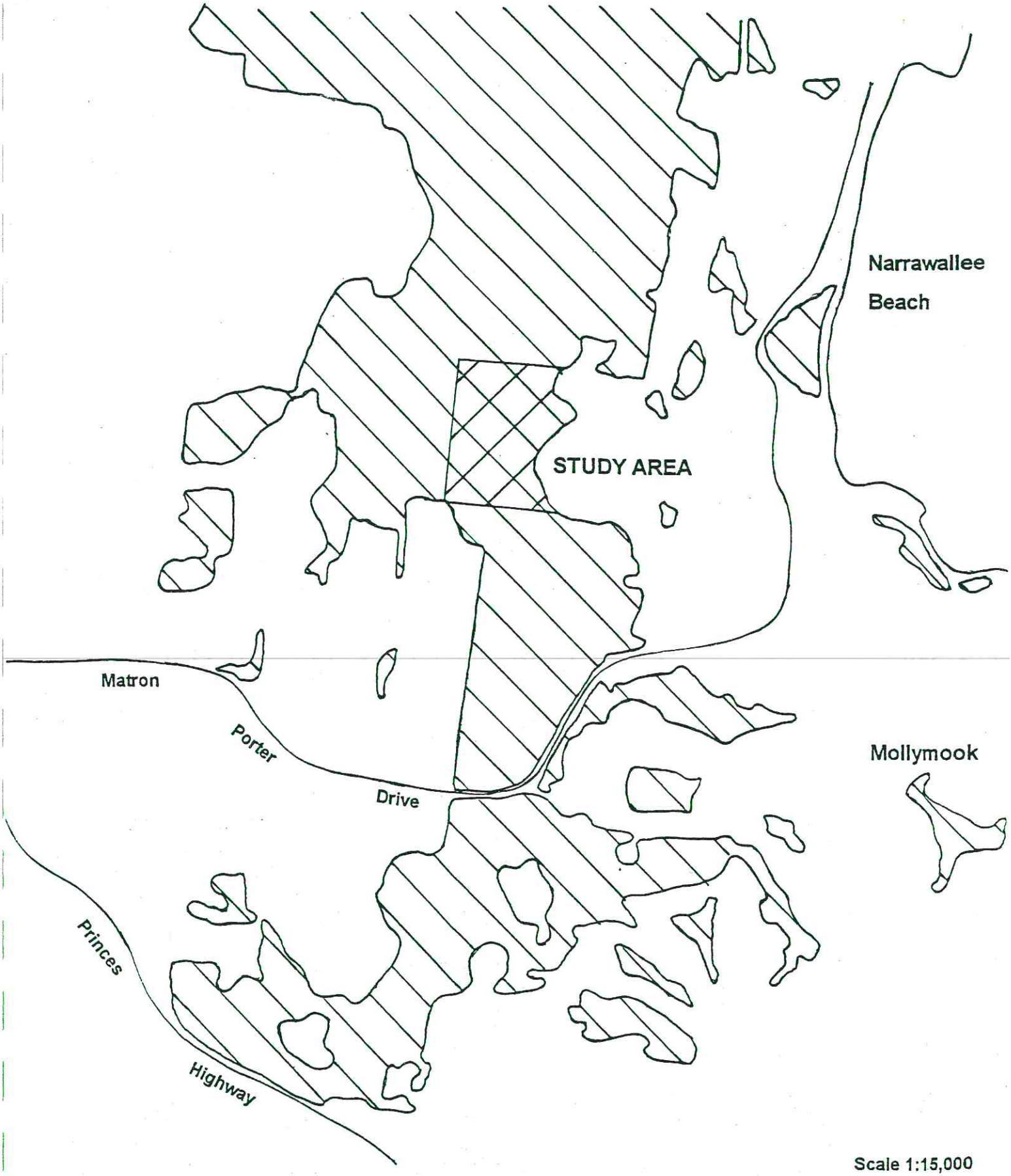


FIGURE 5
EXTENT OF FORESTED LAND IN THE NARRAWALLEE AREA

Occurrence in the District: The Green and Golden Bell Frog has been recorded throughout the coastal parts of the Shoalhaven, although many of the records are pre-1980. Although there are apparently no records from the Milton-Ulladulla district, there are records from: Bendalong (1988; Pyke & White 1996), Lake Conjola (1978; Pyke & White 1996) and Termeil (1965, 1986; Pyke & White 1996).

Potential to Occur in the Study Area: There is no permanent water in the study area and pools probably occur only temporarily, after heavy rain. The species could conceivably occur in the creek further down the valley, beyond the study area, where freshwater may be more permanent. It is unlikely, but not inconceivable, that the Green and Golden Bell Frog would occur in the study area, for it is quite mobile and is sometimes found in ephemeral wetlands.

Regent Honeyeater

Status in New South Wales: Endangered; the species was listed on Schedule 1 of the *Threatened Species Conservation Act 1995* because its population and distribution have been reduced to a critical level, the species concentrates in particular areas, the threatening processes are severe and it is an ecological specialist (NPWS 1992).

Distribution and Abundance: The range of the Regent Honeyeater *Xanthomyza phrygia* extends from southeast Queensland to western Victoria, along the coast and mountains. Its distribution is patchy, for its abundance and range have contracted considerably since 1950 (Blakers, Davies & Reilly 1984); it is absent from parts of its former range and has become vagrant in others.

Habitat, etc.: The Regent Honeyeater is highly nomadic. It mainly occurs in "temperate eucalypt woodland and open forest, including forest edges, wooded farmland and urban areas with mature trees" (Garnett 1992). According to Webster and Menkhorst (1992), Red Ironbark *Eucalyptus sideroxylon*, White Box *Eucalyptus albens* and Yellow Box *Eucalyptus melliodora* are among its favoured trees and the species prefers areas with large trees, many flowering trees and a tall shrub layer.

Threats: The Regent Honeyeater initially declined when large areas of forest were cleared in the 1800s and early 1900s. Webster and Menkhorst (1992) suggest that, since then, the species has been affected by a steady decline in habitat quality, particularly by the loss of old trees; this has been compounded by the effects of dieback and general tree decline in rural areas. The honeyeater must compete with larger and more aggressive birds for the remaining habitat.

Occurrence in the District: The Regent Honeyeater was recorded at Lake Conjola in December 1994 (Morris & Burton 1996) when eight birds were observed; this is apparently the only record from the Milton-Ulladulla district. The species is likely to be only a rare visitor to the coastal parts of the Shoalhaven.

Potential to occur in the Study Area: The Regent Honeyeater may occasionally occur in the forests of the study area, but there are no special features in the study area to attract it, other than flowering eucalypts that also occur throughout the district. The autumn-flowering *Eucalyptus longifolia* may be important for many honeyeaters, although most records of the Regent Honeyeater are obtained in summer.

Southern Brown Bandicoot

Status in New South Wales: Endangered; the species was listed on Schedule 1 of the *Threatened Species Conservation Act 1995* because its population and distribution have been severely reduced and the threatening processes are severe (NPWS 1992).

Distribution and Abundance: The Southern Brown Bandicoot *Isoodon obesulus obesulus* occurs across southern Australia, in southwestern Western Australia, New South Wales and Victoria. In New South Wales, it occurs around Eden and Sydney (Ashby, Lunney, Robertshaw & Harden 1990). Another subspecies, *peninsulae*, occurs at Cape York in Queensland. The range of the Southern Brown Bandicoot has contracted in southern Australia since European settlement, its distribution is patchy and the population size has declined.

Habitat, etc.: Although the habitat requirements of the Southern Brown Bandicoot are not fully known, it is generally agreed that the species prefers scrubby vegetation on sandy soils, with areas of low ground cover that are burnt out periodically. As Braithwaite (1995) explains, "during the early stages of regeneration, after fire, the diversity of growing vegetation supports abundant insect food and is a very favourable habitat. Later, as the vegetation approaches maturity, the food supply is reduced." The Southern Brown Bandicoot is known to inhabit forests, woodlands and heathlands, and has been recorded in ground cover of varying density (Claridge, McNee, Tanton & Davey 1991). Ground cover of low to medium density provides good foraging habitat, and dense vegetation provides shelter. The presence of a mosaic of such habitats is probably necessary to sustain a stable population. The Southern Brown Bandicoot digs conical holes 5-10cm deep, as it seeks subterranean food. Its diet includes insects, larvae, worms, fungi and other plant material below ground level. Its nest is concealed in dense vegetation and organic debris. The home range varies considerably but is thought to be about seven hectares (Braithwaite 1995).

Threats: Threats to the Southern Brown Bandicoot include inappropriate fire regimes, the clearing of habitat for agriculture and forestry, the fragmentation of habitat and predation by feral animals.

Occurrence in the District: There are records of the Southern Brown Bandicoot from the Jervis Bay area, West Cambewarra and Morton National Park (NPWS Wildlife Atlas), but none from Ulladulla. The species may be more common than the records indicate; the lack of survey effort and the difficulty in trapping bandicoots may obscure the actual status of this species in this region.

