



# LANDMARK

Ecological Services Pty Ltd

PO Box 100 Suffolk Park NSW 2461 Australia  
(02) 86808889 landmark@landmarkonline.com.au  
ABN 29 064 548 878

**A Winter Investigation of Vertebrate Faunal Values of the Site of  
the Proposed Hill Top Regional Shooting Complex,  
NSW Southern Highlands  
and  
a Review of the Faunal Component of  
the GHD Ecological Assessment of the Site**

D.R. Milledge  
Director  
Landmark Ecological Services Pty Ltd  
8 July 2008

## *SUMMARY*

*A winter investigation of the vertebrate faunal values of the site of a proposed Regional Shooting Complex at Hill Top in the NSW Southern Highlands found that it supported a relatively rich assemblage of vertebrates including two Threatened species (TSC Act 1995), the Koala Phascolarctos cinereus and Yellow-bellied Glider Petaurus australis. Two other conservation priority species were recorded among a total of 53 species, with healthy populations of a number of other forest-dependent species present such as the Agile Antechinus Antechinus agilis, Sugar Glider Petaurus breviceps, Little Forest Bat Vespadelus vulturinus and Bush Rat Rattus fuscipes.*

*The site represents a locally significant area of substantially undisturbed old-growth forest of relatively high productivity in an infertile landscape, with a very high density and diversity of tree hollows. It provides core foraging habitat for the local Yellow-bellied Glider population as well as supporting a population of the Koala.*

*The habitat attributes present, together with local records in the vicinity, suggest another 12 Threatened species probably occur in the site, most of which are only likely to be detected by comprehensive targeted summer surveys and additional autumn-winter surveys.*

*The site provides key habitat in identified faunal movement pathways or corridors at a local and sub-regional scale and in particular is likely to link Koala populations in the Wollondilly and Nepean catchments.*

*It is predicted that construction and operation of the proposed Regional Shooting Complex at the site will result in the extinction of the local Yellow-bellied Glider colony, the possible loss of the local Koala population and compromise the corridor function of the wider area. In addition to these losses, the cumulative impacts of gunshot noise and other disturbance are likely to have a serious detrimental effect on the health of populations of a number of other sensitive forest-dependent vertebrate species in the area.*

*A faunal assessment of the site by GHD Pty Ltd was found to be manifestly inadequate in evaluating the area as habitat for vertebrate species and failed to adequately assess the potential impacts of the proposal on these species.*

*It is recommended that comprehensive targeted summer surveys, together with additional autumn-winter surveys of the site be undertaken to adequately assess its importance to Threatened species. An accurate, detailed faunal habitat assessment should also be carried out to complement the targeted surveys and the likely impacts of the proposal before any decision is made on its use as a Regional Shooting Complex.*

## INDEX

- 1. Introduction**
- 2. Survey Methods**
  - Opportunistic observations
  - Nocturnal bird and mammal call playback
  - Small terrestrial mammal trapping
  - Microchiropteran bat trapping
  - Scat and sign searches
  - Vertebrate habitat attribute observations
  - Previous vertebrate records for adjoining areas
  - Recent vertebrate records obtained by the HTRAG
- 3. Limitations**
- 4. Results**
  - Vertebrate habitats and habitat attributes
  - Total vertebrate species and significant species
  - Species recorded by call playback
  - Species recorded by small mammal trapping
  - Species recorded by microchiropteran bat trapping
  - Scat and sign searches
  - Other vertebrate faunal findings
- 5. Discussion**
  - Site habitat values
  - Site significance for conservation priority species
  - Site context and corridor value
- 6. Potential impacts from construction of the proposed Regional Shooting Complex**
- 7. GHD Faunal Assessment**
- 8. Recommendations**

## 1. Introduction

An investigation of vertebrate faunal values of the site of the proposed Hill Top Regional Shooting Complex (as defined by GHD 2007), off Rocky Waterholes Road in the NSW Southern Highlands, was undertaken over seven days and nights between 28 and 29 May, and 26 June and 1 July 2008. The investigation was carried out on behalf of the Hill Top Residents Action Group (HTRAG) in order to provide an independent assessment of the faunal values of the site and to review the findings of a faunal investigation previously undertaken in the area by GHD Pty Ltd (GHD 2007).

## 2. Survey Methods

### 2.1 Opportunistic observations

Vertebrate species were searched for opportunistically by visual observation and aural detection during extensive diurnal and nocturnal walking traverses undertaken through the site during 28-29 May and 26-30 June and 1 July 2008. All observations were made using 10x35 binoculars and nocturnal observations were assisted by the use of a 50w hand-held spotlight.

### 2.2 Nocturnal bird and mammal call playback

Standard call playback methods were used in an attempt to detect a number of cryptic species comprising large forest owls, arboreal marsupials and a frog. These consisted of playing approximately 3 mins of the calls of target species through a transistorised horn speaker (CD supplied by David Stewart Nature Sound) followed by a 5 min period of listening and spotlighting. Calls of the Powerful Owl *Ninox strenua*, Masked Owl *Tyto novaehollandiae*, Sooty Owl *T. tenebricosa*, Koala *Phascolarctos cinereus*, Yellow-bellied Glider *Petaurus australis* and Giant Burrowing Frog *Heleioporus australiacus* were broadcast in varying sequences (dependent on habitat suitability) from 5 separate locations across the site (Figure 1, Table 1) during the nights of the 28 and 29 May and 27 and 28 June 2008.

### 2.3 Small terrestrial mammal trapping

Small terrestrial mammals were surveyed along two transects (A and B, Figure 1, Table 2) through the site over four days and nights between 27 June and 1 July 2008. Fifty A-type Elliott traps were set at approximately 20m intervals along each transect (total 100 traps, amounting to 400 trap-nights) and baited with a mixture of peanut butter, oats and golden syrup. Traps were filled with a small amount of leaf litter and were covered with litter to protect captured animals against cold, and were inspected early each morning when captures were released.

