Lands North of 20m AHD on Lots 11-18 in DP 1021340 in DP 1021340 and Lot 529 in DP 752050 Hall Street, Pitt Town.

Fauna Survey and Assessment

Prepared For:

Johnson Property Group,
Suite 3205, Level 32 The Chifley Tower,
2 Chifley Square,
SYDNEY NSW 2000
Tel: (02) 9222 9900 Fax: (02) 9232 5699
Email: paul.hedge@jpg.net.au

31 March 2006
Report No. 200612r1

Prepared By:

Dr Stephen Ambrose
Ambrose Ecological Services Pty Ltd
PO Box 246,
RYDE NSW 1680
Tel : (02) 9808 1236 Fax : (02) 9807 6865
Email : stephen@ambecol.com.au

Report No. 200612rp1

This report has been prepared in accordance with the scope of services described in the contract or agreement between Ambrose Ecological Services Pty Ltd (Ambecol) and the Client. The report relies upon data, surveys, measurements and results taken at or under the particular times and conditions specified herein. Any findings, conclusions or recommendations only apply to the aforementioned circumstances and no greater reliance should be assumed or drawn by the Client. Furthermore, the report has been prepared solely for use by the Client and Ambecol accepts no responsibility for its use by other parties.

Author :	Dr Stephen Ambrose
Position:	Director
Signature:	
Date:	31 March 2006

1

INTRODUCTION

1.1 INTRODUCTION

The purpose of this report is to provide a fauna assessment of the potential impacts of the proposed rezoning for residential development of lands North of 20m AHD on Lots 11-18 in DP 1021340 in DP 1021340 and Lot 529 in DP 752050 Hall Street, Pitt Town in the Hawkesbury Local Government Area (Hawkesbury LGA)

The fauna assessment:

- identifies key fauna habitats within the development site ("the subject site");
- reviews literature and databases relevant to the subject site;
- describes the methodology and results of the fauna surveys;
- addresses potential impacts on fauna and their habitats resulting from the proposed rezoning;
- proposes appropriate impact mitigation measures; and
- provides an assessment of the likelihood of significant impacts on threatened species and populations, and endangered ecological communities, according to Section 5A of the NSW *Environmental Planning and Assessment Act, 1979* (EP&A Act), NSW *Threatened Species Conservation Act, 1995* (TSC Act) and Commonwealth *Environmental Protection and Biodiversity Conservation Act, 1999* (EPBC Act). This was done to determine the need for a Species Impact Statement (SIS) under the TSC Act or an application for development under the EPBC Act.

A comprehensive assessment of the flora and vegetation communities on and adjacent to the subject site is provided by Clements *et al.* (2006).

1.2 SITE DESCRIPTION

The subject site is 59.5 ha in area and is located on land below 20 m AHD adjoining the Hawkesbury River in the north of Pitt Town. It is bounded by the 20 m AHD contour in the south, and slopes down steeply towards the Hawkesbury River in the west, with a gentler slope in the central and eastern parts of the site. At the base of the slope, there is gently undulating pastureland extending to the steep, eroded river banks. The subject site has a long history of disturbance from agricultural activities, as well as extensive erosion and weed invasion along the banks of the river.

The subject site is bounded by:

- the Hawkesbury River to the north-east and north-west;
- rural land and a caravan park to the north;

- existing rural land adjoining Hall Street to the south, and suburban and rural residential land further south;
- the Hawkesbury River and existing rural land to the east; and
- Punt Road to the west with existing rural land further west (Figure 1).

The area of the subject site that is west of Hall Street is mostly cleared pastureland with a few scattered Forest Red Gums (*Eucalyptus tereticornis*) and two planted rows of Slash Pines (*Pinus elliotii*) and Monterey Pines (*Pinus radiata)* (Figure 2).

There are two small farm dams on the land to the east of Hall Street. To the north of this area are cleared grasslands that are dominated by African Lovegrass (*Eragrostris curvula*) with dense thickets of Honey Locust (*Gleditsia triacanthos*). A cleared pasture and a farmhouse occur in the southern part of the subject site.

The riparian zone along the southern bank of the Hawkesbury River is up to 80 m in width. The main canopy species is River Oak (*Casuarina glauca*), reaching up to 15 m I height. The tall shrub layer, when present, is dominated by invasive exotic species such as Green Cestrum (*Cestrum parqui*), Small-leaved Privet (*Ligustrum sinense*), Lantana (*Lantana camara*) and Castor Oil Plant (*Ricinus communis*). Native species that occur infrequently in the shrub layer include Parramatta Wattle (*Acacia parramattensis*), Yellow Tea-tree (*Leptospermum polygalifolium*) and Prickly Paperbark (*Melaleuca stypheloides*). The groundcover is also dominated by exotic species, including Balloon Vine (*Cardiospermum grandiflorum*), Wandering Jew (*Tradescantia albiflora*), Turkey Rhubarb (*Acetosa saggitata*), Paddy's Lucerne (*Sida rhombifolia*), Kikuyu (*Pennisetum clandestinum*) and African Lovegrass. Native species are uncommon in the groundcover layer, but include Blue Spiderwort (*Commelina cyanea*), Oxalis (*Oxalis perrenans*), Meadow Rice-grass (*Microlaena stipoides*) and Couch (*Cynodon dactylon*).

1.3 STATUTORY FRAMEWORK

1.3.1 NSW Legislation

Section 78A of the EP&A Act enables a person to apply to a consent authority to carry out development that is permissible under an environmental planning instrument.

In assessing a development application a consent authority must, pursuant to 79C of the EP&A Act take into consideration, where relevant, the likely impacts of the development on the natural and built environments.

Section 4 of the EP&A Act lists the factors to be taken into consideration in assessing a development application in deciding whether there is likely to be a significant effect on a threatened species or population, endangered ecological community, or their habitats (the eight-part test). If a significant impact is likely to occur then a species impact statement (SIS) must be prepared in accordance with Division 2 of Part 6 of the TSC Act.

An SIS provides a more detailed assessment of threatened biota issues and proposes measures to manage and mitigate adverse impacts on the threatened species, populations or ecological communities, or their habitats, resulting from the proposal.

FIGURE 1 LOCATION OF SUBJECT SITE

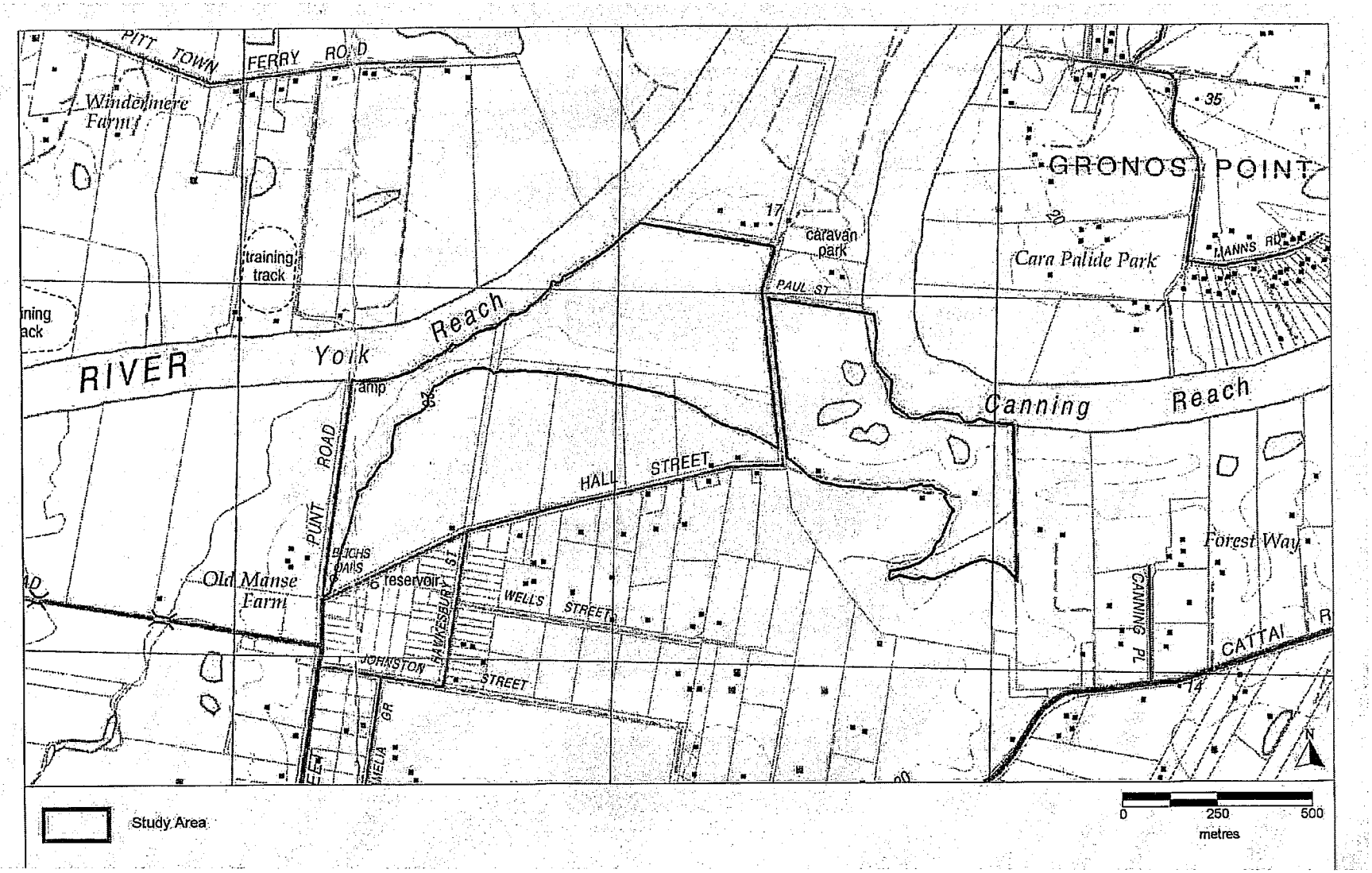

FIGURE 2 AERIAL VIEW OF SUBJECT SITE IN 2005

This report examines the factors, the likely impacts and determine whether or not an SIS is required to be prepared.

1.3.2 Commonwealth Legislation

The *Environmental Protection and Biodiversity Conservation Act, 1999* (EPBC Act) regulates the assessment and approval of actions that have a significant impact on matters of national environmental significance. An action that is likely to have a significant impact requires the approval of the Commonwealth Minister for the Environment. Guidelines for assessing the national significance of impacts are presented on the Environment Australia website.

This report assesses whether or not the proposed development would significantly impact on listed nationally threatened species and ecological communities, and migratory species.

1.3.3 Planning Instruments

The planning instrument that is also considered in the present report is State Environmental Planning Policy 44 (SEPP 44) – Koala Habitat Protection.

1.4 STRUCTURE OF REPORT

This report comprises four chapters and one appendix. The contents of subsequent sections of the report are as follows:

Chapter 2 outlines the methods used to survey and assess key fauna habitats within the subject site. This includes reviews of databases and literature, and descriptions of survey techniques and survey effort for fauna species, including threatened species.

Chapter 3 describes the existing fauna and their habitats within the subject site and their overall conditions and conservation significance.

Chapter 4 identifies potential impacts of the proposed development on native fauna and their habitats. It also recommends appropriate measures for avoiding or minimising impacts on fauna and their habitats that may occur as a result of the proposed residential rezoning.

Appendix A presents Seven-Part Tests of Significance for threatened and regionally significant fauna species and populations that would be potentially impacted on by the proposed residential rezoning.

2

METHODOLOGY

2.1 OVERVIEW

Fauna issues relating to the application for development of the subject site were identified by reviewing relevant literature and databases and conducting field surveys. The methods by which this information was collected and analysed are presented below.

2.2 EXISTING RECORDS

Existing literature relevant to the study area, in particular technical environmental reports produced by NPWS, other consultancies and Hawkesbury City Council, were reviewed to determine the presence of terrestrial and aquatic habitats, and fauna species of conservation significance, within the locality (a 5 km radius around the subject site).

Records of threatened fauna species, listed under the schedules of the TSC and EPBC Acts and species of regional conservation significance, were obtained from databases for the Hawkesbury LGA

The databases searched were:

- NPWS Wildlife Atlas Database;
- NSW Field Ornithologists' Club Atlas Database;
- Birds Australia Atlas Database (1977-81) and (1998 onwards);
- EPBC database; and
- Australian Museum specimen collection database.

These databases only contain indicative records of fauna species in the locality and are not the result of a systematic fauna survey. Database records for individual species will vary in quality, reliability and accuracy of the geographic co-ordinates. Therefore, some species records are highly accurate in space and time such as the Birds Australia Atlas Database and the Australian Museum Specimen Collection Database. However, others are more tentative or only contain estimates of geographical locations, for instance, records from the NPWS Wildlife Atlas Database have a limited accuracy based on a 1 km^2 recording grid.