Potential to Occur in the Study Area: Bandicoot diggings were common in the lower parts of the gully in the study area. Although the diggings are more likely to have been made by the Long-nosed Bandicoot *Perameles nasuta*, the presence of the Southern Brown Bandicoot cannot entirely be discounted. No bandicoots were trapped on the site, although they are clearly very active in the area and one bandicoot was seen fleetingly during the field study. The Southern Brown Bandicoot may occur in the study area.

Giant Burrowing Frog

Status in New South Wales: Vulnerable; the species was listed on Schedule 2 of the *Threatened Species Conservation Act 1995* because its population and distribution are suspected to have been reduced, the threatening processes are moderate and it is an ecological specialist (NPWS 1992).

Distribution and Abundance: The Giant Burrowing Frog *Heleioporus australiacus* occurs on the coast and ranges from the coast of central New South Wales to eastern Victoria (Cogger 1992). It has been recorded in several conservation reserves and state forests, such as Royal National Park, Ku-ring-gai Chase National Park, Morton National Park Marramarra National Park, Barren Grounds Nature Reserve and Watagan State Forest.

Habitat, etc.: The Giant Burrowing Frog inhabits areas underlain by sandstone, where it lives in burrows in the banks of small creeks and gullies (Cogger 1992). Although little is yet known about the ecology of this species, it breeds in permanent and ephemeral streams and may then disperse into other suitable habitat. The species has been recorded in swampy heathland

and in wet and dry eucalypt woodland. Insufficient research has been undertaken to establish the size of its home range and its shelter requirements. According to York, (Mitchell McCotter 1993) the most suitable habitats for the Giant Burrowing Frog are sandstone escarpments, ephemeral or permanent creeks, free flowing rivers, hanging swamps, wet heathlands and eucalypt woodland.

Threats: Ecological research as not clearly established the threats to this species.

Occurrence in the District: The Giant Burrowing Frog has been found at West Ulladulla and in forest to the west of Milton (Kevin Mills & Associates 1997). The species is probably widespread in the region but localised in its occurrence.

Potential to Occur in the Study Area: The forest and the sandy soils in the study area are similar to the habitat in which species occurs at West Ulladulla. However, while there are extensive swampy environments at West Ulladulla, there is no equivalent in the vicinity of the Narrawallee study area. The base of the gully may provide suitable burrowing habitat but there is little if any water for breeding, so it is unlikely that the Giant Burrowing Frog would occur in the Narrawallee study area.

Glossy Black-Cockatoo

Status in New South Wales: The Glossy Black-Cockatoo is a vulnerable species in New South Wales, listed on Schedule 2 of the *Threatened Species Conservation Act* (New South Wales 1995) because its population has been severely reduced, its potential for recovery is poor and it is an ecological specialist (NPWS 1992).

Distribution and Abundance: The Glossy Black-Cockatoo now occurs in three distinct areas, referred to here as the eastern population, the Griffith population and the Kangaroo Island population. Its distribution is very patchy and highly disjunct, strongly influenced by patterns of settlement and land clearing, and the availability of the species' very specialised habitat and dietary requirements. Forshaw (1981) commented that, in New South Wales, the Glossy Black-Cockatoo "is locally common in some districts, resident in small numbers in others and a rare vagrant to most parts of its range". The main population of Glossy Black-Cockatoos is in eastern Australia, where its range extends from as far north as Eungella near Mackay in Queensland to Mallacoota in the Gippsland District in Victoria. The eastern population extends up to 600 kilometres inland, as far west as Augathella about 600 kilometres west of Noosa in Queensland and to Peak Hill near Dubbo in New South Wales, about 500 kilometres inland. The Griffith population mainly occurs in the Cocoparra Range. Land clearing on the western plains has no doubt caused this population to become isolated. The presence of the population on Kangaroo Island in South Australia suggests that the Glossy Black-Cockatoo originally occurred throughout Victoria and on the mainland in South Australia. However, it is clear from the ornithological literature that abundance has declined and the species has disappeared from many parts of its former range.

Habitat, etc.: Glossy Black-Cockatoos live in mature eucalypt forests and woodlands containing stands of mature casuarina trees, which are its primary source of food. The species prefers mature forests, because only mature forests contain tall old eucalypts with hollows for nesting and casuarina fruit in sufficient quantities to sustain whole populations. The Glossy Black-Cockatoo feeds almost exclusively on the seeds of casuarina trees, but selects only particular species; some species appear to be unsuitable. Black She-oak *Allocasuarina littoralis* is the dominant food tree in New South Wales and eastern Victoria. Although the Glossy Black-Cockatoo is reported to eat the seeds of *Angophora*, *Acacia* and *Eucalyptus* (Forshaw 1981), it is rarely observed foraging in anything other than casuarinas. It also eats wood-boring grubs.

The Glossy Black-Cockatoo is both nomadic and sedentary in its behaviour. Its movements are mostly local, as the cockatoos roam from one foraging area to another in a district. They are sometimes more wide ranging, probably when food is scarce.

Threats: The main threat to this species is the loss of habitat, as stands of mature Casuarinas have been cleared for agriculture and urban development. The species is also adversely affected by the clearing of large trees with hollows, used for nesting.

Occurrence in the District: The species has been recorded throughout the Shoalhaven region, including the Milton-Ulladulla area. Local occurrences of this species include Lake Conjola and West Ulladulla. The cockatoo is likely to occur wherever there are mature stands of *Allocasuarina littoralis*.

Potential to Occur in the Study Area: There is one stand of fruiting Black She-oaks in the southwestern corner of the study area as well as occasional trees elsewhere on the site. No Glossy Black-Cockatoos were recorded and no evidence of their presence was found, despite a thorough search for discarded cones beneath potential food trees. The species may occur in the area from time to time, however, for the habitat is suitable.

Swift Parrot

Status in New South Wales: Vulnerable; the species was listed on Schedule 2 of the *Threatened Species Conservation Act 1995* because its population and distribution have been severely reduced, the threatening processes are severe and it is an ecological specialist (NPWS 1992).

Distribution and Abundance: The Swift Parrot *Lathamus discolor* occurs in southeastern Australia and breeds only in Tasmania (Blakers, Davies & Reilly 1984). Swift Parrots mainly occur on the Australian mainland in winter, outside the breeding period.

Habitats, etc.: On the mainland, the Swift Parrot occurs where there are winter-flowering eucalypts such as Red Ironbark *Eucalyptus sideroxylon*, Yellow Gum *Eucalyptus leucoxylon*, White Box *Eucalyptus albens* and Swamp Gum *Eucalyptus ovata* (Brown 1989). It also occurs in fertile forest habitats containing Wollybutt *Eucalyptus longifolia* (Tanton 1994).

Threats: The Swift Parrot is threatened on two fronts. In Tasmania, it has been affected by the reduced abundance of Blue Gum *Eucalyptus globulus*, as large areas of forest have been felled for agriculture, timber production and woodchips. On the mainland, many stands of the Swift Parrot's favoured food trees have been cleared, especially the Box and Ironbark woodlands west of the Great Dividing Range (Garnett 1992).

Occurrence in the District: As far as we can ascertain, the Swift Parrot has not been recorded in the Milton-Ulladulla district. Influxes of the species occur in the winter months every few years, and the species is well recorded to the north of the Shoalhaven River. The Swift Parrot would certainly occur in the Milton-Ulladulla district from time to time.

Potential to Occur in the Study Area: The Swift Parrot may occur in the study area from time to time, mainly because of the presence of Woollybutt *Eucalyptus longifolia* which flowers in autumn.

Squirrel Glider

Status in New South Wales: Vulnerable; the species was listed on Schedule 2 of the *Threatened Species Conservation Act 1995* because its population and distribution have been severely reduced, the potential for recovery is poor, the threatening processes are severe and it is an ecological specialist (NPWS 1992).

Distribution and Abundance: The Squirrel Glider *Petaurus norfolcensis* occurs throughout eastern Australia, in Queensland, New South Wales and central Victoria. It occurs on the coast and ranges, and across the western slopes and plains to central New South Wales.

Habitat: The Squirrel Glider has very specialised habitat requirements. The NPWS (1996) prepared the following description of its habitat: "The Squirrel Glider inhabits open, xeric forests and woodlands and is generally absent from mesic, closed forest (NPWS 1994b). In coastal areas, Squirrel Gliders occupy coastal Blackbutt-Bloodwood forests with heathy understoreys (e.g. banksias), Smooth-barked Angophora-Blackbutt woodlands and forests, and some wetter forests bordering creek-lines which include Sydney Blue Gum (Quin 1995b, D. Quin unpublished data). In southern coastal NSW, Davey (1984) reported the Squirrel Glider to occur in various forest types including creekside *E. botryoides/E. saligna* forests, riparian *E. botryoides*, and various quality stands of Blackbutt *E. piluaris* and Spotted Gum *E. maculata*.

"Squirrel Gliders require an abundance of tree hollows for use as refuges and nest sites (Quin 1995a). The generas *Banksia*, *Xanthorrhoea* and *Acacia* provide important food resources for the glider. The species is an insectivore-exudivore relying upon plant and insect exudates such as eucalypt sap, *Acacia* gum, eucalypt and banksia nectar and pollen, invertebrates, honeydew and manna, and in some instances *Acacia* seeds (Menkhorst & Collier 1987; Menkhorst et al.1988; Quin 1995a; B. J. Traill, pers. comm.). These resources are thought to be more abundant in mature and old growth forests because tree canopy size and surface area of the trunk increase with increasing tree size (SFNSW 1995b). Flower abundance also appears to be correlated with tree or shrub size (Goldingay 1992; Quin 1993), and nectar/pollen production is therefore likely to peak in older forest stands (depending on forest type).

"The Squirrel Glider appears to be restricted to forests and woodlands supporting at least one eucalypt and/or banksia species that flowers heavily in winter, one or more smooth-barked species which sheds bark, and often mature *Acacia* species in the understorey (Menkhorst et al.1988; Quin 1993, 1995a). Smooth-barked eucalypts support decorticating bark which harbours one of the best food supplies for petaurids in the form of bark-dwelling arthropods (Menkhorst et al.1988). Mixed eucalypt stands are thought to provide a more reliable year-round supply of food resources, associated with changes in the different species phenologies understorey (Menkhorst et al.1988; Quin 1993).

"The species is reported to have a home range of between 20-30ha (Gilmore & Parnaby 1994), although in productive lightly logged forests, a mean home range of approximately 3.5ha was reported for one individual (Quin 1995a). In coastal forest the densities varied from 0.9-1.5 animals/ha (Quin 1995a)."

Threats: The species has no doubt been affected by the clearing of eucalypt forests and woodlands for agricultural and forestry purposes. Breeding may have been curtailed by the loss of large trees with nesting hollows.

Occurrence in the District: The Squirrel Glider is very rare in the Shoalhaven region; it has only been recorded at Kioloa. The species has also been reported to occur at Culburra and Lake Wollumboola, and it may occur there, but the source and accuracy of the records are unclear.

Potential to Occur in the Study Area: Statistically, the Squirrel Glider is unlikely to inhabit the study area; the only confirmed sightings have been at Kioloa. The Woollybutt *Eucalyptus longifolia* forest and occurrence of large trees with hollows provide ideal potential habitat for this species.

Common Bentwing-bat

Status in New South Wales: Vulnerable; the species was listed on Schedule 2 of the *Threatened Species Conservation Act 1995* because its population, although probably stable has been reduced, the species concentrates in particular areas, the threatening processes are severe and it is an ecological specialist (NPWS 1992).

Distribution and Abundance: The Common Bentwing-bat *Miniopterus schreibersii* occurs in New Guinea, Indonesia, Malaysia, Africa and Eurasia (Dwyer 1995), as well as in Australia where it occurs throughout the high rainfall zones in the north and east. The species lives along the coast and ranges from Cape York in Queensland to southeastern South Australia, as well as in the Northern Territory and in the north of Western Australia. The species is considered by many authorities to be common (e.g. Parnaby 1992).

Habitat, etc.: The Common Bentwing-bat is a cave dwelling species. It roosts in caves, old mines, stormwater channels and comparable structures, including buildings (Dwyer 1995). Breeding and nurturing take place in nursery caves. This species forages above the tree canopy in well-timbered valleys, where it feeds on insects.

Threats: The main threat to the Common Bentwing-bat is the degradation of nursery caves, which are vulnerable because of the mining of limestone and recreational cave exploration. Disturbance may threaten the ability of some populations to breed. Dwyer (1995) commented that "because of its dependence upon relatively few nursery caves, threats to the existence or structural integrity of any of these may place the survival of widespread populations in jeopardy".

Occurrence in the District: There are only a few records of the Common Bentwing-bat from the Shoalhaven region, although it is likely to be a common species there. The lack of records may reflect the lack of survey effort rather than the scarcity of the species. The bat was recently recorded at West Ulladulla (Kevin Mills & Associates 1997).

Potential to Occur in the Study Area: The Common Bentwing-bat was not recorded in the study area. Although the bat may forage in the area, there are no suitable roosting sites for the species such as caves and buildings.

Other Insectivorous Bats

The following four threatened bat species from the Milton-Ulladulla district, may occur in the study area at Narrawallee, although there are no records, suitable habitat is present.

Eastern Freetail-bat

The Eastern Freetail-bat *Mormopterus norfolkensis* was not recorded during the fauna survey and has not been recorded in the local area. Nor has it been recorded anywhere in the area covered by the Ulladulla 1:100,000 map (NPWS 1997). If present in the study area, it is expected to shelter in tree hollows.

Eastern False Pipistrelle

The Eastern False Pipistrelle *Falsistrellus tasmaniensis* was not recorded during the fauna survey and has not been recorded in the local area or anywhere in the area covered by the Ulladulla 1:100,000 map (NPWS 1997). If present in the study area, it would roost and forage in the forests.

Yellow-bellied Sheathtail-bat

The Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris* was not recorded in the study area and there are apparently no records of the species from anywhere in the region (NPWS 1997). If it occurs in the study area, it would roost and forage in the forest.

Greater Broad-nosed Bat

The Greater Broad-nosed Bat *Scoteanax rueppellii* has been recorded at Swan Lake and in Kioloa State Forest, but there are few records from the region (NPWS 1996). It was not recorded in the study area. If this species is present, it would roost in the forest and forage along the edge.

3.5 PRESENCE OF KOALA HABITAT

State Environmental Planning Policy No. 44 - Koala Habitat Protection (New South Wales 1995) applies to the City of Shoalhaven, which is among the local government areas listed on Schedule 1 of the Policy. The Policy "aims to encourage the proper conservation and management of areas of natural vegetation that provide habitat for Koalas to ensure a permanent free-living population over their present range and reverse the current trend of Koala population decline:

a. by requiring the preparation of plans of management before development consent can be granted in relation to areas of core Koala habitat;

b. by encouraging the identification of areas of core Koala habitat; and

c. by encouraging the inclusion of areas of core Koala habitat in environment protection zones."

The Policy aims to identify "potential Koala habitat". This is defined as native vegetation where trees of the species listed on Schedule 2 of the Policy constitute at least 15% of the total number of trees in the upper or lower strata of the tree component. If none of the tree species listed on Schedule 2 are present or if these species constitute less than 15% of the total number of trees present, then no further provisions of the Policy are applicable. If more than 15% of the trees on the site are of the species listed on Schedule 2, then an assessment by a qualified person must be undertaken to determine if the area contains "core Koala habitat". Core Koala habitat is defined in clause 4 of the Policy as "an area of land with a resident population of Koalas, evidenced by attributes such as breeding females (that is, females with young), and recent sightings of and historical records of a Koala population".

Seven eucalypt species occur in the study area: Blackbutt *Eucalyptus pilularis*, Red Bloodwood *Eucalyptus gummifera*, Yertchuk *Eucalyptus consideniana*, White Stringybark *Eucalyptus globoidea*, Grey Ironbark *Eucalyptus paniculata*, Woollybutt *Eucalyptus longifolia* and Bangalay *Eucalyptus botryoides*. None of these tree species is listed on Schedule 2 of the Policy, so the study area is not "potential Koala habitat". No further provisions of the Policy apply. The Koala probably occurred in the Ulladulla district until early this century, although there appear to be no recent records.

4 ASSESSMENT OF THE PROPOSED REZONING

One of the main objectives of this study is to assess the impact of the proposal to rezone the land in the study area from Environmental Protection 7(d2) to a residential zoning that would allow urban expansion. The subdivision plan has not yet been finalised and the sketch plan of the subdivision, prepared by Watkinson Apperley Pty Limited and dated 11 April 1998, is only conceptual (see Figure 4). However, the plan gives an indication of how the development may be arranged on the site. The potential impact of the proposed rezoning and subsequent residential development of the land are discussed below.

4.1 IMPACT ON VEGETATION

Although the impact of the subdivision on the vegetation cannot be accurately assessed until a subdivision plan has been prepared, rezoning of all of the land to allow residential development is likely to lead to the removal of most of the Blackbutt tall forest and Woollybutt-Paperbark forest on the site. This would represent a loss of about 13.7 hectares of bushland.

The conceptual subdivision plan shown in Figure 4 would lead to the removal of all of the bushland on the eastern half of the site, where lot density is highest. Although some trees may be retained, experience shows that forest trees usually do not survive in an urban environment in the long term. They are progressively removed, or die from root disturbance, changed drainage patterns and exposure.

The prognosis for the long term survival of the bushland on the western half of the site, where lot diversity is lower, is also poor. The creation of the mandatory 40 metres fuel exclusion/reduction zone to provide protection from bushfires would lead to the removal of a large proportion of the bushland. Although some of the trees and patches of undergrowth may be retained lower downslope by some landowners, in reality most of the blocks would be underscrubbed, grazed and/or landscaped.

As previously discussed, most of the bushland on the site is Blackbutt tall forest. This forest type is reasonably common in the Ulladulla area, although much has been removed and the remaining areas have become quite fragmented; see Figure 5. Based on the vegetation maps prepared by Kevin Mills & Associates (1996), there are about 763 hectares of PIL-SYN Blackbutt tall forest in the Milton-Ulladulla district, which is about 47% of all the vegetation mapped in the district.

Using the land use zoning maps and the above mentioned vegetation map, Shoalhaven City Council has determined the areas of Blackbutt forest covered by the various land use zones; this information is provided in Table 8. Although the Woollybutt forest has been included in these figures, only a small area of Woollybutt forest is present in the study area, insufficient to significantly influence the results in Table 8.