2.3 TAXONOMY

The following references were used to identify and classify animal groups:

- birds - Simpson & Day (1998); Christidis & Boles (1994);
- mammals (excluding bats) - Cronin (2000c), Menkhorst & Knight (2001),
- bats - Richards and Hall (1993) and Reinhold *et al.* (2001); and
- amphibians - Cogger (2000), Anstis (2002);
- reptiles – Cogger (2000), Cronin (2001), Swan *et al.* (2004).

2.4 FIELD SURVEY

2.4.1 Overview

The conservation value of the subject site for native fauna was assessed during one diurnal and one brief nocturnal inspection on 29 March 2006. Given the site's rural setting and the relatively cleared and degraded nature of habitats, this is considered an appropriate amount of search effort required to assess the native fauna and habitat values of the site.

2.4.2 Fauna Habitat Assessment and Survey

(a) Fauna Habitat Assessment

It was not possible to determine with certainty all the fauna that utilise habitats in the subject site. This is because of the likely seasonal occurrences of some fauna species, the occasional occurrence of vagrant species, and because some species are difficult to detect because of their timid or cryptic behaviour. Therefore, fauna investigations comprised an assessment of fauna habitats present on the site and an indication of their potential to support native wildlife populations and, in particular, threatened species.

The assessment criteria included:

Mammals:	extent of ground cover, shrub layer and tree canopy, hollow-bearing trees, substrate type (for burrowing etc), evidence such as droppings, diggings, footprints, scratches on trees, nests, burrow paths and runways.
Birds:	structural features such as the extent and nature of the canopy, understorey and ground strata and flowering characteristics, bird species.
Reptiles and Amphibians:	cover, shelter, suitable substrate, basking and breeding site availability. Reptiles and frogs sought in likely sheltering places.
Invertebrates	logs and other debris, leaf and bark accumulations around bases of trees, grass clumps, loose soil for burrowing.
Wildlife Corridor Values	Importance of the creek systems and riparian vegetation as movement corridors for fauna, especially birds, aquatic fauna, mammals (e.g. microchiropteran bats) & amphibians.

(b) Fauna Survey

A search for fauna species on the subject site was conducted during a diurnal site inspection (0800 to 1230 hrs) and a nocturnal inspection (1830 to 2130 hrs) on 26 March 2006. Information collected was used in conjunction with other surveys and records in determining fauna use of the subject site and, in particular, use or potential use of the subject site by threatened species.

Weather conditions were recorded during the time of the survey. In addition to fauna habitat assessment, the results of systematic surveys and incidental sightings of terrestrial

vertebrates and threatened invertebrates (e.g. Cumberland Plain Land Snail) were used to determine faunal assemblages on the subject site. These techniques are described in greater detail below:

(i) Bird Surveys

Within treed areas, area searches for birds were conducted in which the observer walked at random through the remnant, stopping at will, with a search effort equivalent to a 2 ha coverage over a 30-minute period. All bird species that were observed or heard during the survey were noted. Opportunistic observations of birds in the green field part of the subject site were also recorded.

Owl presence was investigated at night by playing the calls of owls that could potentially occur in the locality and subsequently searching for owls that may be responding to these calls.

(ii) Reptiles and Amphibians

Reptiles and amphibians were identified using indirect observation methods. Species were searched for in fallen logs, suitable rock basking substrates and underneath other fallen material. At night time, responses to playback recordings, together with spotlighting, helped identify frog species that could have potentially occurred in water-logged areas of the subject site.

(iii) Microchiropteran Bats

Microchiropteran bats often fly through woodland or forest habitats by moving along creeks and open areas of forest. They are most easily detected around dusk when they emerge from their day-time roosts and begin to actively forage for food. A hand-held Anabat II Bat Detector (Titley Electronics) was used on the subject site from 1830 to 2100 hrs on 29 March 2006 to record the ultrasonic calls of bats that may have been in or near the subject site.

Bat calls that are recorded during surveys are routinely identified with the assistance of Anabat 6.3 Software (Titley Electronics), Richards *et al.* (1993) and Reinhold *et al.* (2001).

(iv) Other Mammals

Opportunistic observations were recorded if mammals were seen at night during spotlighting surveys and during the day when searching for other fauna.

(v) Cumberland Plain Land Snail

Treed areas were searched on foot for the presence of the Cumberland Plain Land Snail. This involved searching for snails underneath fallen bark at the base of tree trunks, fallen ground debris (e.g. branches, tree limbs and leaf litter), under grass tussocks, and under human garbage.

2.2.2 *Species of Conservation Significance*

Native fauna species and populations considered threatened in New South Wales are listed in Schedules 1 and 2 of the *Threatened Species Conservation (TSC) Act 1995*. A Seven-Part Test was conducted for all those threatened species detected on a site or for those considered to potentially occur there due to the availability of habitat.

2.3 ASSESSMENT OF CONSERVATION VALUE

2.3.1 Conservation Value Parameters

The conservation value of fauna habitats on the subject site was determined by reference to the following criteria:

- *representativeness* - whether the vegetation communities of the site are unique, typical or common in the bioregion. In addition, the criteria takes into account whether or not such vegetation units are presently held in conservation reserves;
- the presence of threatened or regionally significant species on the site;
- The extent of human influence on the natural environment of the site and the condition of habitats (e.g. the presence of weeds, fire frequency etc.);
- the uniqueness of the natural values of the site;
- the amount of native vegetation to be cleared or modified by the proposed development in relation to what remnant vegetation will remain in the locality; and
- the relative importance of a site as a corridor for the movement of wildlife.

2.4 KOALA HABITAT ASSESSMENT

An assessment of Koala habitat on the subject site, according to the *State Environment Planning Policy No. 44 – Koala Habitat Protection* (SEPP 44), was completed on 29 March 2006 as part of the overall fauna survey and assessment.

It is necessary to identify whether the site consists of *potential* and/or *core* Koala habitat as defined under SEPP 44 when seeking development consent in local government areas to which the policy applies.

Potential Koala habitat is defined as *"areas of native vegetation where the trees of the types listed in Schedule 2 (of SEPP 44) constitute at least 15% of the total number of trees in the upper or lower strata of the tree componen*t". Trees listed in Schedule 2 are presented in Table 2.1

Core Koala habitat means *"an area of land with a resident population of Koalas, evidenced by attributes such as breeding females (that is, females with young) and recent sightings and historical records of a Koala population"*. The subject site in the present study is not Potential or Core Habitat according to these definitions.

Table 2.1 **TREES LISTED IN SCHEDULE 2 OF SEPP 44**

Scientific Name	Common Name
Eucalyptus albens	White Box
Eucalyptus camaldulensis	River Red Gum
Eucalyptus haemastoma	Broad-leaved Scribbly Gum
Eucalyptus microcorys	Tallowwood
Eucalyptus populnea	Bimble Box
Eucalyptus punctata	Grey Gum
Eucalyptus robusta	Swamp Mahogany
Eucalyptus signata	Scribbly Gum
Eucalyptus tereticornis	Forest Red Gum
Eucalyptus viminalis	Ribbon Gum

3

RESULTS

3.1 OVERVIEW

This chapter describes the native fauna and their habitats on the subject site. It describes the fauna habitats that are present on the site, assesses their conservation values and discusses the possibility of threatened and locally significant species occurring there.

3.2 VEGETATION COMMUNITIES

The floristic diversity and structure of vegetation communities on the subject site are described in detail by Clements *et al.* (2006)

3.3 FAUNA PARAMETERS

3.3.1 Fauna Habitats

There are three main habitats for native fauna on the subject site:

- Forest and woodland remnants;
- Grassland/Cleared lands; and
- Aquatic Habitats

Each of these habitats is discussed in detail below.

(a) Forest and Woodland Remnants

Occurrence: Riparian zone along the southern bank of the Hawkesbury River (northern boundary of subject site) and scattered trees in north-eastern and north-western parts of the subject site.

Habitat Elements: The tree canopy has the potential of producing seeds, nectar and/or fruits for nectarivorous and frugivorous birds and bats, and arboreal mammals. It also provides potential nesting and roosting sites for common native birds (e.g. honeyeaters, pardalotes, gerygones, thornbills, corvids and artamids) and for some arboreal mammals (e.g. possums). There are no trees on the subject site with hollows that are large enough to be used as roosting and breeding habitat and shelter by microchiropteran bats, hollow-dependent birds (e.g. treecreepers, owls, cockatoos and parrots), some arboreal mammals (e.g. gliders, possums, marsupial mice and rats), reptiles and amphibians.

There is a medium amount of fallen timber on the ground, mostly branches that have fallen off the taller trees and some fallen logs. These are potential shelter and refuge sites for reptiles, amphibians and small ground-dwelling mammals (e.g. marsupial mice and rats) and the Cumberland Land Snail (*Meridolum corneovirens*).

Native grasses are potential food sources for macropods (e.g. Swamp Wallabies and Grey Kangaroos). Seeding grasses are potential food for native finches (e.g. Red-browed Firetail Finches) and grass-feeding parrots (e.g. Red-rumped Parrots).

The riparian zone along the banks of the Hawkesbury River is likely to act as a wildlife corridor for native fauna as they move through the rural landscape.

Disturbance: The tall shrub layer, when present, is dominated by invasive exotic species such as Green Cestrum (*Cestrum parqui*), Small-leaved Privet (*Ligustrum sinense*), Lantana (*Lantana camara*) and Castor Oil Plant (*Ricinus communis*). The groundcover is also dominated by exotic species, including Balloon Vine (*Cardiospermum grandiflorum*), Wandering Jew (*Tradescantia albiflora*), Turkey Rhubarb (*Acetosa saggitata*), Paddy's Lucerne (*Sida rhombifolia*), Kikuyu (*Pennisetum clandestinum*) and African Lovegrass. The banks of the Hawkesbury River are heavily eroded as a result of trampling by livestock and water runoff.

(b) Grassland/Cleared Land

Occurrence: Across most of the subject site, south of the riparian zone of the Hawkesbury River.

Habitat Elements: The cleared or disturbed grassland areas of the subject site provide potential foraging habitat for common ground-foraging bird species, such as Masked Lapwings (*Vanellus miles*), Galahs (*Cacatua roseicapilla*), Red-rumped Parrots (*Psephotus haematonotus*), Australian Pipits (*Anthus australis*), Brown Songlarks (*Cinclorhamphus mathewsi*), Magpie-larks (*Grallina cyanoleuca*) and Australian Magpies (*Gymnorhina tibicen*).

Disturbance: These areas have been subject to livestock grazing in the past. Exotic plants dominate this part of the landscape and include African Lovegrass (*Eragrostris curvula*) with dense thickets of Honey Locust (*Gleditsia triacanthos*).

(c) Aquatic/Riparian Habitats

Occurrence: Hawkesbury River and farm dams in the eastern part of the subject site.

Habitat Elements: The water bodies provide potential calling, breeding and foraging habitat for adult frogs and foraging habitat for tadpoles. The dams also provide potential foraging habitat for some waterfowl species (e.g. grebes and ducks), gallinules (coots, swamphens and moorhens), rails and crakes, and wading birds (egrets and herons), and drinking and bathing habitat for bushland birds.

The riparian zone along the Hawkesbury River provides potential foraging habitat for threatened bitterns.

Disturbance: Water along the edges of the Hawkesbury River and farm dams is turbid as a result of erosion of the banks and nutrient-enrichment resulting from livestock grazing.

The wetland vegetation communities are dominated by exotic plant species such as Scotch Thistle (*Cirsium vulgare*), Catsear (*Hypochoeris radicata*), Redflower Mallow (*Modiola caroliniana*), *Paspalum urvillei,* Plantain, Fireweed and Pigeon Grass.

3.3.2 Fauna

Twenty-four (24) fauna species (three amphibian species, two reptile species, 16 bird species, and two mammal species) were recorded on the subject site (Table 3.1). Two of the bird species (Common Starling and Indian Mynah) are exotic species and the remaining 22 fauna species are locally native to the Sydney Basin Bioregion.

Table 3.1 FAUNA SPECIES RECORDED ON OR ADJACENT TO THE SUBJECT SITE

Legend to Methods of Detection [Present Study]:
An: Anabat II Detector
C: Call identification
O: Observed
P: Call playback response
Sc: Scat, track or sign indication.
Sp: Spotlighting
* Introduced species

Species in bold type are listed as threatened under the schedules of the *Threatened Species Conservation Act, 1995*.