Table 8
Area of Blackbutt Forest in Land Use Zones

Zone	Area (ha)	(%)
1(a)	194.84	(25.5)
1(b)	15.86	(2.1)
1(c1)	51.72	(6.8)
1(c3)	3.39	(0.4)
1(d)	26.58	(3.5)
1(f)	15.58	(2.0)
1(g)	37.68	(4.9)
Rural	345.65	(45.3%)
2(a)	10.65	(1.4)
2(b)	4.64	(0.6)
2(b2)	4.64	(0.6)
2(c)	119.51	(15.7)
2(d)	3.20	(0.4)
Residential	142.64	(18.7%)
3(g)	0.17	(0.02)
5(a)	3.26	(0.)
5(c)	3.90	(0.5%)
5(d)	1.30	(0.2)
Special Uses	8.63	(1.1%)
6(a)	78.36	(10.3)

6(b)		1.21	(0.3)	
6(c)		39.79	(5.2)	
	Open Space	119.36		(15.6%)
7(a)		6.48	(0.8)	
7(b)		4.02	(0.5)	
7(d1)		62.89	(8.2)	
7(d2)		72.99	(9.6)	
7(f1)		0.30	(0.04)	
	Environmental Protection	146.68		(19.2%)
Total Area		762.96ha		(100%)

It can be ascertained that:

- Most Blackbutt forest (45%) occurs on land zoned for rural purposes.
- Blackbutt forest is reasonably well protected in open space 6(a) and Environmental Protection 7 zones, but only 29.5% of the total area of Blackbutt forest occurs in these zones.
- 70.5% of all Blackbutt forest occurs in land use zones that may be cleared.
- About 19% of all the Blackbutt forest occurs on land that has already been zoned for urban expansion.

The study area contains about 2% of the total area of Blackbutt forest in the Milton-Ulladulla district. The forest is of good quality and is floristically diverse. Although some logging has been undertaken, mainly on the eastern side of the study area, the forest is generally mature, containing old growth elements. It is free of weeds and has a relatively natural understorey. The quality of the 763 hectares Blackbutt forest varies throughout the district; many areas have been heavily logged and burnt, and have become weed infested. The forest in the study area is generally of a high quality not found in many other parts of the district.

The Woollybutt-Paperbark forest is rare in the Milton-Ulladulla area and is uncommon in the Shoalhaven region. Only 14.46 hectares of the *Eucalyptus robusta - Eucalyptus longifolia* forest was mapped in the study by Kevin Mills & Associates (1996) in the Milton-Ulladulla district. The small patch in the study area was not delineated in the above mapping project. Woollybutt forest is clearly an uncommon forest type and of botanical conservation importance. This forest is also important because Woollybutt flowers in autumn, when many other sources of nectar are unavailable, providing an important source of food for many nectar-feeding fauna. The forest is therefore of high fauna conservation value. As noted elsewhere, some of the fauna utilising Woollybutt are threatened species.

4.2 IMPACT ON FAUNA HABITATS

The rezoning would lead to the removal of most of the wildlife habitat in the study area. Although some of the trees and patches of understorey would initially be retained, most of the habitat on the site would eventually be removed. The value of any areas of habitat remaining in the study area could be reduced by people's activities, such as landscaping and the disposal of garden refuse, as well as the keeping of grazing animals, cats and dogs.

The forest in the study area is located in a critical location in the corridor of forest extending north-south along the western edge of Narrawallee. This corridor is, in fact, the only corridor linking the bushland in the Narrawallee Creek area, including Narrawallee Creek Nature Reserve, with the bushland to the west of Mollymook and to the west of Ulladulla. Figure 5, which shows the forest corridor and the cleared land to the east and west, clearly demonstrates the critical location of the study area.

4.3 IMPACT ON THREATENED SPECIES

The rezoning would lead to the removal of an area of threatened species habitat; one threatened species, the Powerful Owl, was recorded in the study area. The study area appears to be within the home range of a pair of Powerful Owls that inhabit the forests to the west of Narrawallee. It is not known whether the owls breed in the gully in the study area, but habitat suitable for breeding is certainly present; the tall, old trees with hollows are ideal. The forest also supports a good population of arboreal mammals, essential prey for the Powerful Owl.

Although none were recorded, several other threatened species may occur, if only intermittently, in the study area; these include the Southern Brown Bandicoot, Giant Burrowing Frog, Glossy Black-Cockatoo, Swift Parrot and the Common Bentwing-bat and other bat species.

4.4 ASSESSMENT BY THE NPWS

The National Parks and Wildlife Service (NPWS) has previously expressed concern about future development in the area. In a submission following the exhibition of the Milton-Ulladulla Structure Plan, the NPWS stated, in part, that:

> "The concept of expansion of most coastal urban areas within the scope of the Plan is questioned in terms of consistency with the principles of ecologically sustainable development and potential impact on the already fragmented and depleted areas of bushland remaining in the Milton-Ulladulla area."

The views of the NPWS were sought at the commencement of this study and a meeting of representatives from the NPWS and Shoalhaven City Council was held on site on 9 March 1998. The NPWS subsequently stated its concerns about the proposed rezoning and residential development in correspondence dated 30 March 1998; see Appendix 5. The NPWS commented that "the subject land would appear to have high biodiversity values and on initial inspection would have a number of natural heritage constraints to residential development". The main concerns expressed by the Service are:

- "that the proposed rezoning would appear at odds with strategic planning principles being implemented in the Milton/Ulladulla area through the structure plan in that Council are now considering the possibility of reducing the existing Environmental Protection Zone area on an ad hoc basis".
- The potential impact of rezoning and urban expansion on threatened species and threatened fauna habitat.
- The removal of good quality forest and habitat.
- The potential for the indirect impacts of urban expansion to degrade the forest.

The Service concluded that "indications are that the site is unsuitable for residential development" and that "the proposal should not be considered without detailed and exhaustive survey and assessment to justify the loss of the potential habitat evident on the land".

The NPWS's submission is provided in full, in Appendix 5. All of the issues raised by the NPWS have been addressed in this report.

5 CONCLUSION

Flora

The study brief requires the consultant to provide "a statement as to whether on flora grounds the rezoning could or should not proceed and, if so, whether any special protection measures should be put in place to minimise the impact".

As already stated, the study area contains good quality mature forest with old growth elements. It is floristically diverse and has, with the exception of the upper part of the slope, a relatively natural structure. No threatened plant species were found in the study area, and it seems unlikely that any of the species known from the Milton-Ulladulla area (Kevin Mills & Associates 1996) would occur in the forest in the study area. One species of regional interest, the fern *Blechnum indicum*, occurs in the base of the valley along the creek.

On flora grounds, it is our opinion that rezoning of the whole site to allow residential subdivision should not proceed because it would probably ultimately lead to the removal or serious degradation of a relatively large area of good quality forest, about 13.7 hectares. Although Blackbutt tall forest is quite common in the Milton-Ulladulla area, forest of such quality is not common. There is no Blackbutt forest in conservation reserves. Woollybutt forest, which occurs along the base of the valley, is naturally more restricted and should be conserved wherever possible.

Fauna

The study brief also requires the consultant to provide "a statement as to whether on fauna grounds the rezoning could or should not proceed and, if so, whether any special protection measures should be put in place to minimise the impact".

On fauna grounds, it is our opinion that rezoning of the whole site to allow residential subdivision should not proceed because it would lead to the removal of a substantial area of habitat supporting at least one threatened species, the Powerful Owl, and a high diversity of other fauna. Fauna habitat of such good quality and with such a large number of mature trees with hollows is not common in the district and, in our opinion, should not be cleared. This opinion is supported by the National Parks and Wildlife Service; see Appendix 5.

The forest is the study area appears to be in a fairly important location in terms of the bushland corridor to the west of Narrawallee; see Figure 5. Removal or serious degradation of all of the forest in the study area could have a serious impact on the viability of this forest corridor.

Although the application of the "eight part test" is not required under the *Threatened Species Conservation Act 1995* for a proposed rezoning, and was therefore not part of the brief for this study, in our opinion residential subdivision of the whole site may have a significant affect on the habitat of a threatened species, the Powerful Owl, and that the preparation of a Species Impact Statement would be required. At the very least, additional field survey work would be required to determine the status of the Powerful Owl in the study area and the Narrawallee area in general before a definitive statement on the value of the forest in the study area to the Powerful Owl, and other threatened species, could be made.

Potential to Minimise the Impact of Residential Development

If the Council considers that rezoning is appropriate for a part of the study area, then consideration should be given to the following matter.

Any subdivision of the study area will have some impact on flora and fauna. Finding an acceptable level of impact is a most difficult task in cases such as this. Clearly, the smaller the area covered by residential development the least impact there will be. If some subdivision is

contemplated, then the following attributes would reduce the impact on the main area of importance on the site, which is the lower part of the valley.

- Lots should be restricted to the upper part of the slope, where disturbance has been greatest.
- A road should be located on the western edge of the subdivision to help confine impacts to the residential area and to assist with bushfire protection. This will reduce or possibly eliminate the need to carry out bushfire hazard reduction activities downslope of the subdivision.
- Drainage control works should be restricted to the residential area.
- All services, eg. sewer, power, water, should be restricted to the residential side of the above road.
- Wherever possible trees should be retained on the lots.
- The lower valley should retain the existing environmental protection zoning. It is far preferable to retain this area in one parcel of land.
- A management regime should be developed for the lower valley that ensures that its important natural values are maintained.

* * * * *

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APPENDIX 1
STRUCTURAL FORMATION CLASSES IN AUSTRALIAN VEGETATION COMMUNITIES

Crown Separation	D Closed or dense	M Mid-dense	S Sparse	B Very sparse	I Isolated plants	L Isolated clumps
Field criteria	Touching - overlap	Touching - slight separation	Clearly separated	Well separated	Isolated	Isolated
Crown separation ratio	<0	0-0.25	0.25-1	1-20	>20	>20
Growth Form	Structural Formation Classes					
T Tree	Closed forest	Open forest	Woodland	Open woodland	Isolated trees	Isolated clump of trees
M Tree mallee	Closed mallee forest	Open mallee forest	Mallee woodland	Open mallee woodland	Isolated mallee trees	Isolated clump of mallee trees
S Shrub	Closed shrubland	Shrubland	Open shrubland	Sparse shrubland	Isolated shrubs	Isolated clump of mallee shrubs
Y Mallee shrub	Closed mallee shrubland	Mallee shrubland	Open mallee shrubland	Sparse mallee shrubland	Isolated mallee shrubs	Isolated clump of mallee shrubs
Z Heath shrub	Closed heathland	Heathland	Open heath	Sparse heath	Isolated heath shrubs	Isolated clump of heath shrubs
C Chenopod shrub	Closed chenopod shrubland	Chenopod shrubland	Open chenopod shrubland	Sparse chenopod shrubland	Isolated chenopod shrubs	Isolated clump of chenopod shrubs
Crown class	D Closed or dense	M Mid-dense	S Sparse	B Very sparse	I Isolated plants	L Isolated clumps
Foliage cover	>70	30-70	10-30	<10	<1	<1
Growth Form	Structural Formation Classes					
G Tussock grass	Closed grassland	Grassland	Open grassland	Sparse grassland	Isolated grasses	Isolated clump of tussock grasses
H Hummock grass	Closed hummock grassland	Hummock grassland	Open hummock grassland	Sparse hummock grassland	Isolated hummock grasses	Isolated clump of hummock grasses
D Sod grass	Closed sod grassland	Sod grassland	Open sod grassland	Sparse sod grassland	Isolated sod grasses	Isolated clump of sod grasses
V Sedge	Closed sedgeland	Sedgeland	Open sedgeland	Sparse sedgeland	Isolated sedges	Isolated clump of sedges
R Rush	Closed rushland	Rushland	Open rushland	Sparse rushland	Isolated rushes	Isolated clump of rushes
F Forb	Closed forbland	Forbland	Open forbland	Sparse forbland	Isolated forbs	Isolated clump of forbs
E Fern	Closed fernland	Fernland	Open fernland	Sparse fernland	Isolated ferns	Isolated clump of ferns
O Moss	Closed mossland	Mossland	Open mossland	Sparse mossland	Isolated mosses	Isolated clump of mosses
L Vine	Closed vineland	Vineland	Open vineland	Sparse vineland	Isolated vines	Isolated clump of vines

Based on Walker and Hopkins (1984)

APPENDIX 2
VEGETATION SURVEY SHEETS

Vegetation Community Survey Sheet

Site No.: U39

Vegetation Type: LON-MEL Woollybutt-Paperbark Forest

Date: 24 February 1998

Location: West of Narrawallee

Grid Reference: 35°19'01" 150°27'25"

Land Tenure: Freehold

Soil Type: Deep sand

Topography: Floor of a shallow valley

Altitude: 18m Slope: Level

Aspect: -

Vegetation: (1 rare to 5 dominant)

Canopy: 50-70% cover, 25m high

Eucalyptus longifolia	2
Eucalyptus botryoides	3
Melaleuca linariifolia	2

Middle Canopy: 60-70% cover, 4-6m high

Melaleuca ericifolia	3	*Callicoma serratifolia*	1
Glochidion ferdinandi	2		
Melaleuca linariifolia	2		

Understorey: 80% cover, 1-3m high

Melaleuca ericifolia	4	*Callicoma serratifolia*	1
Acacia longifolia	1		
Leptospermum juniperinum			

Ground Cover: 100% cover, <1m high

Restio tetraphyllus	3	*Hypolepis muelleri*	2
Entolasia marginata	4	*Gahnia clarkei*	2
Viola hederacea	2	*Carex appressa*	2
Blechnum indicum	1		

Vines:

Parsonsia straminea	1
Kennedia rubicunda	1

Vegetation Community Survey Sheet

Site No.: U40

Vegetation Type: PIL-SYN Blackbutt Tall Forest

Date: 24 February 1998

Location: West of Narrawallee

Grid Reference: 35°19'05" 150°27'25"

Land Tenure: Freehold

Soil Type: Sand

Topography: Gentle lower slope

Altitude: 22m

Slope: Gentle

Aspect: West

Vegetation: (1 rare to 5 dominant)

Canopy: 50-70% cover, 30m high

Eucalyptus pilularis	5
Angophora floribunda	1
Syncarpia glomulifera	3
Eucalyptus gummifera	1

Middle Canopy: 5% cover, 8m high

Banksia serrata	1

Understorey: 30% cover, 1-2m high

Banksia spinulosa	3	*Persoonia mollis*	1
Persoonia linearis	1	*Callicoma serratifolia*	1
Acacia longifolia	1		

Ground Cover: 90% cover, <1m high

Lepidosperma filiforme	3	*Amperea xiphoclada*	1
Calochlaena dubia	3	*Dianella caerulea*	2
Pteridium esculentum	4	*Gompholobium latifolium*	2
Gonocarpus teucrioides	2	*Hibbertia aspera*	2
Acacia terminalis	2	*Pultenaea blakelyi*	2
Lomandra longifolia	2	*Imperata cylindrica*	2

Vines:

Billardiera scandens	1
Kennedia rubicunda	1

Epiphytes:

Cymbidium suave	1

APPENDIX 3
LIST OF NATIVE PLANT SPECIES FOR THE NARRAWALLEE STUDY AREA

PTERIDOPHYTA (Ferns)

BLECHNACEAE
Blechnum indicum Burm. f.

DENNSTAEDTIACEAE
Pteridium esculentum (Forster f.) Cockayne
Hypolepis muelleri Wakef.

DICKSONIACEAE
Calochlaena dubia (R. Br.) M. Turner & R. White

GLEICHENIACEAE
Gleichenia dicarpa R. Br.

LINDSAEACEAE
Lindsaea linearis Sw.

SELAGINELLACEAE
Selaginella uliginosa (Labill.) Spring

ANGIOSPERMAE (Flowering Plants)

ACANTHACEAE
Brunoniella pumilio (R. Br.) Bremek.

APIACEAE
Hydrocotyle laxiflora DC.
Platysace lanceolata (Labill.) Druce
Trachymene incisa Rudge

APOCYNACEAE
Parsonsia straminea (R. Br.) F. Muell.

ASCLEPIADACEAE
Marsdenia suaveolens R. Br.

ASTERACEAE
Lagenifera stipitata (Labill.) Druce
Ozothamnus diosmifolius (Vent.) DC.

CASUARINACEAE
Allocasuarina littoralis (Salisb.) L. Johnson

CUNONIACEAE
Callicoma serratifolia Andrews

CYPERACEAE
Gahnia clarkei Benl
Lepidosperma filiforme Labill.
Lepidosperma laterale R. Br.

DILLENIACEAE
Hibbertia aspera DC.
Hibbertia dentata R. Br. ex DC.
Hibbertia linearis R. Br. ex DC.
Hibbertia riparia (R. Br. ex DC.) Hoogl. *s. lat.*

Hibbertia scandens (Willd.) Gilg

ELAEOCARPACEAE
Elaeocarpus reticulatus Smith

EPACRIDACEAE
Leucopogon lanceolatus (Smith) R. Br.

EUPHORBIACEAE
Amperea xiphoclada (Sieber ex Sprengel) Druce
Breynia oblongifolia Muell. Arg.
Glochidion ferdinandi (Muell. Arg.) Bailey
Phyllanthus hirtellus F. Muell. ex Muell. Arg.
Ricinocarpos pinifolius Desf.

FABACEAE
FABOIDEAE (subfamily)
Aotus ericoides (Vent.) Don
Bossiaea ensata Sieber ex DC.
Bossiaea obcordata (Vent.) Druce
Daviesia corymbosa Smith
Glycine clandestina Wendl.
Gompholobium latifolium Smith
Hardenbergia violacea (Schneev.) Stearn
Kennedia prostrata R. Br.
Kennedia rubicunda (Schneev.) Vent.
Oxylobium ilicifolium (Andr.) Domin
Platylobium formosum Smith
Pultenaea blakelyi J. Thompson
Pultenaea daphnoides Wendl.
Pultenaea linophylla Schrad.
Viminaria juncea (Schrader & Wendl.) Hoffsgg.