Common Name	Scientific Name	Method of Detection
AMPHIBIANS		
Peron's Tree Frog	*Litoria peronii*	P, C, Sp
Striped Marsh Frog	*Limnodynastes peronii*	P, C, Sp
Common Eastern Froglet	*Crinia signifera*	P, C, Sp
REPTILES		
Eastern Water Skink	*Eulamprus quoyii*	O
Grass Sun-skink	*Lampropholis guichenoti*	O
BIRDS		
Masked Lapwing	*Vanellus miles*	O, C
Black-shouldered Kite	*Elanus axillaries*	O
Australian Kestrel	*Falco cenchroides*	O
Crested Pigeon	*Ocyphaps lophotes*	O
Eastern Rosella	*Platycercus eximius*	O, C
Australian Pipit	*Anthus australis*	O
Willie Wagtail	*Rhipdura leucophrys*	O, C
Grey Fantail	*Rhipidura fuliginosa*	O, C
Welcome Swallow	*Hirundo neoxena*	O, C
Red-browed Finch	*Neochmia temporalis*	O, C
Silvereye	*Zosterops lateralis*	O, C
Australian Magpie-lark	*Grallina cyanoleuca*	O,C
Australian Magpie	*Gymnorhina tibicen*	O,C
Common Starling *	*Sturnus vulgaris*	O,C
Indian Mynah *	*Acridotheres tristis*	O, C
MAMMALS		
Common Brushtail Possum	*Trichosurus vulpecula*	Sp
Gould's Wattled Bat	*Chalinolobus gouldii*	An

3.3.3 *Threatened and Regionally Significant Fauna Species*

(a) Threatened Species

Threatened fauna species that have been detected in the locality, their habitat requirements, and their likelihood of occurring on the subject site are shown in Table 3.2.

No threatened fauna species were recorded on the subject site. However, potential habitat occurs within the subject site for the following threatened species that have been recorded in the locality:

- Giant Burrowing Frog (*Heleioporus australiacus*);
- Red-crowned Toadlet (*Pseudophryne australis*);
- Green and Golden Bell Frog (*Litoria aurea*);
- Black Bittern (*Ixobrychus flavicollis*)
- Grey-headed Flying-fox (*Pteropus poliocephalus*);
- Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*)
- Large-eared Pied Bat (*Chalinolobus dwyeri*);
- East Coast Freetail Bat (*Mormopterus norfolkensis*);
- Eastern Bentwing-bat (*Miniopterus schreibersii*);
- Large-footed Mouse-eared Bat (*Myotis adversus*);
- Greater Broad-nosed Bat (*Scoteanax ruepelli*); and
- Cumberland Plains Land Snail (*Meridolem corneovirens*).

Impacts of the proposed rezoning of the subject site on the status of these species and their habitats are discussed in Chapter 4 and Appendix A.

Fauna species that are considered rare in the western parts of the Cumberland Plain include the Buff-rumped Thornbill (*Acanthiza reguloides*), White-winged Chough (*Corcorax melanorhamphos*), Eastern Grey Kangaroo (*Macropus giganteus*), Swamp Wallaby (*Wallabia bicolor*) and Red-necked Wallaby (*Macropus rufogriseus*). No regionally significant species were observed during the field surveys.

3.3.4 *Likelihood of Listed Migratory Species*

Migratory species that are protected under the Japan-Australia Migratory Bird Agreement (JAMBA) and China-Australia Migratory Bird Agreement (CAMBA) are listed under the schedules of the EPBC Act.

The Regent Honeyeater and Swift Parrot (*Lathamus discolor*) may occasionally forage within the canopy in woodland areas of the subject site, but these species are likely to be, at best, occasional vagrants to the site. Latham's Snipe (*Gallinago hardwicki*) may occasionally forage in the disturbed, cleared areas of the subject site. Fork-tailed Swifts (*Apus pacificus*) and White-throated Needletails (*Hirundapus caudacutus*) may occasionally fly high over the subject site. The area of habitat on the subject site is a negligible amount of area available to these species.

3.4 WILDLIFE CORRIDOR VALUES OF SUBJECT SITE

3.4.1 Wildlife Corridors & Principles

Wildlife corridors allow movement of flora and fauna between patches of wildlife habitat (Soule & Gilpin 1991). The preservation or establishment of corridors to link habitats has been proposed as a practical conservation measure to ameliorate habitat loss and fragmentation effects (Bennett 1990).

Corridor habitats are thought to help conserve invertebrates, can protect certain forest types, act as fauna refuges, link adjoining reserve areas and provide shelter and nesting sites for fauna (Taylor 1991).

It is essential for a corridor to have the following characteristics if they are to be effective:

- Vegetated corridors that comprise a mosaic of different habitats are considered more likely to contain the necessary food, shelter and nesting resources for fauna. Seasonal resource requirements are essential for survival and may only be found between a range of habitats at different altitudes and geographic variations (Recher 1993). Therefore, corridors that link patches over the entire ecological gradient from ridge to gully would conserve more species, especially those that have large home ranges and changing seasonal requirements (Lindenmayer *et al.* 1994).

- The quality of the habitat within the corridor is important. Some fauna would reluctantly utilise corridors of low quality, such as areas invaded by weeds or subject to frequent fires, or due to a reduction in the availability of essential resources (such as feeding, shelter, roosting and breeding sites).

- The size of the corridor is also important. For example, corridors with mature trees, but with little or no understorey may afford good habitat links for birds, bats and some arboreal fauna, but not for ground-dwelling fauna.

  Corridors that are 200 or more metres in width tend to facilitate the movement of all fauna by providing at least some core interior habitat that is not affected by edge environments (Lindenmayer 1994). Corridors between 80 and 200 m width tend to be effective at moving many fauna, including some fauna that do not tolerate urban disturbance and fragmentation (such as Sugar Gliders and some forest-dependent birds) (Bennett 1990, Saunders & de Rebeira 1991, Catterall *et al.* 1991, Bentley & Catterall 1997). Corridors less than 30 m in width tend to effective only for servicing the most tolerant of urban fauna (for instance, Brushtail Possums, Bush Rats, common urban birds, and fauna habitat generalists) (Bentley 1990, Lindenmayer 1994, Catterall *et al.* 1991, Bentley & Catterall 1997).

  Gaps between vegetation links should be narrow. Catterall *et al.* (1991) found that gaps greater than 15 m in width represent a significant barrier to the movement of forest dependent birds. Barnett (1978) found that a small mammal's ability to cross an unvegetated gap was inversely proportional to the size of the gap. Lynch & Saunders (1991) found that the existence of a well-developed understorey was the single most important vegetation-related factor in corridor use by small bushland bids (Sewell & Catterall 1998).

3.4.2 *Application to the Subject Site*

The main wildlife corridor through the locality ishe vegetated riparian zone along the Hawkesbury River, along the northern boundary of the subject site. The width of this corridor ranges from 0 to 80 m on the subject site and would only be suitable for use as a wildlife corridor by urban- or rural-tolerant species.

3.5 KOALA HABITAT ASSESSMENT

There are no known records of Koalas occurring on the subject site or within a 5 km radius of the site. The Forest Red Gum (*Eucalyptus tereticornis*) is the only recognised Koala roost or food tree species.

No Koala scats or tree scratchings were observed on trees within the subject site or neighbouring bushland areas, suggesting that Koalas do not use these areas on a regular basis and, at best, are likely to be occasional vagrants. Koalas are most unlikely to occur on the subject site because of the rural and urbanised nature of the surrounding landscape (including busy roads), the site's isolation from remnant areas of bushland, its small size, and the lack of recent records of Koalas occurring in the locality in recent times.

Table 3.2 THREATENED FAUNA SPECIES RECORDED WITHIN LOCALITY (10 KM OF SUBJECT SITE)

Scientific Name	Common Name	EPBC Act Status	TSC Act Status	Habitat Requirements and Likelihood of Occurrence	Seven Part Test required?
AMPHIBIANS					
Heleioporus australiacus (Shaw & Nodder, 1795)	Giant Burrowing Frog	V*	V	Mostly restricted to Hawkesbury Sandstone, usually found around sandy creek banks, with crayfish burrows in this area. Potential habitat along the Hawkesbury River banks.	Yes
Pseudophryne australis (Gray, 1835)	Red-crowned Toadlet		V	Restricted to Hawkesbury Sandstone and may be found beside temporary creeks, gutters and soaks within this area, and under rocks and logs. Potential habitat along the Hawkesbury River banks.	Yes
Litoria aurea (Lesson, 1829)	Green and Golden Bell Frog	V*	E	Large permanent swamps and ponds with plenty of emergent vegetation, especially bullrushes. In areas free of the Mosquito Fish (*Gambusia affinus*). Potential habitat along the Hawkesbury River banks.	Yes
Mixophyes iterates	Giant-barred Frog		V	Rainforests, Antarctic Beech forests and wet sclerophyll forests. Ranges from Bunya Mtns, Qld, and coast and ranges of south-eastern Qld and northern NSW south to about Narooma. No potential habitat on or adjacent to subject site.	No
REPTILES					
Hoplocephalus bungaroides	Broad-headed Snake	V*	E	An aggressive, nocturnal snake largely confined to the Hawkesbury sandstone, where it is usually found under large slabs or rocky ridges, or in rocky crevices. No potential habitat on subject site.	No
Varanus rosenbergi (Mertens, 1957)	Heath Monitor		V	Coastal heaths, humid woodlands and both wet and dry sclerophyll forests. A mostly terrestrial species which shelters in burrows, hollow logs and rock crevices. No potential habitat on subject site.	No
BIRDS					
Nettapus coromandelianus	Cotton Pygmy-goose		E	Found in deep lagoons, swamps and dams, particularly with water lilies and other floating vegetation. No available habitat. Not detected on site.	No
Stictnonetta naevosa	Freckled Duck		V	Breeds in heavily vegetated freshwater swamps; moves to	No

Scientific Name	Common Name	EPBC Act Status	TSC Act Status	Habitat Requirements and Likelihood of Occurrence	Seven Part Test required?
				freshwater or salty permanent open lakes, especially in droughts. No available habitat. Not detected on site.	
Botaurus poiciloptilus	Australasian Bittern		V	Roosts and breed in rush- and reed-filled marshes. No potential habitat on site.	No
Ixobrychus flavicollis (Latham, 1790)	Black Bittern		V	Rests in waterside vegetation and emerges at dusk and dawn to hunt for fish, amphibians, molluscs and insects. Potential habitat along the banks of the Hawksbury River..	Yes
Lophoictinia isura	Square-tailed Kite			Open forests, riverine woodlands, scrubs and heathlands, mostly in inland NSW. May very occasionally occur in the study area as a vagrant when inland populations disperse during drought periods. The proposed development will not limit resources for this species.	No
Falco hypoleucos	Grey Falcon		V	Occurs in open grassy woodlands of inland Australia. Vagrants may very occasionally disperse to coastal regions, especially in periods of prolonged drought. No limiting resources in the study area. Therefore, species is unlikely to be impacted by development.	No
Burhinus grallarius	Bush Stone-curlew		E	Occurs in lightly timbered open forest or grassy woodland habitat. Often associated with woodlands of casuarina, eucalyptus, acacia and epolycarpa. Also found in dry, open grassland and cropland with cover nearby. No available habitat on site.	No
Charadrius leschenaulti	Greater Sand Plover		V	Forages on intertidal sand and mudflats in estuaries, and roosts during high tide on sandy beaches or rocky shores. Occasional sightings have also occurred on near-coast salt lakes, brackish swamps, shallow freshwater wetlands and grassed paddocks. No available habitat on site.	No
Charadrius mongolus	Lesser Sand Plover		V	Favours coastal habitats including beaches, mudflats and mangroves. In NSW, most often seen on intertidal sand and mudflats in estuaries or roosting on sandy beaches or rocky shores at high tide. No available habitat on site.	No
Irediparra gallinacea	Comb-crested Jacana		V	Swamps, lakes and lagoons. Walks on floating plants. No available habitat on site.	No
Rostratula benghalensis	Painted Snipe		V	Occurs in shallow freshwater (occasionally brackish) wetlands,	No