MIMOSOIDEAE (subfamily)
Acacia longifolia (Andrews) Willd.
Acacia mearnsii De Wild.
Acacia myrtifolia (Smith) Willd.
Acacia suaveolens (Smith) Willd.
Acacia terminalis (Salisb.) J. F. Macbr.
Acacia ulicifolia (Salisb.) Court

GOODENIACEAE
Goodenia heterophylla Smith
Goodenia ovata Smith

HALORAGACEAE
Gonocarpus teucrioides DC.

IRIDACEAE
Patersonia sericea R. Br. ex Ker

LAURACEAE
Cassytha pubescens R. Br.

LOBELIACEAE
Lobelia alata Labill.
Pratia purpurascens (R. Br.) E. Wimmer

LOMANDRACEAE
Lomandra longifolia Labill.
Lomandra obliqua (Thunb.) J. F. Macbr.

LORANTHACEAE
Amyema pendulum (Sieber ex Sprengel) Tieghem

MENYANTHACEAE
Villarsia exaltata (Sol. ex Sims) G. Don

MYRTACEAE
Angophora floribunda (Smith) Sweet
Eucalyptus botryoides Smith
Eucalyptus consideniana Maiden
Eucalyptus globoidea Blakely
Eucalyptus gummifera (Sol. ex Gaertner) Hochr.
Eucalyptus longifolia Link
Eucalyptus paniculata Smith
Eucalyptus pilularis Smith
Kunzea ambigua (Smith) Druce
Leptospermum juniperinum Smith
Leptospermum polygalifolium Salisb.
Melaleuca ericifolia Smith
Melaleuca linariifolia Smith
Syncarpia glomulifera (Smith) Niedenzu

ORCHIDACEAE
Cryptostylis sp..
Cymbidium suave R. Br.

PHORMIACEAE
Dianella caerulea Sims

PITTOSPORACEAE
Billardiera scandens Smith
Bursaria spinosa Cav.
Pittosporum revolutum Aiton

POACEAE
Entolasia marginata (R. Br.) Hughes
Entolasia stricta (R. Br.) Hughes
Imperata cylindrica P. Beauv. var. *major* (Nees) C. E. Hubb.
Panicum simile
Stipa sp.
Themeda australis (R. Br.) Stapf

POLYGONACEAE
Persicaria decipiens (R. Br.) K. L. Wilson

PROTEACEAE
Banksia serrata L. f.
Banksia spinulosa Smith
Hakea sericea Schrader
Lomatia ilicifolia R. Br.
Persoonia levis (Cav.) Domin
Persoonia linearis Andrews
Persoonia mollis R. Br.
Petrophile pedunculata R. Br.

RESTIONACEAE
Restio tetraphyllus Labill. subsp. *meiostachyus* L. Johnson & O. D. Evans

ROSACEAE
Rubus parvifolius L.

RUBIACEAE
Pomax umbellata (Gaertner) Sol. ex A. Rich.

RUTACEAE
Zieria smithii Jackson

SAPINDACEAE
Dodonaea triquetra Wendl.

SMILACACEAE
Smilax glyciphylla Sm.

THYMELAEACEAE
Pimelea linifolia Smith

TREMANDRACEAE
Tetratheca thymifolia Smith

UVULARIACEAE
Schelhammera undulata R. Br.

VIOLACEAE
Viola hederacea Labill.

XANTHORRHOEACEAE
Xanthorrhoea concava (A. T. Lee) D. J. Bedford

APPENDIX 4
LIST OF BIRD SPECIES FOR THE MILTON - ULLADULLA DISTRICT AND IN THE STUDY AREA

Notes:

a. Estimate of abundance in New South Wales.
Six orders of magnitude were defined by Morris, McGill and Holmes (1981) to describe maximum population size in any given year:

Rare (R)	< 100	Moderately common (MC)	10,000 - 100,000
Scarce (S)	100 - 1,000	Common (C)	100,000 - 1,000,000
Uncommon (U)	1,000 - 10,000	Abundant (A)	> 1,000,000

b. Source of record.
1. Recorded in the 10' grid blocks 35°15' 150°25' and 35°25' 150°25' (RAOU Bird Atlas Scheme, Melbourne).
2. Recorded in the area by the Pilot Atlas Scheme (Disney 1979).
3. Recorded in the Milton-Ulladulla area from other sources.
4. Observed in or adjacent to the study area in April 1994 and February 1998.

c. Introduced bird species are indicated by an asterisk (*).

d. Taxonomic names and common names are based on Christidis and Boles (1994).

Family/Species		Abundance in NSW[a]	Record[b]
PHASIANIDAE			
Stubble Quail	*Coturnix pectoralis*	A	1
Brown Quail	*Coturnix ypsilophora*	C	2
ANATIDAE			
Musk Duck	*Biziura lobata*	MC	1
Black Swan	*Cygnus atratus*	C	1 2
Australian Wood Duck	*Chenonetta jubata*	A	1 2 3
Pacific Black Duck	*Anas superciliosa*	A	1 2 3
Grey Teal	*Anas gracilis*	A	1 2
Chestnut Teal	*Anas castanea*	MC	1 2 3
Hardhead	*Aythya australis*	C	1
PODICIPEDIDAE			
Australasian Grebe	*Tachybaptus novaehollandiae*	A	1 2
Hoary-headed Grebe	*Poliocephalus poliocephalus*	C	1
SPHENISCIFORMES			
Little Penguin	*Eudyptula minor*	MC	1 2
PROCELLARIIDAE			
Wedge-tailed Shearwater	*Puffinus pacificus*	C	1 2
Short-tailed Shearwater	*Puffinus tenuirostris*	A	1 2
Fluttering Shearwater	*Puffinus gavia*	C-MC	1 2
DIOMEDEIDAE			
Wandering Albatross	*Diomedea exulans*	U	2
SULIDAE			
Australasian Gannet	*Morus serrator*	U	1 2 3
ANHINGIDAE			
Darter	*Anhinga melanogaster*	MC	1 2
PHALACROCORACIDAE			
Little Pied Cormorant	*Phalacrocorax melanoleucos*	A	1 2 3
Pied Cormorant	*Phalacrocorax varius*	MC	1
Little Black Cormorant	*Phalacrocorax sulcirostris*	A	1 2 3
Great Cormorant	*Phalacrocorax carbo*	C	1 2 3
PELECANIDAE			
Australian Pelican	*Pelecanus conspicillatus*	C-MC	1 3

Family/Species		in NSW [a]	Abundance Record [b]				
ARDEIDAE							
White-faced Heron	*Egretta novaehollandiae*	A	1	2	3		
Little Egret	*Egretta garzetta*	MC	1	2			
Eastern Reef Egret	*Egretta sacra*	S	1	2			
White-necked Heron	*Ardea pacifica*	C	1	2	3		
Great Egret	*Ardea alba*	C	1	2	3		
Intermediate Egret	*Ardea intermedia*	MC	1				
Cattle Egret	*Ardea ibis*	MC	1	2	3		
Striated Heron	*Butorides striatus*	U	1	2			
Nankeen Night Heron	*Nycticorax caledonicus*	C-MC	1				
THRESKIORNITHIDAE							
Australian White Ibis	*Threskiornis molucca*	A	1	2	3		
Straw-necked Ibis	*Threskiornis spinicollis*	A	1	2	3		
Royal Spoonbill	*Platalea regia*	MC	1	2	3		
Yellow-billed Spoonbill	*Platalea flavipes*	MC			3		
ACCIPITRIDAE							
Osprey	*Pandion haliaetus*	R	1				
Black-shouldered Kite	*Elanus axillaris*	C-MC	1	2			
Whistling Kite	*Haliastur sphenurus*	MC	1	2	3	4	
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	U	1	2	3	4	
Swamp Harrier	*Circus approximans*	MC	1	2	3		
Brown Goshawk	*Accipiter fasciatus*	MC	1	2	3		
Grey Goshawk	*Accipiter novaehollandiae*	U	1				
Collared Sparrowhawk	*Accipiter cirrhocephalus*	MC		2			
Wedge-tailed Eagle	*Aquila audax*	MC	1	2	3		
Little Eagle	*Hieraaetus morphnoides*	MC	1	2	3		
FALCONIDAE							
Brown Falcon	*Falco berigora*	MC	1	2	3		
Australian Hobby	*Falco longipennis*	MC	1	2			
Peregrine Falcon	*Falco peregrinus*	U	1	2			
Nankeen Kestrel	*Falco cenchroides*	C	1	2	3		
RALLIDAE							
Buff-banded Rail	*Gallirallus philippensis*	MC			3		
Purple Swamphen	*Porphyrio porphyrio*	A	1	2			
Dusky Moorhen	*Gallinula tenebrosa*	A	1	2			
Eurasian Coot	*Fulica atra*	A	1				
TURNICIDAE							
Painted Button-quail	*Turnix varia*	MC	1	2			
SCOLOPACIDAE							
Latham's Snipe	*Gallinago hardwickii*	MC	1				
Bar-tailed Godwit	*Limosa lapponica*	U	1	2	3		
Whimbrel	*Numenius phaeopus*	U		2			
Eastern Curlew	*Numenius madagascariensis*	U	1		3		
Common Greenshank	*Tringa nebularia*	U	1				
Marsh Sandpiper	*Tringia stagnalilis*	U		1			
Common Sandpiper	*Atitis hypoleucos*	S					
Grey-tailed Tattler	*Heteroscelus brevipes*	U		2			
Sharp-tailed Sandpiper	*Calidris acuminata*	C	1	2			
Curlew Sandpiper	*Calidris ferruginea*	MC	1	2			
Wood Sandpiper		1					

Family/Species	in NSW [a]	Abundance Record [b]				
HAEMATOPODIDAE						
Pied Oystercatcher	*Haematopus longirostris*	S	1	2	3	
Sooty Oystercatcher	*Haematopus fuliginosus*	S	1	2	3	
RECURVIROSTRIDAE						
Black-winged Stilt	*Himantopus himantopus*	C	1	2		
CHARADRIIDAE						
Red-capped Plover	*Charadrius ruficapillus*	C	1	2		
Double-banded Plover	*Charadrius bicinctus*	U	1	2		
Black-fronted Dotterel	*Elseyornis melanops*	C	1	2		
Hooded Plover	*Thinornis rubricollis*	S	1	2		
Red-kneed Dotterel	*Erythrogonys cinctus*	MC				
Masked Lapwing	*Vanellus miles*	A	1	2	3	
LARIDAE						
Silver Gull	*Larus novaehollandiae*	A	1	2	3	
Caspian Tern	*Sterna caspia*	U	1			
Crested Tern	*Sterna bergii*	MC	1	2	3	
White-fronted Tern	*Sterna striata*	U-S		2		
Common Tern	*Sterna hirundo*	U	1			
COLUMBIDAE						
Rock Dove*	*Columba livia*	A	1	2		
Spotted Turtle-Dove*	*Streptopelia chinensis*	A	1	2	3	4
Brown Cuckoo-Dove	*Macropygia amboinensis*	C	1	2	3	
Common Bronzewing	*Phaps chalcoptera*	A	1	2		
Brush Bronzewing	*Phaps elegans*	MC	1	2		
Crested Pigeon	*Ocyphaps lophotes*	A			3	4
Peaceful Dove	*Geopelia striata*	A		2	3	4
Wonga Pigeon	*Leucosarcia melanoleuca*	MC	1	2		
Topknot Pigeon	*Lopholaimus antarcticus*	MC	1	2	3	
CACATUIDAE						
Glossy Black-Cockatoo	*Calyptorhynchus lathami*	MC	1			
Yellow-tailed Black-Cockatoo	*Calyptorhynchus funereus*	MC	1	2	3	4
Gang-gang Cockatoo	*Callocephalon fimbriatum*	MC	1	2	3	4
Galah	*Cacatua roseicapilla*	A	1	2	3	4
Sulphur-crested Cockatoo	*Cacatua galerita*	C	1		3	4
PSITTACIDAE						
Rainbow Lorikeet	*Trichoglossus haematodus*	C	1	2	3	4
Musk Lorikeet	*Glossopsitta concinna*	MC	1	2	3	4
Little Lorikeet	*Glossopsitta pusilla*	C	1	2		
Australian King-Parrot	*Alisterus scapularis*	C	1	2	3	4
Crimson Rosella	*Platycercus elegans*	A	1	2	3	4
Eastern Rosella	*Platycercus eximius*	A	1	2	3	
Ground Parrot	*Pezoporus wallicus*	S		2		
CUCULIDAE						
Pallid Cuckoo	*Cuculus pallidus*	C	1	2		
Brush Cuckoo	*Cacomantis variolosus*	M	1			
Fan-tailed Cuckoo	*Cacomantis flabelliformis*	C	1	2	3	
Horsfield's Bronze-Cuckoo	*Chrysococcyx basalis*	C-MC	1	2		
Shining Bronze-Cuckoo	*Chrysococcyx lucidus*	S	1	2		
Common Koel	*Eudynamys scolopacea*	MC	1	2	3	
Channel-billed Cuckoo	*Scythrops novaehollandiae*	U	1	2	3	

Family/Species	in NSW [a]	Abundance Record [b]				
STRIGIDAE						
Powerful Owl	*Ninox strenua*	U				4
Southern Boobook	*Ninox novaeseelandiae*	C	1	2	3	
TYTONIDAE						
Masked Owl	*Tyto novaehollandiae*	U			3	
Barn Owl	*Tyto alba*	C-MC		2	3	
PODARGIDAE						
Tawny Frogmouth	*Podargus strigoides*	A		2	3	
AEGOTHELIDAE						
Australian Owlet-nightjar	*Aegotheles cristatus*	A		2		
APODIDAE						
White-throated Needletail	*Hirundapus caudacutus*	A	1	2	3	
Fork-tailed Swift	*Apus pacificus*	S	1			
ALCEDINIDAE						
Azure Kingfisher	*Alcedo azurea*	MC	1	2	3	
HALCYONIDAE						
Laughing Kookaburra	*Dacelo novaeguineae*	A	1	2	3	4
Sacred Kingfisher	*Todiramphus sanctus*	A	1	2	3	
CORACIIDAE						
Dollarbird	*Eurystomus orientalis*	MC	1	2	3	
MENURIDAE						
Superb Lyrebird	*Menura novaehollandiae*	C	1	2		
CLIMACTERIDAE						
White-throated Treecreeper	*Cormobates leucophaeus*	A	1	2	3	4
Red-browed Treecreeper	*Climacteris erythrops*	C	1	2	3	
MALURIDAE						
Superb Fairy-wren	*Malurus cyaneus*	A	1	2	3	4
Variegated Fairy-wren	*Malurus lamberti*	C	1	2	3	4
Southern Emu-wren	*Stipiturus malachurus*	MC	1	2	3	
PARDALOTIDAE						
Spotted Pardalote	*Pardalotus punctatus*	A	1	2	3	4
Striated Pardalote	*Pardalotus striatus*	A	1	2	3	
Pilotbird	*Pycnoptilus floccosus*	MC	1	2		
Rockwarbler	*Origma solitaria*	MC	1	2		
White-browed Scrubwren	*Sericornis frontalis*	A	1	2	3	4
Large-billed Scrubwren	*Sericornis magnirostris*	A		2	3	
Chestnut-rumped Heathwren	*Hylacola pyrrhopygia*	MC	1		3	
Striated Fieldwren	*Calamanthus fuliginosus*	U	1			
Weebill	*Smicrornis brevirostris*	A	1			
Brown Gerygone	*Gerygone mouki*	A	1	2	3	4
White-throated Gerygone	*Gerygone olivacea*	A		2		
Brown Thornbill	*Acanthiza pusilla*	A	1	2	3	4
Buff-rumped Thornbill	*Acanthiza reguloides*	A	1	2		
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*	A	1	2	3	
Yellow Thornbill	*Acanthiza nana*	A	1	2		
Striated Thornbill	*Acanthiza lineata*	A	1	2	3	4

Family/Species		in NSW [a]	Abundance Record [b]				
MELIPHAGIDAE							
Red Wattlebird	*Anthochaera carunculata*	A	1	2	3	4	
Little Wattlebird	*Anthochaera chrysoptera*	C	1	2	3	4	
Noisy Friarbird	*Philemon corniculatus*	A	1	2	3	4	
Bell Miner	*Manorina melanophrys*	A		2			
Lewin's Honeyeater	*Meliphaga lewinii*	A	1	2	3	4	
Yellow-faced Honeyeater	*Lichenostomus chrysops*	A	1	2	3	4	
White-eared Honeyeater	*Lichenostomus leucotis*	A	1	2			
Yellow-tufted Honeyeater	*Lichenostomus melanops*	A	1				
Fuscous Honeyeater	*Lichenostomus fuscus*	A	1				
White-plumed Honeyeater	*Lichenostomus penicillatus*	A	1				
Brown-headed Honeyeater	*Melithreptus brevirostris*	A	1	2	3		
White-naped Honeyeater	*Melithreptus lunatus*	A	1	2	3		
Crescent Honeyeater	*Phylidonyris pyrrhoptera*	MC	1	2	3		
New Holland Honeyeater	*Phylidonyris novaehollandiae*	A	1	2	3	4	
White-cheeked Honeyeater	*Phylidonyris nigra*	A	1		3		
Tawny-crowned Honeyeater	*Phylidonyris melanops*	MC	1	2	3		
Eastern Spinebill	*Acanthorhynchus tenuirostris*	A	1	2	3		
Scarlet Honeyeater	*Myzomela sanguinolenta*	C	1	2	3	4	
White-fronted Chat	*Epthianura albifrons*	C	1	2			
PETROICIDAE							
Jacky Winter	*Microeca fascinans*	A	1	2	3		
Scarlet Robin	*Petroica multicolor*	C	1	2	3		
Flame Robin	*Petroica phoenicea*	C			3		
Rose Robin	*Petroica rosea*	C	1	2			
Eastern Yellow Robin	*Eopsaltria australis*	A	1	2	3	4	
CINCLOSOMATIDAE							
Eastern Whipbird	*Psophodes olivaceus*	A	1	2	3	4	
Spotted Quail-thrush	*Cinclosoma punctatum*	MC	1	2			
NEOSITTIDAE							
Varied Sittella	*Daphoenositta chrysoptera*	C	1	2	3		
PACHYCEPHALIDAE							
Crested Shrike-tit	*Falcunculus frontatus*	C	1	2	3	4	
Olive Whistler	*Pachycephala olivacea*	MC	1				
Golden Whistler	*Pachycephala pectoralis*	A	1	2	3	4	
Rufous Whistler	*Pachycephala rufiventris*	A	1	2	3	4	
Grey Shrike-thrush	*Colluricincla harmonica*	A	1	2	3	4	
DICRURIDAE							
Black-faced Monarch	*Monarcha melanopsis*	C	1	2	3		
Leaden Flycatcher	*Myiagra rubecula*	C	1	2	3		
Restless Flycatcher	*Myiagra inquieta*	A	1	2	3		
Magpie-lark	*Grallina cyanoleuca*	A	1	2	3	4	
Rufous Fantail	*Rhipidura rufifrons*	C	1	2	3	4	
Grey Fantail	*Rhipidura fuliginosa*	A	1	2	3	4	
Willie Wagtail	*Rhipidura leucophrys*	A	1	2	3		
Spangled Drongo	*Dicrurus bracteatus*	MC	1	2			
CAMPEPHAGIDAE							
Black-faced Cuckoo-shrike	*Coracina novaehollandiae*	A	1	2	3	4	
White-bellied Cuckoo-shrike	*Coracina papuensis*	MC		2			
Cicadabird	*Coracina tenuirostris*	MC	1	2	3		
White-winged Triller	*Lalage sueurii*	MC	1				