Scientific Name	Common Name	EPBC Act Status	TSC Act Status	Habitat Requirements and Likelihood of Occurrence	Seven Part Test required?
				including inundated or waterlogged grassland or saltmarsh. No available habitat on site.	
Ephipporhynchus asiaticus	Black-necked Stork		E	River pools, swamps and intertidal flats. Potential habitat occurs in wetlands and aquatic herbfields of the subject site. The Hunter region is outside the core distribution of this species and the small number of individuals recorded in the region are of vagrants. No limiting resources on subject site.	No
Calyptorhynchus lathami (Temmink, 1807)	Glossy Black-Cockatoo		V	Eucalypt forests of eastern Australia. Feeds exclusively on *Allocasuarina* (sheoak) seeds, particularly *A. littoralis* and *A. torulosa*. No potential habitat on the subject site.	No
Lathamus discolor (Shaw, 1790)	Swift Parrot	E*	V*	Breeds in Tasmania and migrates to mainland between March and September to feed on eucalypt blossoms. Potential foraging habitat occurs in forested areas of the subject site, but is likely to be an infrequent visitor to the site. Therefore, there are no limiting resources on site. Not detected on subject site.	No
Neophema pulchella (Shaw, 1792)	Turquoise Parrot		V	Steep, rocky ridges and gullies, rolling hills, valleys and river flats and the nearby plains of the Great Dividing Plain. No potential habitat on subject site.	No
Polytelis swainsonii (Desmarest, 1826)	Superb Parrot	V*	V	Woodlands of western watershed of Great Dividing Range, NSW. Vagrants may very occasionally disperse to coastal regions, especially in periods of prolonged drought. No limiting resources in the study area. Therefore, species is unlikely to be impacted by development.	No
Ninox connivens (Latham, 1851)	Barking Owl		V	Inhabits forest, woodland and most common in savannah. No potential habitat on the subject site.	No
Ninox strenua (Gould, 1838)	Powerful Owl		V	Wet sclerophyll forest along coast hills and Great Dividing Range. No potential habitat on the subject site.	No
Tyto novaehollandiae	Masked Owl		V	Occurs in forest, savanna woodland and treeless areas with caves over much of Australia except central Australia and arid areas of Western Australia. No potential habitat on the subject site.	No
Tyto tenebricosa	Sooty Owl		V	Rainforests, particularly rainforest gullies overtopped by eucalypts, along eastern scarp of Great Dividing Range. No potential habitat on the subject site.	No

Scientific Name	Common Name	EPBC Act Status	TSC Act Status	Habitat Requirements and Likelihood of Occurrence	Seven Part Test required?
Tyto capensis	Grass Owl		V	Mainly inhabits open tussock grasslands. Usually in treeless areas, but in western Qld it has been recorded in grasslands interspersed with tree-lined creeks. Often in marshy areas vegetated with tall dense tussocks of grass. No available habitat on site.	No
Grantiella picta	Painted Honeyeater		V	Occurs in open forests and woodlands, particularly where trees are infested with mistletoe. No limiting resources in the study area. Therefore, species is unlikely to be impacted by development.	No
Xanthomyza phrygia (Shaw, 1794)	Regent Honeyeater	E*	E	Semi-nomadic, occurring in temperate eucalypt woodland forest in south-eastern Australia. Most records are from box-ironbark forests dominated by Swamp Mahogany, Spotted Gum and Riverina Casuarina woodlands. No limiting resources in the study area. Therefore, species is unlikely to be impacted by development.	No
Petroica rodinogaster	Pink Robin			Dense gullies of tall open forest. No potential habitat on site.	No
MAMMALS					
Dasyurus maculatus (Kerr, 1792)	Spotted-tailed Quoll	V*	V	Wet and dry sclerophyll forests, rainforests, woodlands and coastal heaths. No recent records of this species in the locality.	No
Phascolarctus cinereus (Goldfuss, 1817)	Koala		V	Eucalypt forests and woodlands. No core or potential foraging or roosting habitat in the study area.	No
Petaurus australis ((Shaw, 1791)	Yellow-bellied Glider		V	Wet and dry eucalypt forests and woodlands, often in mountainous areas. No potential habitat on the subject site.	No
Pteropus poliocephalus	Grey-headed Flying-fox		V	Wet and dry sclerophyll forests, rainforests, paperbark swamps and mangroves to 700 m elevation. Potential foraging habitat occurs in the forested areas of the subject site.	Yes
Saccolaimus flaviventris (Peters, 1867)	Yellow-bellied Sheathtail Bat		V	Most habitats from rainforests, sclerophyll forests and woodlands, to grasslands and deserts. Potential foraging habitat occurs in the forested areas of the subject site.	Yes
Mormopterus norfolkensis	East Coast Freetail Bat		V	Sclerophyll forests, woodlands and, occasionally, rainforests. Potential foraging habitat occurs in the forested areas of the subject site.	Yes
Chalinolobus dwyeri	Large-eared Pied Bat	V*	V	Occurs in drier habitats such as dry sclerophyll forests and	Yes

Scientific Name	Common Name	EPBC Act Status	TSC Act Status	Habitat Requirements and Likelihood of Occurrence	Seven Part Test required?
				woodland, although they have been detected in tall open eucalypt forest with an understorey of scattered small trees and palms. It roosts in caves and mines in colonies of 3 to 37, clustered in indentations in the ceiling. Potential foraging habitat occurs in the forested areas of the subject site.	
Falsistrellus tasmaniensis (Gould, 1858)	Eastern False Pipistrelle		V	Wet forests and woodlands, preferring gullies and highland areas up to 1500 m above sea level.	Yes
Miniopterus schreibersii (Kuhl, 1817)	Eastern Bent-wing Bat		V	From Kimberly to the Top End and from Cape York Peninsula on eastern side of the Great Dividing Range through to the south-east corner of South Australia. Found in rainforest, wet and dry sclerophyll forests, woodland and grasslands. Roosts in culverts and mines. Potential foraging habitat occurs in the forested areas of the subject site.	Yes
Myotis adversus ((Horsfield, 1824)	Large-footed Mouse-eared Bat		V	Sclerophyll forests, mangroves, paperbark swamps, woodlands and rainforests near slow-moving creeks, lakes and estuaries. Potential foraging habitat occurs in the forested areas of the subject site.	Yes
Scoteanax ruepellii	Greater Broad-nosed Bat		V	Found in sclerophyll forests, rainforests, woodlands and moist gullies below 500 m above sea level. Potential foraging habitat occurs in the forested areas of the subject site.	Yes
INVERTEBRATES					
Meridolum corneovirens	Cumberland Land Snail		E	Restricted to the Cumberland Plain and Castlereagh Woodlands of Western Sydney and also along the fringes of River Flat Forest, especially where it meets Cumberland Plain Woodland. Potential habitat in treed areas of the subject site.	Yes

Notes: Habitat requirements for birds taken from Simpson & Day (2004).
Habitat requirements for reptiles and amphibians taken from Cogger (2000) and Cronin (2001).
Habitat requirements for mammals taken from Cronin (2000b) and Menkhorst & Knight (2001).
** = Listed under the Commonwealth Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act).*
E1 = Endangered under Schedule 1 of the NSW Threatened Species Conservation Act 1995 (TSC Act).
E4 = Presumed Extinct under Schedule 1 of the NSW Threatened Species Conservation Act 1995 (TSC Act).
E1 = Endangered under Schedule 1 of the TSC Act and EPBC Act.*

E4 = Presumed Extinct under Schedule 1 of the NSW Threatened Species Conservation Act 1995 (TSC Act).*
V = Vulnerable under Schedule 2 of the TSC Act.
V = Vulnerable under Schedule 2 of the TSC Act and EPBC Act.*

4

CONCLUSIONS AND RECOMMENDATIONS

4.1 OVERVIEW

This chapter evaluates if the proposed development will significantly impact on ecological processes and the conservation value of the subject site, especially with respect to threatened fauna species and their habitats, and on the ecological integrity of the landscape. It also recommends ways in which impacts can be minimised or avoided.

The potential impacts may be grouped into the following categories:

- loss of native fauna habitat;
- impacts on wildlife corridors;
- impacts on threatened and migratory species;
- disturbance to native wildlife (e.g. noise and human activity).

Each of these impacts already exist on the subject site to a significant extent. However, each is discussed in detail below with respect to the proposed rezoning.

4.2 IMPACTS

4.2.1 Loss of Fauna Habitat

The majority of the subject site has been cleared in the past for agricultural activities,. The most important fauna habitats are the treed areas (that is, the riparian zone) along the Hawkesbury River, which should be retained. The small dams are likely to be infilled, however, these represent an insignificant proportion of wetland habitat that occurs within the locality and their disappearance will not significantly impact on the availability of wetlands for fauna within the locality and Sydney Basin Bioregion.

4.2.2 Impacts on Wildlife Corridor

There will be no impacts on the wildlife corridor if the riparian zone along the Hawkesbury River is retained and bush rehabilitated so that it is a minimum of 40 m in width from the top of the southern bank of the river along the entire northern boundary of the subject site.

4.2.3 Impacts on Threatened Species

No threatened fauna species were recorded on the subject site. However, there is potential habitat for 12 threatened fauna species on the site. Seven-part tests in Appendix A conclude that the proposed rezoning would not significantly impact on the status of these species (Giant Burrowing Frog, Red-crowned Toadlet, Green and Golden Bell Frog, Black Bittern, Grey-headed Flying-fox, Yellow-bellied Sheathtail Bat, Large-eared Pied Bat, East Coast Freetail Bat, Esatern Bentwing Bat, Large-footed Mouse-eared Bat, Greater Broad-nosed Bat

and Cumberland Plain Land Snail), or their habitats, provided that the recommendations listed in Section 4.3 of the present report are implemented.

One nationally vulnerable fauna species (the Grey-headed Flying-fox) may potentially occur within the forested areas of the subject site. Two nationally endangered fauna species (Swift Parrot, Regent Honeyeater) may very occasionally occur on the subject site as vagrants.

Under the EPBC Act, a nationally vulnerable species is significantly impacted on if a proposal is likely to:

- lead to a long-term decrease in the size of an important population of a species; or
- reduce the area of occupancy of an important population; or
- fragment an existing important population into two or more populations; or
- adversely affect habitat critical to the survival of a species; or
- disrupt the breeding cycle of an important population; or
- modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline; or
- result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat; or
- interfere substantially with the recovery of a species.

The Grey-headed Flying-fox is a highly mobile species and the proposed rezoning of the subject site would not hinder the movement of this species to the extent that a population would be fragmented. In the Sydney region, this species congregates in areas where there is prolific flowering of Swamp Mahogany and/or Coast Banksia (*Banksia integrifolia*). Neither of these species occurs within the subject site.

Under the EPBC Act, a nationally endangered species is significantly impacted on if a proposal is likely to:

- lead to a long-term decrease in the size of a population; or
- reduce the area of occupancy of a species; or
- fragment an existing population into two or more populations; or
- adversely affect habitat critical to the survival of a species; or
- disrupt the breeding cycle of a population; or
- modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline; or
- result in invasive species that are harmful to a endangered species becoming established in the endangered species' habitat; or
- interfere substantially with the recovery of a species.

The Swift Parrot and Regent Honeyeater may occasionally feed on the nectar of eucalypts and other trees when these trees are flowering within the subject site. However, there are no limiting resources for these two species on the subject site.

4.2.4 *Impacts on Migratory Species*

Under the EPBC Act, a migratory species is significantly impacted on if a proposal will or is likely to:

- substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat of the migratory species; or
- result in invasive species that are harmful to the migratory species becoming established in an area of important habitat of the migratory species; or
- seriously disrupt the life cycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of the species.

The Regent Honeyeater and Swift Parrot (*Lathamus discolor*) may occasionally forage within the canopy in woodland areas of the subject site, but these species are likely to be, at best, occasional vagrants to the site. Latham's Snipe (*Gallinago hardwicki*) may occasionally forage in the disturbed, cleared areas of the subject site. Fork-tailed Swifts (*Apus pacificus*) and White-throated Needletails (*Hirundapus caudacutus*) may occasionally fly high over the subject site. The area of habitat that would be cleared from the subject site is a negligible amount of area available to these species. Therefore, the proposed rezoning is unlikely to have a significant impact on the status of migratory species.

4.2.5 *Disturbance to Native Wildlife*

Increased noise and human activity during the construction and use of the proposed facilities, may disturb some native fauna. However, this is likely to be a short-term impact because many species become habituated to such disturbances.

4.3 RECOMMENDATIONS

4.3.1 *Subdivision Design*

- **Where possible, retain as many remnant canopy trees on other parts of the subject site by incorporating them into the subject site's landscape plan.** This will help maintain the natural tree heritage of the locality, provide habitat for urban-tolerant native fauna species, and help maintain the local gene pool for CPW tree canopy species.
- **Maintain a buffer zone of at least 40 metres in width from the top of the bank of the Hawkesbury River along the northern boundary of the subject site.** This will help protect the Hawkesbury River and its associated native fauna from the direct impacts (e.g. bank erosion) and indirect impacts (e.g. weed invasion, sediment and excessive water runoff) of the proposed subdivision.

4.3.2 *Construction Period*

- **Silt fences and sediment ponds should be appropriately placed around construction areas on the subject site** to prevent runoff of sediment and nutrient-enriched waters into nearby drainage lines and bushland areas. The effectiveness of

these traps should be closely monitored during construction, ensuring that treated site run-off meets EPA guidelines.