Family/Species	in NSW [a]	Abundance Record [b]				
ORIOLIDAE						
Olive-backed Oriole	*Oriolus sagittatus*	C	1	2	3	4
Figbird	*Sphecotheres viridis*	MC		2	3	
ARTAMIDAE						
Dusky Woodswallow	*Artamus cyanopterus*	A	1	2	3	
Grey Butcherbird	*Cracticus torquatus*	A	1	2	3	4
Australian Magpie	*Gymnorhina tibicen*	A	1	2	3	4
Pied Currawong	*Strepera graculina*	A	1	2	3	4
Grey Currawong	*Strepera versicolor*	MC	1	2		
CORVIDAE						
Australian Raven	*Corvus coronoides*	A	1	2	3	4
CORCORACIDAE						
White-winged Chough	*Corcorax melanorhamphos*	C	1			
PTILONORHYNCHIDAE						
Satin Bowerbird	*Ptilonorhynchus violaceus*	C	1	2	3	4
ALAUDIDAE						
Skylark*	*Alauda arvensis*	MC		2		
MOTACILLIDAE						
Richard's Pipit	*Anthus novaeseelandiae*	A	1	2	3	
PASSERIDAE						
House Sparrow*	*Passer domesticus*	A	1	2	3	
Double-barred Finch	*Taeniopygia bichenovii*	A	1		3	
Red-browed Finch	*Neochmia temporalis*	A	1	2	3	4
Beautiful Firetail	*Stagonopleura bella*	U	1			
FRINGILLIDAE						
European Goldfinch*	*Carduelis carduelis*	A	1	2		
DICAEIDAE						
Mistletoebird	*Dicaeum hirundinaceum*	A	1	2	3	4
HIRUNDINIDAE						
Welcome Swallow	*Hirundo neoxena*	A	1	2	3	
Tree Martin	*Hirundo nigricans*	A	1	2		
Fairy Martin	*Hirundo ariel*	A	1			
SYLVIIDAE						
Clamorous Reed-Warbler	*Acrocephalus stentoreus*	A		2		
Little Grassbird	*Megalurus gramineus*	A	1	2		
Golden-headed Cisticola	*Cisticola exilis*	A	1	2		
ZOSTEROPIDAE						
Silvereye	*Zosterops lateralis*	A	1	2	3	4
MUSCICAPIDAE						
Bassian Thrush	*Zoothera lunulata*	C	1	2		
STURNIDAE						
Common Starling*	*Sturnus vulgaris*	A	1	2	3	
Common Mynah*	*Acridotheres tristis*	A			3	

APPENDIX 5
CORRESPONDENCE FROM THE NATIONAL PARKS AND WILDLIFE SERVICE

NSW NATIONAL PARKS AND WILDLIFE SERVICE

Mr Kevin Mills
Kevin Mills & Associates
222 North Curramore Road
Jamberoo NSW 2533

Our reference: ZF:0270 SN98/25
Your reference:

30 March 1998

Dear Mr Mills

Re: Proposed Residential Rezoning Seaspray Street, Narrawallee

Reference is made to your letter of 4 February 1998 in which you consult with the National Parks and Wildlife Service (NPWS) on the above rezoning proposal, for which you have been engaged by Council to carry out a flora and fauna study. It is understood an archaeological survey has already been carried out.

As discussed the onsite meeting of 9 March 1998, NPWS endorses the need for detailed site survey and assessment. The subject land would appear to have high biodiveristy values and on initial inspection would have a number of natural heritage constraints to residential development.

LES/LEP Process

It is noted that the subject land is currently zoned Environmental Protection 7(d2) Special Scenic and this zoning was also seen as appropriate in the draft Rural LEP nearing gazettal.

The NPWS in commenting on the Milton Ulladulla Structure Plan identified a number of important bushland remnants that warranted protection by extension of the Environmental Protection zone system. The proposed rezoning would appear at odds with strategic planning principles being implemented in the Milton/Ulladulla area through the structure plan in that Council are now considering the possibility of reducing the existing Environmental Protection Zone area on an ad hoc basis.

Threatened Species Issues

The NPWS strongly encourages Council's to assess the potential impact on any threatened flora and fauna at the LEP preparation stage as required in accordance with Section 34 of *Environmental Planning and Assessment Act 1979*. This would greatly assist in reducing the potential for threatened species issues to arise later in the planning process. While there is no requirement to carry out the 8 part test of significance under Section 5A of the *EP&A Act*, these sections are indicative of the issues that should be addressed.

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This is particularly the case for a residential rezoning where the impacts of urbanisation are quite apparent and well documented, usually leading to total loss of habitat both directly or indirectly over time within the subdivided area. In such circumstances there is less scope for mitigation of impacts. If threatened species or their habitats are present where urban development is proposed in most instances there would likely be a significant effect under Section 5A of the *EP&A Act* and a Species Impact Statement (SIS) would be required at the development application stage.

There are a number of threatened fauna records in the Milton Ulladulla area such as Squirrel Glider, Long nosed Potoroo, Southern Brown Bandicoot, Powerful Owl, Giant Burrowing Frog, Glossy Black Cockatoo and a number of forest dependent bats. As the habitat on site is similar to the West Ulladulla area, the species lists from the recently undertaken studies would be indicative of species that may also occur on site.

Areas within the site, such as the gully system are likely to contain threatened fauna habitat as the existing forest contains many large old trees which are of high habitat significance due to the importance of tree hollows.

NPWS databases have not identified any known occurrences of Rare or Threatened flora species, as opposed to communities, in the immediate area of the site. However, this may be partly due to lack of survey, and the possibility remains that there could be populations of Rare or Threatened flora within remaining native vegetation in these areas.

Native Vegetation Communities

It was noted that vegetation onsite is dominated by a blackbutt/bangalay community with a number of bloodwood and wollybutt patches evident in the gully area. The vegetation, particularly in the western section, is in good condition with intact understorey and absence of weeds.

Coastal *Eucalyptus pilularis* Forests were mapped in the recent NSW Interim Forest Assessment process (IAP) as poorly represented in dedicated reserve areas for the region (See attached summary of Vegetation Associations typing). This implies that surviving patches of such vegetation communities on privately owned land are therefore of conservation significance at a regional level. This would be especially the case where you have the association with the mature *Eucalyptus longifolia* patches in the gully area.

An examination of aerial photographs indicates that the proposed rezoning area is part of a substantial patch of remnant native vegetation that extends southward from Narrawallee Inlet. The area may have habitat corridor attributes that should be considered in any assessment of the site. In particular the impact of clearing of the land on connectivity of the bushland should be evaluated as the vegetation to the south of the property is already fragmented.

Preliminary Subdivision Layout

The preliminary subdivision plan indicates larger lots on the western side of the subject land. While it is acknowledged the actual building envelopes will prevent development of the moist gully with its higher biodiversity attributes, still the indirect impacts of urban development would be evident such as weed infestation, incidental clearing, and, as lots would drain to the gully area, the pollution impacts of urban runoff.

In conclusion, from the initial site inspection and existing knowledge of threatened species habitat in the area , indications are that the site is unsuitable for residential development. The proposal should not be considered without detailed and exhaustive survey and assessment to justify the loss of the potential habitat evident on the land in these circumstances.

If you have any questions concerning this matter, please contact Miles Boak, Environmental Planning Officer, on (02) 6298 9708.

Yours sincerely

A Sullivan

Amanda Sullivan
A/Manager, Environmental Planning Unit
Southern Zone

cc Alan Stafiukynas Shoalhaven City Council