- **Trees and other vegetation that are to be removed from the subject site for the proposed development should be conducted with minimal disturbance to the soil.** This will maintain the stability of the banks of the Hawkesbury River and reduce the risk of soil and other sediment from entering drainage lines.

- **When trees or bushes have to be cleared from the subject site, they should be checked for the presence of active nests of birds (that is, those nests containing fertile eggs or nestlings) and arboreal mammals (such as possums).** These plants should not be removed or pruned until animals that are nesting in them have completed their breeding cycle.

- **Trees or bushes that are cleared or pruned should be checked for animals before and after felling or pruning**. Injured animals should be taken to a local vet or the local wildlife rescue service should be notified.

- **Vegetation that is removed is to be retained for use as native mulch in areas that are proposed for landscaping.** This could include using logs for habitat features and seed-bearing species for brush-matting.

- **Construction wastes will require appropriate management to prevent accidental discharge of chemicals, truck washings or other pollutants into waterways and vegetation on the subject site and downstream.**

REFERENCES

Anstis, M. (2002). *Tadpoles of South-eastern Australia: A Guide With Keys* (Reed New Holland, Sydney).

Barnett, J.L., Howe, R.A. and Humphreys, W.F. (1978). The use of habitat components by small mammals in eastern Australia. *Australian Journal of Ecology*. 3: 277-285.

Bennett, A.F. (1990a). *Habitat Corridors: Their Role in Wildlife Management and Conservation* (Department of Conservation and Environment, Victoria).

Bennett, A.F. (1990b). Habitat corridors and the conservation of small mammals in a fragmented forest environment. *Landscape Ecology*. 4: 109-122.

Bennett, A.F., Lumsden, L.F., Alexander, J.S.A., Duncan, P.E., Johnson, P.G. and Silveira, D.E. (1991). Habitat use by arboreal mammals along an environmental gradient in north-eastern Victoria. *Australian Wildlife Research*. 18: 125-146.

Bentley, J.M. and Catterall, C.P. (1997). The use of bushland, corridors and linear remnants by birds in south-eastern Queensland, Australia. *Conservation Biology*. 11: 1173-1189.

Braithwaite, L.W. (1983). Studies on the arboreal marsupial fauna of eucalypt forests being harvested for wood pulp at Eden, NSW. I The species and distribution of animals. *Australian Wildlife Research*. 10: 219-229.

Caterall, C.P., Green, R.J. and Jones, D.N. (1991). Habitat use by birds across a forest-suburb interface in Brisbane: implications for corridors. In: Saunders, D.A. & Hobbs, R.J. (eds). *Nature Conservation 2: The Role of Corridors* (Surrey Beatty & Sons, Chipping Norton).

Catterall, C.P., Storey, R.J. and Kingston, M.B. (1997). Reality versus rhetoric: a case study monitoring regional deforestation. In "Conservation Outside Nature Reserves". (eds. P. Hale and D. Lamb). Pp. 367-377. (Centre for Conservation Biology, University of Queensland, Brisbane).

Christidis, L. & Boles, W.E. (1994). *The Taxonomy and Species of the Birds of Australia*. RAOU Monograph No. 2 (Royal Australasian Ornithologists Union, Melbourne).

Clements, A., Rodd, T, Rodd, J., Laxton, E. & Crew, S. (2006). Flora Assessment: Lands North of 20 m AHD on Lots 11-18 in DP 1021340 and Lot 529 in DP 752050, Hall Street, Pitt Town. Report prepared by Anne Clements & Associates Pty Ltd for Johnson Property Group (dated 21 March 2006).

Cogger, H.G. (2000) *Reptiles and Amphibians of Australia* (Reed Books, Chatswood).

Cronin, L. (2000b). *A Field Guide to Mammals of Australia* (Envirobooks, Annandale, NSW)

Cronin, L. (2001). *Key Guide to Australian Reptiles and Amphibians* (Envirobooks, Annandale, NSW).

Lindenmayer, D.B. (1994). Wildlife corridors and the mitigation of logging impacts on fauna in wood-production forests in south-eastern Australia: a review. *Wildlife Resources*. 21: 323-340.

Lindenmayer, D.B., Cunningham, R.B., Donnelly, C.F., Triggs, B.J. and Belvedere, M. (1994). The conservation of arboreal marsupials in montane ash forests of the Central Highlands of Victoria, south-eastern Australia. Patterns of use and the microhabitat requirements of the Mountain Brushtail Possum *Gymnobelidus leadbeateri* in linear retained habitats (wildlife corridors). *Biological Conservation*. 68: 43-51.

Lynch, D & Saunders, D.A. (1991). Responses of bird species to habitat fragmentation in the wheatbelt of Western Australia: interiors, edges and corridors. In: Saunders, D.A. & Hobbs, R.J. (eds). *Nature Conservation 2: The Role of Corridors* (Surrey Beatty & Sons, Chipping Norton).

Menkhorst, P. and Knight, F. (2001). *A Field Guide to the Mammals of Australia* (Oxford University Press, Melbourne).

Pressey, R.L. and Griffith, S.J. (1992). Vegetation of the coastal lowlands of the Tweed Shire, Northern New South Wales: plant communities, species and conservation. *Proceedings of the Linnaean Society of New South Wales*. 113: 203-243.

Recher, H.F. (1993). Conservation and management of eucalypt forest vertebrates. In: DeGraff, R. & Miller, R. (eds). *The Conservation of Wildlife Diversity in Forested Landscapes Around the Globe* (U.S. Forest National Service).

Reinhold, L., Law, B., Ford, G. and Pennay, M. (2001). *Key to the Bats of South-east Queensland and North-east New South Wales*. Report prepared by Queensland Department of Natural Resources and Mines, State Forests of New South Wales, University of Southern Queensland and NSW National Parks and Wildlife Service).

Richards, G.C. and Hall, L.S. (1996). *The Action Plan for Australian Bats* (Australian Nature Conservation Agency, Canberra).

Saunders, D.A. and de Rebeira, C.P. (1991). Values of corridors to avian populations in a fragmented landscape. In: Saunders, D.A. & Hobbs, R.J. (eds). *Nature Conservation 2: The Role of Corridors* (Surrey Beatty & Sons, Chipping Norton).

Sewell, S.R. and Catterall, C.P. (1998). Bushland modification and styles of urban development: their effects on birds in south-eastern Queensland. *Wildlife Research*. 25: 41-63.

Simpson, K. and Day, N. (2004). *A Field Guide to Birds of Australia* 7th Ed (Viking Press, Sydney).

Soule, M.E. and Gilpin, M.E. (1991). The theory of wildlife corridor capability. In: Saunders, D.A. & Hobbs, R.J. (eds). *Nature Conservation 2: The Role of Corridors* (Surrey Beatty & Sons, Chipping Norton).

Swan, G., Shea, G. and Sadlier, R. (2004). A Field Guide to Reptiles of New South Wales (Reed New Holland, Sydney).

Taylor, R. (1991). The role of retained strips for fauna conservation in production forests in Tasmania. In: Lunney, D. (ed). *Conservation of Australia's Forest Fauna* (Royal Zoological Society of NSW, Sydney).

Appendix A

Seven-part Tests of Significance

APPENDIX A
SEVEN-PART TESTS OF SIGNIFICANCE

INTRODUCTION

The Seven-Part Test is a standard set of questions devised by the Scientific Committee established under the *Threatened Species Conservation Amendment Act 2002*. The Test should be applied individually to all threatened species, populations and ecological communities and their habitats that are to be, or likely to be, on the site to be developed.

The results of a Seven-Part Test help determine the nature and significance of impacts of the proposed development or activity on threatened species, populations or ecological communities, or their habitats, and whether the preparation of *Species Impact Statement* (SIS) is required.

An SIS provides a more detailed assessment of threatened biota issues and proposes measures to manage and mitigate adverse impacts on the threatened species, populations or ecological communities, or their habitats, resulting from the proposal.

Appendix A provides Seven-part tests for the following threatened fauna in relation to the proposed residential rezoning:

Frogs:

- Giant Burrowing Frog (*Heleioporus australiacus*);
- Red-crowned Toadlet (*Pseudophryne australis*); and
- Green and Golden Bell Frog (*Litoria aurea*).

Birds:

- Black Bittern (*Ixobrychus flavicollis*).

Bats:

- Grey-headed Flying-fox (*Pteropus poliocephalus*);
- Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*)
- Large-eared Pied Bat (*Chalinolobus dwyeri*);
- East Coast Freetail Bat (*Mormopterus norfolkensis*);
- Eastern Bentwing-bat (*Miniopterus schreibersii*);
- Large-footed Mouse-eared Bat (*Myotis adversus*); and
- Greater Broad-nosed Bat (*Scoteanax ruepelli*).

Invertebrates:

- Cumberland Plains Land Snail (*Meridolem corneovirens*).

FROGS

1. SPECIES PROFILES

Giant Burrowing Frog (*Heleioporus australiacus*)

The Giant Burrowing Frog (*Heleioporus australiacus*) is a large ground dwelling species of the family Myobatrachidae, reaching 90 millimetres in length. It is dark chocolate brown with white and yellowish spots on the side, but not on the back, white below with some brown on the throat. Its skin is granular with warts capped on the back spine. This species inhabits burrows in the banks of small creeks, particularly unused crayfish burrows, breeds in the summer and autumn, burrowing in the banks of small creeks.

The Giant Burrowing Frog inhabits coastal sclerophyll forests with an underlying substrate of sandstone and ranges from the central coast of NSW to eastern VIC. It is widely distributed over its range but at low population densities. It calls during the first rains of August, when temperatures are above 16 degrees Celsius, and continues calling on damp nights until late March (Barker and Grigg, 1977). Males call from burrows situated in sandy banks, a few metres from the water. The lifecycle of the frog is likely to be disrupted if:

- sandstone in creeks and drainage lines is disturbed or removed;
- feral carnivores prey upon the frog;
- erosion causes sedimentation of creeks and ponds;
- fire management practices cause sedimentation of creeks and ponds; and
- forest leaf litter is disturbed.

Red-crowned Toadlet (*Pseudophryne australis*)

The Red-crowned Toadlet (Family Myobatrichidae) is a small dark brown to black ground-dwelling frog with a distinctive bright red or orange triangle on its head and a red or orange coccygeal stripe. Often the Red-crowned Toadlet's back is scattered with reddish flecks. There is a white patch on the base of each arm, and the ventral surface has large black and white blotches mixed with grey, black and white mottling. The skin appears to have a few low warts on the frog's back and is smooth underneath. This species feeds on small arthropods, ants, termites, and mites, which are commonly found in the leaf litter (Webb, 1983).

This species is an opportunistic breeder and males can be heard calling throughout the year at temperatures as low as 5°C (Smith and Smith, 1990; Robinson, 1995). After heavy rain, *Pseudophryne australis* sometimes call diurnally. Breeding congregations occur in deep grass and in debris near non-perennial creeks (Cogger, 1992). Red-crowned Toadlets have not been recorded breeding in permanently flowing streams or waters that are even mildly polluted. Females lay small egg masses under leaf litter, among vegetation in sandstone seepage lines or in damp soil along creek lines (Woodruff, 1977; Barker and Grigg, 1977). The individual eggs of the Red-crowned Toadlet are large and the female can lay up to 20 eggs over a period of four to five nights (Woodruff, 1977). These eggs are laid in a small pool created by temporary dams of twigs and leaves washed down the water line in times of rain (Harrison, 1992).

When not breeding, Red-crowned Toadlets are thought to disperse over wider areas of its sandstone habitat (that is, into non-breeding areas) and many individuals have been observed sheltering under cover that would not be suitable for egg-laying. However, it is likely that such dispersion is only I the order of a few tens of metres from suitable breeding areas. Red-crowned Toadlets are quite localised species that appear to be largely restricted to the immediate vicinity of suitable breeding habitat, so recruitment and recolonisation of areas of vacant habitat is likely to be low.

Several land-use practices and activities are believed to be operating individually and/or in concert with other known and perhaps unknown factors to threaten the survival of this species. Such threats include:

- high frequency fire resulting in the disruption of life cycle processes;
- bush rock removal;
- expanding urbanisation (particularly along ridge tops);
- disease, particularly Chytrid fungus;
- water pollution; and
- changed hydrological regimes.

Green & Golden Bell Frog (*Litoria aurea*)

The Green and Golden Bell Frog is a relatively large frog with a stout body form. Adult size ranges from approximately 45 to 100 mm snout to vent length (SVL), with most individuals being in the 60 to 80 mm size class. Males are generally smaller than females (maximum size 70 mm) and when mature, tend to have a yellowish darkening of the throat area. Males also develop nuptial pads on the inner finger and appears as a brown pigmented patch. Mature females are larger bodied (maximum size 90 to 100 mm) (White and Pyke 1996).

The dorsal coloration is quite variable being a vivid pea green splotched with an almost metallic brass brown or gold. The backs of some individuals may be almost entirely green while in others the golden brown markings may almost cover the dorsum. When the frogs are inactive coloration can darken to almost black. A glandular creamish white stripe extends from behind the eye almost to the groin. The lower margin of this dorso-lateral stripe is black or dark brown, the upper margin is edged gold.

The belly is usually an immaculate granular creamish white. The lateral margins of the body are adorned with raised glandular creamish spots of irregular size. Legs are a variegated green and gold with the groin area and inside leg a brilliant electric blue. The fingers and toes have expanded terminal pads but are rarely wider than the toe/finger itself. The toes are heavily webbed. The eye has a horizontal elliptical pupil and a golden yellow iris. Juveniles are similar to adults and metamorphose at 25 to 30 mm SVL.]

Tadpoles are relatively large, reaching 65 to 80 mm. They are deep bodied and possess long tails with a high fin that extens almost to mid-body. They swim actively and evade capture. As tadpoles become larger, the golden dorso-lateral stripe and a green tinge to the back can be observed just before the limb growth commences (White 1995).

The Green and Golden Bell Frog was formerly distributed from the NSW north coast near Brunswick Heads southwards along the NSW coast to Victoria where it extends into Queensland (White & Pyke 1996; Gillespie 1996), west to Bathurst, Tumut and the ACT (Moore 1961, Osborne *et al.* 1996). There are records from the NSW tableland areas such as Armidale/Ulong (New England Tableland) and Canberra, Cobargo and Jindabyne (Monaro Tableland).

In the 1960s the species was considered widespread, abundant and commonly encountered. Declines were noticed in the 1970s and became severe in the 1980s such that today the species exists as a series of isolated populations within its former known range. Since 1990 there have been approximately 50 locations in NSW where the species is confirmed to still exist (only 11 in conservation reserves). There are six populations of substantial size (numbers over 300); two are located in the Sydney metropolitan area, two in the Shoalhaven area, and two on the mid north coast (White and Pyke 1996).

The Green and Golden Bell Frog inhabits marshes, dams and stream sides, particularly those containing bullrushes (*Typha* spp.) or spikerushes (*Eleocharis* spp.). Optimum habitat includes water bodies which are unshaded, free of the predatory fish *Gambusia holbrooki,* have a grassy area nearby and diurnal sheltering sites such as vegetation and/or rocks (White and Pyke 1996). Some sites, particularly in the Greater Sydney region, are in highly disturbed areas such as disused industrial sites, brick pits, landfill areas and cleared land.

The Green and Golden Bell Frog is frequently active by day and usually breeds in summer when conditions are warm and wet (Cogger 2000). Males call while floating in water and females produce a raft of eggs which initially float before settling to the bottom, often among the vegetation (Harrison 1922). Tadpoles take approximately six weeks to develop, though this varies considerably and is dependent on temperature and other conditions (Pyke and White 1996). Tadpoles feed on algae and other vegetative matter while adults are voracious insectivores and will also readily eat other frogs and juveniles of their own species. They are preyed upon by snakes and various wading birds, and are presumably fed on as larvae by eels, other fish and tortoises.

Threats to this species include:

- Alteration of drainage patterns and stormwater runoff (White and Pyke 1996).
- A fungal pathogen (Berger and Speare 1998).
- Changes to water quality (Goldingay 1996).
- Predation by feral animals such as foxes and cats (Daly 1995 & 1996).
- Road mortality where populations are already small due to other threats (Daly 1996).
- Predation by exotic fish, particularly the Plague Minnow Gambusia holbrooki (Morgan & Buttemer 1996).
- Loss of suitable breeding habitat through alteration by infilling and destruction of wetlands (Morgan and Buttemer 1996, Clancy 1996).

2. SEVEN-PART TEST

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

No Red-crowned Toadlets, Giant Burrowing Frogs or Green and Golden Bell Frogs were recorded along the Hawkesbury River adjacent to the subject site, or in farm dams on the site, by present or previous studies, despite targeted surveys for them.

Heavy weed infestation along the banks of the river, which is a recognised threat to the status of Red-crowned Toadlets and Giant Burrowing Frogs, suggest that these three species do not occur in this section of the Hawkesbury River. The presence of Mosquito Fish in the river, an introduced predator, which is a threat to the status of Green and Golden Bell Frogs, suggests that this frog species does not occur there.

Large areas of suitable habitat for the local populations of the Red-crowned Toadlet, Giant Burrowing Frog and Green and Golden Bell Frog occur elsewhere in the locality, including the Nepean River, other sections of the Hawkesbury River and their tributaries. The proposed residential subdivision of the subject site is unlikely to impact on local populations of threatened frog species in the Hawkesbury River if:

- a 40-m wide buffer zone is established between the top of the creek bank and the edge of the subdivision area; and
- adequate controls are established for avoiding sediment and water runoff from construction sites.

Therefore, it is unlikely that proposed rezoning of the subject site would adversely impact on threatened frog species, or their habitats, to the extent that local viable populations of these species are at risk of extinction.

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

Not applicable. Each frog species listed as a threatened species rather than as an endangered population.

(c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

Not applicable. Each frog species is listed as a threatened species rather than as an endangered or critically endangered ecological community.

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

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

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

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

(i) Potential habitat for threatened frog species along the banks of the Hawkesbury River will not be removed. Bushland rehabilitation of the riparian zone will improve potential foraging habitat for adults of the threatened species.

(ii) No area of habitat of threatened frog species will be fragmented or isolated as a result of the proposed development.

(iii) No threatened frog species were detected along the banks of the Hawkesbury River within the subject site. Therefore, this stretch of the river and its riparian zone is potential rather than actual habitat of threatened frog species. This part of the subject site will be protected and improved as part of a recommended bushland rehabilitation program. Therefore, no important habitat of threatened frog species will be removed, fragmented or isolated as part of the proposed rezoning.

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

No critical habitat for threatened frog species occurs in the locality.

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

There are currently no recovery plans or threat abatement plans for Red-crowned Toadlets or Giant Burrowing Frogs in NSW.

The specific objectives of the draft Green and Golden Bell Frog draft recovery plan (February 2005) are to:

- increase the security of key Green and Golden Bell Frog (GGBF) populations by way of preventing further loss of GGBF habitat at key populations across the species' range and where possible secure opportunities for increasing protection of habitat areas;

- ensure extant GGBF populations are managed to eliminate or attenuate the operation of factors that are known or discovered to be detrimentally affecting the species;

- implement habitat management initiatives that are informed by data obtained through investigations into the general biology and ecology of the GGBF through a systematic and coordinated monitoring program;

- establish, within more than one institution, self-sustaining and representative captive populations (particularly 'at risk' populations) of the GGBF for the primary purpose of maintaining 'insurance' colonies for re-establishment and supplementation of populations of the species; and

- increase the level of regional and local awareness of the conservation status of the GGBF and provide greater opportunity for community involvement in the implementation of the recovery plan.

The proposed rezoning of the subject site is consistent with the objectives of this recovery plan.

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

The proposed rezoning of the subject site for residential development is not part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process for threatened frog species.

3. CONCLUSION

The proposed residential rezoning of the subject site will not significantly impact on the status of the Red-crowned Toadlet, Giant Burrowing Frog or Green and Golden Bell Frog, or their habitats. Therefore, a Species Impact Statement is NOT required for these species in relation to the proposed rezoning.

4. REFERENCES

Barker, J. and Grigg, G. (1977). *A Field Guide to Australian Frogs.* Rigby, Adelaide.

Berger, L. and Speare, R. (1998). Chytridiomycosis - a new disease of amphibians. *ANZCCART News.* 11(4): 1-3.

Clancy, G.P. (1996). The Green and Golden Bell Frog *Litoria aurea* in the Station Creek area of Yuraygir National Park. *Australian Zoologist.* 30: 214-7.

Cogger, H.G. (2000). *Reptiles and Amphibians of Australia.* 6th ed (Reed New Holland, Sydney).

Cogger, H.G., Cameron, E.E. & Cogger, H.M. (1983). Zoological Catalogue of Australia. Vol. 1 Amphibia and Reptilia. Australian Government Publishing Service : Canberra.

Daly, G. (1995). Observations of the Green and Golden Bell Frog (*Litoria aurea*) (Anura: Hylidae) in southern NSW. *Herpetofauna.* 25: 1-9.

Daly, G. (1996). Some problems in the management of the Green and Golden Bell Frog *Litoria aurea* (Lesson, 1829) (Anura: Hylidae) at Coomonderry Swamp in the south coast of NSW. in Victoria. *Australian Zoologist.* 30: 233-6.

Davies, M. (1991). Descriptions of the tadpoles of some Australian limnodynastine leptodactylid frogs. Transactions of the Royal Society of South Australia 115: 67-76.

Gillespie, G.R. (1996). Distribution, habitat and conservation status of the Green and Golden in Victoria. *Australian Zoologist.* 30: 199-207.

Goldingay, R.L. (1996). The Green and Golden Bell Frog *Litoria aurea* -from riches to ruins: conservation of a formerly common species. *Australian Zoologist.* 30: 248-57.

Harrison, L. (1922). On the breeding habits of some Australian frogs. *Australian Zoologist.* 3: 17-34.

Lemckert, F., Brassil, T. & McCray, K. (1998). Recent records of the Giant Burrowing Frog (*Helioporus australiacus*) from the far south coast of NSW. *Herpetofauna.* 28: 32-39.

Mahony, M.J. (1993). The status of frogs in the Watagan Mountains area of the Central Coast of New South Wales. Pp. 257-264 In Lunney, D. and Ayers, D. (eds), Herpetology in Australia. A diverse discipline. (Royal Zoological Society of New South Wales: Mosman). 414pp.

Moore, J.A. (1961). The frogs of eastern New South Wales. *Bull. Amer. Mus Nat. Hist.* 121: 141-386.

Morgan, L.A. and Buttemer, W.A. (1996). Predation by the non-native fish *Gambusia holbrooki* on small *Litoria aurea* and *L. dentata* tadpoles. *Australian Zoologist.* 30: 143-9.

NPWS (1999). *Atlas of NSW Wildlife* (National Parks and Wildlife Service, Hurstville).

Osborne, W.S., Littlejohn, M.J and Thomson, S.A. (1996). Former distribution and apparent disappearance of the *Litoria aurea* complex from the Southern Tablelands of New south Wales and the Australian Capital Territory. *Australian Zoologist.* 30: 190-8.

Pyke, G.H. and White, A.W. (1996). Habitat requirements for the Green and Golden Bell Frog *Litoria aurea* (Anura: Hylidae). *Australian Zoologist.* 30: 224-32.

Robinson, M. (1995) A Field Guide to Frogs of Australia. From Port Augusta to Fraser Island including Tasmania. Australian Museum/Reed Books.

Tyler, M.J. (1997). The Action Plan for Australian Frogs, Environment Australia, Canberra.

Watson, G.F., and Martin, A.A. (1973). Life history, larval morphology and relationships of Australian leptodactylid frogs. Transactions of the Royal Society of South Australia 97 : 33-45.

Webb, G.A. (1983). Diet in a herpetofaunal community on the Hawkesbury Sandstone Formation in the Sydney Area. *Herpetofauna.* 14: 87-91.

White, A.W. (1995). The Green and Golden Bell Frog (*Litoria aurea*). *Frog Facts.* 5: 1-4 (Frog and Tadpole Study Group, Sydney).

White, A.W. and Pyke, G.H. (1996). Distribution and conservation status of the Green and Golden Bell Frog *Litoria aurea* in New South Wales. *Australian Zoologist.* 30: 177-89.

Woodruff, D.S. (1977). Hybridisation between two species of *Pseudophryne* (Anura: Myobatrichidae) in the Sydney Basin, Australia. *Proceedings of the Linnaen Society of NSW.* 102: 131-147.

BIRD SPECIES

1. SPECIES PROFILES

Black Bittern (*Ixobrychus flavicollis*)

The Black Bittern inhabits both terrestrial and estuarine wetlands, generally in areas of permanent water and dense vegetation (Marchant & Higgins 1990). Where permanent water is present, this species may occur in flooded grassland, forest woodland, rainforest and mangroves (Marchant & Higgins 1990).

The Black Bittern has a wide distribution from southern NSW north to Cape York, along the entire coastline of the Kimberley region, and in south-western WA (Marchant & Higgins 1990). In NSW, records of the species are scattered along the east coast. Individuals are rarely recorded south of Sydney and in inland regions (Marchant & Higgins 1990).

Black Bitterns forage on reptiles, fish and invertebrates, including dragonflies, shrimps and crayfish (Barker & Vestjens 1989). Individuals generally feed at dusk, and at night and during they day they may roost in trees or on the ground among dense reeds (Marchant & Higgins 1990).

The species is generally solitary, but may occur in pairs during the breeding season, which is thought to be from December to March (Marchant & Higgins 1990). Nests may be located on a brach overhanging water and consists of a bed of sticks and reeds on a base of larger sticks (Marchant & Higgins 1990).

There is limited information regarding breeding. The clutch size is thought to be between 3 and 5 eggs (Gilmore & Parnaby 1994) and both the male and female are involved in incubation and rearing of the young (Marchant & Higgins 1990).

Threats to Black Bitterns include (Gilmore & Parnaby 1994):

- grazing and trampling of riparian vegetation by cattle;
- predation by feral cats on eggs and juveniles;
- clearing of riparian vegetation for agriculture;
- drainage, salinisation, siltation and pollution of wetlands and waterbodies; and
- poor representation of preferred habitats in conservation reserves.

2. SEVEN-PART TEST

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

Potential habitat for the Black Bittern occurs along the Hawkesbury River, however, it was not recorded within or adjacent to the subject site, despite targeted nocturnal and diurnal surveys for them.

Large areas of suitable habitat for the local populations of Black Bittern occur elsewhere in the locality, including other parts of the Hawkesbury and Nepean Rivers and all of their tributaries. Potential habitat along the Hawkesbury River, adjacent to the subject site will be protected from the impacts of the proposed subdivision if a 40-m wide buffer zone is established between the top of the bank and the edge of the proposed subdivision area. Therefore, it is unlikely that the proposal will adversely impact on the Black Bittern, or its habitat, to the extent that a local viable population of this species is at risk of extinction.

Predation from dogs, feral cats and foxes is a recognized threat to Black Bitterns. It is probable that bitterns may already be impacted on significantly if they occur along the Hawkesbury River if dogs and foxes from the surrounding farmland and urban areas visit the river. It is unlikely that the proposal will increase the magnitude of this threat.

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

Not applicable. The Black Bittern is listed as a threatened species rather than as an endangered population.

(c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
- **(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**
- **(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.**

Not applicable. The Black Bittern is listed as a threatened species rather than as an endangered or critically endangered ecological community.

(d) In relation to a habitat of a threatened species, population or ecological community:
- **(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and**
- **(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and**
- **(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.**

(i) Potential habitat for Black Bittern along the banks of the Hawkesbury River will not be removed. Bushland rehabilitation of the riparian zone will improve potential foraging habitat this species.

(iv) No area of habitat of Black Bitterns will be fragmented or isolated as a result of the proposed development.

(v) No Black Bitterns were detected along the banks of the Hawkesbury River within the subject site. Therefore, this stretch of the river and its riparian zone is potential rather than actual habitat of Black Bitterns. This part of the subject site will be protected and improved as part of a recommended bushland rehabilitation program. Therefore, no important habitat of Black Bitterns will be removed, fragmented or isolated as part of the proposed rezoning.

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

No critical habitat for Black Bitterns occurs in the locality.

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

There are currently no recovery plan or threat abatement plan for Black Bitterns in NSW.

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

The proposed rezoning of the subject site for residential development is not part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process for threatened bird species.

3. CONCLUSION

The proposed residential rezoning of the subject site will not significantly impact on the status of the Black Bittern, or its habitats. Therefore, a Species Impact Statement is NOT required for this species in relation to the proposed rezoning.

4. REFERENCES

Barker, R.D. and Vestjens, W.J.M. (1989). *The Food of Australian Birds. Vol. I: Non-Passerines* (CSIRO, Melbourne).

Gilmore, A.M. and Parnaby, H.E. (1994). Vertebrate fauna of conservation concern in north-east NSW forests. An internal report prepared for the North East Forests Biodiversity Study (NPWS, Hurstville).

Marchant, S. and Higgins, P.J. (1990) (eds). *Handbook of Australian, New Zealand & Antarctic Birds. Vol. I: Ratites to Ducks, Part B* (Oxford University Press, Melbourne).

BAT SPECIES

1. SPECIES PROFILES

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

Historically, Grey-headed Flying-foxes had a greater range in Australia and numbers were estimated as being in the millions. Counts of flying-foxes over the past decade suggest that the national population may have declined up to 30% (Birt 2000; Richards 2000). Regular visits to flying-fox camps during this period have shown a marked decline in the numbers using these camps (Eby 2000; Parry-Jones 2000). It has also been estimated that the population will continue to decrease by at least 20% in the next three generations given the continuation of the current rate of habitat loss and culling (Martin 2000).

This species is a canopy-feeding frugivore and nectarivore of rainforests, open forests, woodlands, *Melaleuca* swamps and *Banksia* woodlands. It plays an important ecosystem function by providing a means of seed dispersal and pollination for many indigenous tree species (Eby 1996; Pallin 2000). The species also feed on introduced trees including commercial fruit crops.

Grey-headed Flying-foxes congregate in large numbers at roosting sites (camps) that may be found in rainforest patches, Melaleuca stands, mangroves, riparian woodland or modified vegetation in urban areas. Individuals generally exhibit a high fidelity to traditional camps and return annually to give birth and rear offspring (Lunney & Moon 1997; Augee & Ford 1999). They forage opportunistically, often at distances from camp of up to 60-70 km per night, in response to patchy food resources (Augee & Ford 1999).

Grey-headed Flying-foxes show a regular pattern of seasonal movement. Much of the population concentrates in May and Junes in northern NSW and Queensland where animals exploit winter-flowering trees such as Swamp Mahogany *Eucalyptus robusta*, Forest Red Gum *E. tereticornis* and Paperbark *Melaleuca quinqernervia* (Eby *et al.* 1999). Food availability, particularly nectar flow from flowering gums, varies between places and from year to year.
Movement patterns of Grey-headed Flying-foxes are also irregular and unpredictable towards the edges of their distributional range. For instance, it appears that numbers in Victoria are highest in years when flowering of eucalypts in the coastal forests of southern NSW is poor. Conversely, in years when flowering in southern NSW is prolific, the number visiting Victoria is very low (Aston 1987; Parry-Jones 1987).

Grey-headed Flying-foxes are relatively long-lived mammals, with a generation length of six to 10 years. They have a low rate of reproduction because sexual maturity is reached after at least three years and generally only one offspring is produced each year (Martin *et al.* 1996).
Although mating can be observed throughout the year, males are apparently fertile only for a short period during March and April, and breeding is highly seasonal (Nelson 1965a; Martin *et al.* 1987).

Gestation lasts about six months and mot females give birth to a single young each September or October. For the first four or five weeks of life they cling to their mothers' belly fur. For a further 12 weeks young are flightless and are left in the camp while their mother forages and are suckled on return. Young are weaned at five or six months (Martin *et al.* 1987). At the end of summer food becomes scarce and the large camps break up. Many adults then lead a dispersed nomadic existence (Nelson 1965a,b), but others travel hundreds of kilometres to congregate at winter camps near reliable food supplies.

The main threat to Grey-headed Flying-foxes in NSW is the clearing or modification of native vegetation. This removes appropriate camp habitat and limits the availability of natural food resources, particularly winter feeding habitat in north-eastern NSW. The urbanisation of coastal plains of south-eastern Queensland and northern NSW has seen the removal of critical feeding sites, and this threatening process continues (Catterall *et al.* 1997; Pressey & Griffith 1992).

The use of non-destructive deterrents, such as netting and noise generators, to limit flying-fox damage to fruit crops is not universal in the horticultural industry. While licences are issue to cull limited numbers of Grey-headed Fly-foxes, uncontrolled culling using destructive methods such as shooting and electrocution occurs and large numbers of bats are culled (Vardon & Tidemann 1995; Richards 2000). The impacts of destructive methods has not been measured, but is greatest when natural food is scarce. Also, culling has a disproportionate impact on lactating and pregnant females (Parry-Jones 1993).

The species is also threatened by direct harassment at roosts, the destruction of their camps and by being possible carriers for viral pathogens (Tidemann 1999).

Grey-headed Flying-foxes face potential competition and hybridisation from Black Flying-foxes Pteropus alecto, because this latter species is extending its range south in to northern NSW (Webb & Tidemann 1995).

The Yellow-bellied Sheathtail Bat is probably the least understood of the NSW microchiropteran bats. Although the species is rare, records come from urban, agricultural, semi-arid and tall wet forest habitats; the diversity of habitats making it difficult to generalise about the species' requirements.

It is usually a solitary-roosting species, although small groups of 2-6 have been observed in northern Australia, especially in late winter and spring (Hall & Richards 1979). It normally roosts in tree spouts. Breeding appears to occur from early December to late March (Chimimba & Kitchener 1987).

Yellow-bellied Sheathtail Bats fly high and fast above the canopy (McKenzie & Robinson 1987), although they also forage within 2 m of the ground in clearings. Known to eat grasshoppers, shield bugs and beetles.

Large-eared Pied Bat (*Chalinolobus dwyeri*)

The species generally occurs in drier habitats such as dry sclerophyll forests and woodland, although they have been detected in tall open eucalypt forest with an understorey of scattered

small trees and palms (Churchill, 1998). It roosts in caves and mines in colonies of 3 to 37, clustered in indentations in the ceiling (Churchill, 1998). They tend to roost in the twilight areas of the caves not far from the entrance and have been known to roost in abandoned bottle-shaped mud nests of Fairy Martins (Dwyer, 1995). This species is insectivorous and flies relatively slowly along creek beds or at mid-canopy level 6 to 10 metres above the ground (Churchill, 1998). Mating takes place in autumn or spring and young are born in November and are independent by late February (Churchill, 1998).

East Coast Freetail Bat *(Mormopterus norfolkensis)*

This species is found in sclerophyll forests, woodlands and occasionally in rainforests along the east coast of Australia from south-east Qld through to Sydney. Active mainly at night, East-coast Freetail Bats roost by day alone or in small colonies in tree hollows and crevices, under loose bark, in caves and in buildings. They hunt for insects over the forest canopy and in clearings, flying fast and direct but with limited manoeuvrability. They also forage on the ground, scurrying around searching for terrestrial insects. The species' breeding biology has not been studied but, like other freetail bats, individuals probably give birth to a single young that suckles from a teat in the mother's armpit (Cronin 2000).

Eastern Bent-wing Bat *(Miniopterus schreibersii)*

The Common Bentwing-bat is distributed along the entire eastern seaboard from Cape York Peninsula, Queensland to South Australia (Dwyer, 1995a). The species is highly mobile, migrating over large distances and utilising different roosts for different seasonal needs (Ferrier *et. al.*, 1992). This species is found in a range of habitats from grasslands through to subtropical rainforest but are typically found in well timbered valleys. Colonies are established often in caves to meet breeding and over-wintering needs (NPWS 1996). The diet consists of small airborne insects including moths and mosquitoes (NPWS, 1996). Females form colonies during spring and summer to give birth and nurture young. They give birth to a single young around December. Maternity caves serve animals from a radius of several hundred kilometres (Dwyer 1995a).

Large-footed Mouse-eared Bat *(Myotis adversus)*

The Large-footed Myotis is a microchiropteran species that forages on fish and insects from the permanent freshwater rivers, dams and creeks of coastal eastern and northern Australia. The species makes maternity roosts in caves close to freshwater, under bridges and buildings and other such structures, and among dense foliage and pandanus leaves . Its preferred natural habitats are sclerophyll forests, mangroves, paperbark swamps, woodlands and rainforests near slow-flowing creeks, lakes and estuaries. Individual colonies usually consist of 10-15 bats, but may have as many as 200 individuals.

Males are territorial and form harems of up to 12 females when breeding. At other times the males roost alone. A single litter is produced in November-December. The single young suckles for about 8 weeks from a teat in the mother's armpit, and remains with her until independent 3-4 weeks later.

Greater Broad-nosed Bat (*Scoteanax ruepelli*)

Found in sclerophyll forests, rainforests, woodlands and moist gullies below 500 m above sea level. Active from dusk to dawn, Greater Broad-nosed Bats are one of the first bat species to emerge after sunset.

Their flight path is low and direct, and they hunt 3-6 m above ground, making only slight deviations from their flight path to catch moths, beetles and other large, slow-flying insects. They forage in forests and woodlands, utilising openings in the forest and corridors above creeks and small rivers, hawking back and forth looking for prey, taking small animals from the ground and foliage. They roost by day in tree hollows and the roof spaces of abandoned buildings.

Pregnant females congregate at maternity sites in suitable trees where they give birth and raise their young, apparently excluding males. Little is known about the reproductive biology of this species, however, it is known that a single young is produced in January and it suckles from a teat in the mother's armpit.

2. SEVEN-PART TEST

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

Grey-headed Flying-fox

This species roosts in large colonies, none of which are located within the locality. Small numbers of individuals may occasionally visit the subject site when mature trees are flowering. Removal of some or all of these trees will not significantly result in significantly limiting food resources for local populations of flying-foxes. Therefore, proposed subdivision of the subject site will not place local populations of this species at risk of extinction.

East Coast Freetail Bat, Yellow-bellied Sheathtail Bat and Greater Broad-nosed Bat

Individuals of these three species roost in hollow-bearing trees. There are few hollow-bearing trees on the subject site that are suitable for roosting by bats. Therefore, removal of trees from the subject site is unlikely to significantly impact on local populations of these species.

Large-eared Pied Bat, Eastern Bent-wing Bat and Large-footed Mouse-eared Bat

These species roost in caves, mines, tunnels and under bridges. These features are not present on the subject site.

The Large-footed Mouse-eared Bat forages for aerial insects over waterbodies and may potentially forage around small farm dams on the site or along the Hawkesbury River. The removal of these farm dams will not significantly impact on the availability of foraging habitat

for this bat species. The Hawkesbury River will also be protected from the impacts of the proposed subdivision.

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

Not applicable. Each bat species listed as a threatened species rather than as an endangered population.

- **In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:**
  - **(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**
  - **(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.**

Not applicable. Each bat species is listed as a threatened species rather than as an endangered or critically endangered ecological community.

(c) In relation to a habitat of a threatened species, population or ecological community:
- **(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and**
- **(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and**
- **(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.**

(j) Potential foraging, roosting and corridor habitat for threatened bat species occurs along the Hawkesbury River. This habitat will not be cleared or modified for the proposed development.

(vi) No area of habitat of threatened bat species will be fragmented or isolated as a result of the proposed development.

(vii) Potential foraging, roosting and corridor habitat for threatened bat species occurs along the Hawkesbury River. It is not regarded as important for the survival of these species in the locality because there is no potential nesting habitat and the foraging, dispersal and roosting habitat is a negligible proportion of habitat available for this species in the locality and bioregion. This habitat will not be cleared or modified for the proposed development.

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

No critical habitat for threatened bat species occurs in the locality.

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

There are currently no recovery plans or threat abatement plans for threatened bat species in NSW.

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

Habitat clearance is a recognised threat to threatened bat species. As mentioned earlier, the proportion of potential foraging and dispersal habitat that may be cleared for the proposed development is likely to be an insignificant proportion of the total habitat available for these species.

3. CONCLUSION

No known roosting habitat of threatened bat species and an insignificant proportion of potential foraging and dispersal habitat will be cleared or indirectly impacted upon by the proposed development. Therefore, a Species Impact Statement is NOT required for any of the threatened bats as part of this proposed development.

4. REFERENCES

Aston, H. (1987). Influx of the Grey-headed Flying-fox *Pteropus poliocephalus* (Chiroptera: Pteropidae) to the Melbourne area, Victoria, in 1986. *Victorian Naturalist.* 104: 9-13.

Augee, M.L. & Ford, D. (1999). Radio-tracking studies of Grey-headed Flying-foxes, *Pteropus poliocephalus* from the Gordon colony, Sydney. *Proceedings of the Linnaean Society of NSW.* 121: 61-70.

Birt, P. (2000). In "Proceedings of a Workshop to Assess the Status of the Grey-headed Flying-fox". (Eds. G. Richards and L. Hall) (Australasian Bat Society, Canberra).

Chimimba, C.T. and Kitchener, D.J. (1987). Breeding in the Australian Yellow-bellied Sheath-tail Bat, *Saccolaimus flaviventris* (Peters, 1867) (Chiroptera: Emballonuridae). *Records of the Western Australian Museum.* 13: 241-248.

Churchill, S. (1998) *Australian Bats.* New Holland Publishers.

Cronin, L. (2000). *A Field Guide to Mammals of Australia.* Envirobooks, Sydney.

Dwyer, P. D. (1995) Large-eared Pied Bat. In: *The Complete Book of Australian Mammals,* pps 510-511. (Ed. R. Strahan). Reed Books. Sydney.

Dwyer, P. D. (1995a) Common Bentwing-bat. In: *The Complete Book of Australian Mammals,* pps 494-495. (Ed. R. Strahan). Reed Books. Sydney.

Eby (2000). In "Proceedings of a Workshop to Assess the Status of the Grey-headed Flying-fox". (Eds. G .Richards and L. Hall) (Australasian Bat Society, Canberra).

Eby, P., Collins, L., Richards, G. and Parry-Jones, K. (1999). The distribution, abundance and vulnerability to population reduction of a nomadic nectarivore, *Pteropus policephalus* during a period of resource concentration. *Australian Zoologist.* 31: 240-253.

Ferrier, S., Shields, J., Lemkert, F. L., Wilson, P., Mackowski, C. M. and Saxon, M. (1992) *Fauna Impact Statements - a standard methodology for surveying endangered species.* A joint report for the NPWS & NSW Forestry Commission.

Hall, L.S. and Richards, G.C. (1979). *Bats of Eastern Australia.* Queensland Museum Booklet No. 12.

Lunney, D. & Moon, C. (1997). Flying-foxes and their camps in the remnant forests of north-east New South Wales. In "Australia's Ever-Changing Forests. Vol. III. Proceedings of the Third National Conference of Australian Forest History" (Ed. J. Dargavel). Pp. 247-277 (Centre for Resource and Environmental Studies, Australian National University, Canberra).

McKenzie, N.L. and Robinson, A.C. (1987). A biological survey of the Nullarbor Region, South and Western Australia, in 1984. National Parks and Wildlife Service, Department of Environment and Planning, South Australia.

Martin, L. (2000). In "Proceedings of a Workshop to Assess the Status of the Grey-headed Flying-fox". (Eds. G. Richards and L. Hall) (Australasian Bat Society, Canberra).

Martin, L., Kennedy, J.H., Little L., Luckhoff, H., O'brien, G.M., Pow, C.S.T., Towers, P.A., Waldon, A.K. and Wang, D.Y. (1996). The reproductive biology of Australian flying-foxes (genus *Pteropus*). *Symposium of the Zoological Society of London.* 67: 167-184.

Nelson, J.E. (1965a). Behaviour of Australian Pteropidae (Megachiroptera). Australian Behaviour. 13: 544-557.

Nelson, J.E. (1965b). Movements of Australian Flying-foxes (Pteropidae: Megachiroptera). Australian Journal of Zoology. 13: 735-759.

Nelson, J.E. (1965a). Behaviour of Australian Pteropidae (Megachiroptera). Australian Behaviour. 13: 544-557.

Nelson, J.E. (1965b). Movements of Australian Flying-foxes (Pteropidae: Megachiroptera). Australian Journal of Zoology. 13: 735-759.

Richards, G. (2000). In "Proceedings of a Workshop to Assess the Status of the Grey-headed Flying-fox". (Eds. G. Richards and L. Hall) (Australasian Bat Society, Canberra).

Tidemann, C.R. (1999). Biology and management of the Grey-headed Flying-fox, *Pteropus poliocephalus. Acta Chiropterologica.* 1: 151-164.

Vardon, M.J. and Tiddeman, C.R. (1995). Harvesting of Flying-foxes (*Pteropus* spp.) in Australia: could it promote the conservation of endangered Pacific Island species? In "Conservation Through the Sustainable Use of Wildlife." (Eds G. Grigg, P. Hale and D. Lunney). Pp. 82-85. (University of Queensland, Brisbane).

Webb, N. & Tidemann, C.R. (1995). Hybridisation between Black (*Pteropus alecto*) and Grey-headed (*P. poliocephalus*) Flying-foxes (Megachiroptera: Pteropidae). *Australian Mammalogy*. 18: 19-26.

CUMBERLAND LAND SNAIL (*Meridolum corneovirens*)

1. SPECIES PROFILE

1.1 Conservation Status

The Cumberland Plain Land Snail is listed as an endangered species on Schedule 1 of the *TSC Act 1995.*

1.2 Description

Meridolum corneovirens is a native snail species with a typical adult shell diameter ranging between 15-30 mm. The colour is generally tan to dark brown with a green or yellow tinge. The underside of the shell, especially in living individuals, tends to have a glossy appearance and is semi-transparent. The upper side of the shell has a coarse wrinkly appearance. In adult shells the edge of the aperture is reflected, forming a slight lip. This is typically white in colour. However, the feature is absent in both juvenile and sub-adult individuals. The juveniles have a more angular shell and tend to have an open area in the central part of the underside of the shell, known as the umbilicus. Generally, in adults the umbilicus is closed or partially covered. Sometimes there is a reddish brown patch around the umbilical area.

1.3 Distribution and Habitat

Meridolem corneovirens occurs within the Cumberland Plain region of western Sydney. It is currently known from over 100 locations. However, most of these locations are scatterd throughout the region and are often small and isolated. Populations are known from Baulkham Hills, Blacktown, Camden, Campbelltown, Fairfield, Hawkesbury, Holroyd, Liverpool, Penrith and Wollondilly local government areas.

Meridolem corneovirens is restricted to the Cumberland Plain and Castereagh Woodlands, and also along the fringes of River Flat Forest, especially where it meets Cumberland Plain Woodland. The species typically occurs under logs and other debris, among leaf and bark accumulations around bases of trees and sometimes underneath grass clumps. Where possible, it will burrow into loose soil.

1.4 Threats

The bulk of the known populations are small, isolated and vulnerable to impacts from clearing and habitat modification such as weed invasion, inappropriate fire management and removal of ground cover. These forms of modification remove shelter, breeding habitat and sources of food.

2. SEVEN-PART TEST

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

Potential habitat for the Cumberland Plain Land Snail occurs within treed areas of the subject site and within the riparian zone of the Hawkesbury River. However no Cumberland Plain Land Snails were detected on the subject site, despite targeted surveys for them, and at best, the subject site is only marginal habitat for this species. The riparian zone, which is the best potential habitat on the subject site for the Cumberland Plain Land Snail is to be retained and bush rehabilitated.

Therefore, the proposed rezoning of the subject site for residential sububdivision will not have an adverse effect on the life cycle of the Cumberland Plain Land Snail such that a viable local population of the species is likely to be placed at risk of extinction.

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

Not applicable. The Cumberland Plain Land Snail listed as a threatened species rather than as an endangered population.

(c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
- **(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**
- **(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.**

Not applicable. The Cumberland Plain Land Snail is listed as a threatened species rather than as an endangered or critically endangered ecological community.

(d) In relation to a habitat of a threatened species, population or ecological community:
- **(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and**
- **(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and**
- **(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.**

(i) The riparian zone, which is the best potential habitat on the subject site for the Cumberland Plain Land Snail is to be retained and bush rehabilitated. Therefore, potential marginal

habitat for this species is likely to be improved as a result of the proposed rezoning of the land.

(ii) No habitat of the Cumberland Plain Land Snail will become fragmented or isolated from other areas of habitat as a result of the proposed action.

(iii) No Cumberland Plain Land Snails were found on the subject site and it represents a negligible amount of habitat that is available for this species within the locality and the Sydney Basin Bioregion. Therefore, the proposed rezoning of the land will not significantly change the status of the Cumberland Plain Land Snail within the locality.

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

No critical habitat for the Cumberland Plain Land Snail occurs in the locality.

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

There are currently no recovery plans or threat abatement plans for the Cumberland Plain Land Snail in NSW.

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

Habitat clearance is a recognised threat to the Cumberland Plain Land Snail. As mentioned earlier, the proportion of potential habitat that will be cleared for the proposed development is likely to be an insignificant proportion of the total habitat available for this species within the locality and Sydney Basin Bioregion.

3. CONCLUSION

No Cumberland Plain Land Snails were detected on the subject site. Potential habitat occurs within treed areas of the subject site, including the existing riparian zone along the Hawkesbury River. A minor amount of remnant vegetation will be cleared or modified for the proposed development, representing a negligible proportion of potential habitat in the locality that is available for Cumberland Plain Land Snails. Therefore, a Species Impact Statement is NOT required for this species in relation to the proposed development.

4. REFERENCES

Australian Museum Business Services (AMBS) (1999). Flora and Fauna Assessment of Surplus Lands, Wonderland Sydney, Eastern Creek. Prepared for Gutteridge Haskins & Davey (dated August 1999).

Australian Museum Business Services (AMBS) (2002a). Eastern Creek Precinct Flora and Fauna Study. Prepared for Blacktown City Council (dated July 2002).

Australian Museum Business Services (AMBS) (2002b). Flora and Fauna Assessment for Zones A1, A2 and B, Wonderland Business Park, Eastern Creek. Prepared for Australand Pty Ltd (dated September 2002).