### 2.4 Microchiropteran bat trapping

Microchiropteran bats were surveyed at three locations in the site (Figure 1, Table 3) on the nights of 28, 29 and 30 June 2008. Two Faunatech harp traps were set along vehicular tracks through the site pre-dusk and removed early the following morning, being cleared of bats mid-evening and prior to removal on the following day. All bats caught were released at the point of capture the following evening.

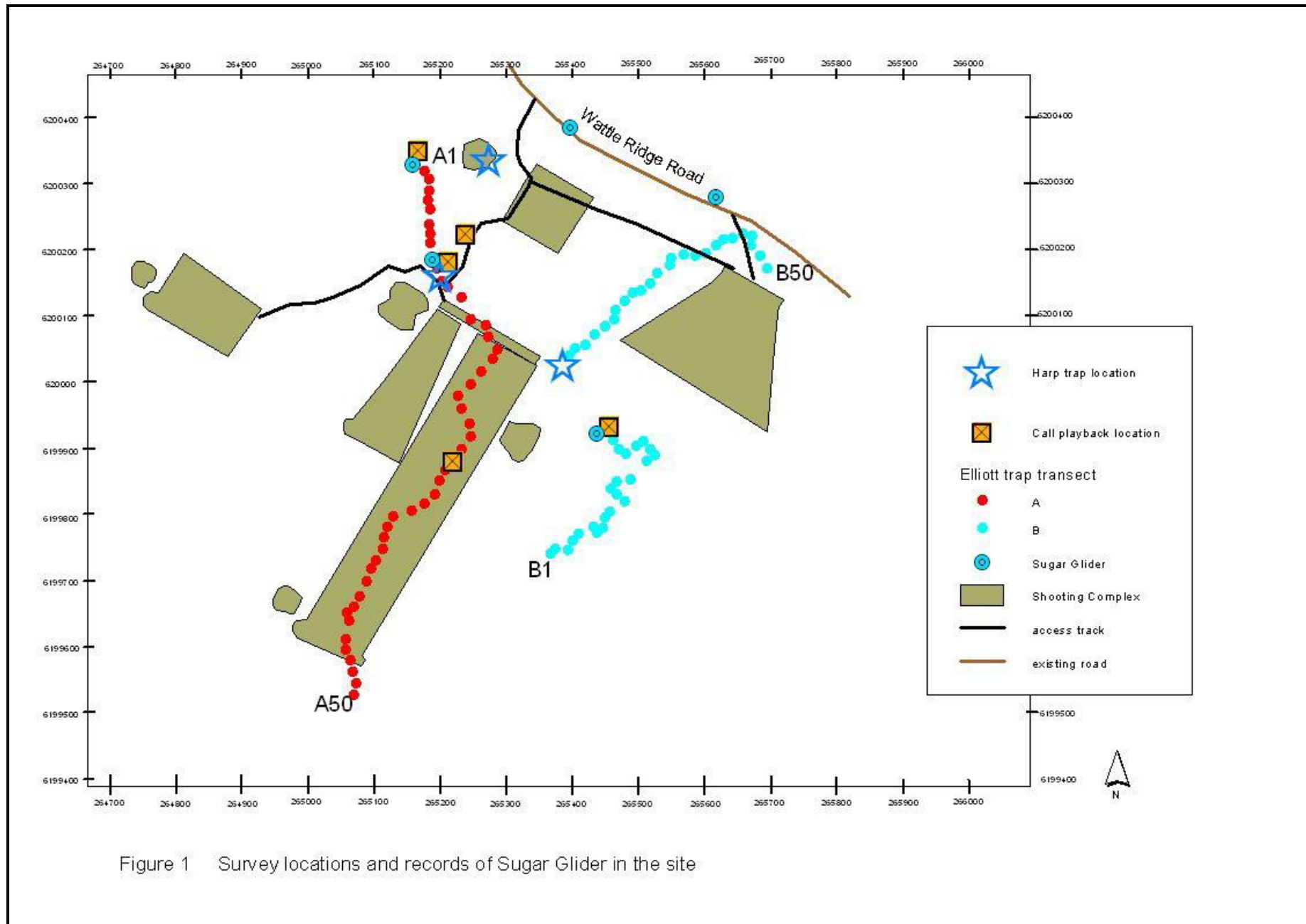


Figure 1 Survey locations and records of Sugar Glider in the site

### 2.5 Scat and sign searches

In addition to the use of direct methods of vertebrate detection, tracks and signs such as scats and feeding marks were searched for opportunistically throughout the site to indicate the presence of particular reptile and marsupial species. For example, searches for sloughed skins of the Broad-headed Snake *Hoplocephalus bungaroides* were made under rocks, for Koala scats and scratch marks about the bases and on the trunks of Grey Gums *Eucalyptus punctata* respectively, and for Yellow-bellied Glider sap-feeding incision scars on the trunks and branches of Grey Gums.

### 2.6 Vertebrate habitat attribute observations

Opportunistic observations were also made of the relative abundance of habitat attributes providing foraging substrates and shelter sites for vertebrate fauna throughout the site. These included the occurrence of dominant canopy tree and understorey tree and shrub species, and the presence of dead trees, tree hollows, flowering plants, logs, exfoliating rock and water bodies.

### 2.7 Previous vertebrate records for adjoining areas

References including previous fauna surveys in similar habitats in adjoining areas and databases containing records for the area were consulted to provide lists of fauna species likely to be present in the site. These included DEC 2004a, DECC 2007a, b, c and d, and the NSW National Parks and Wildlife Service (DECC) Wildlife Atlas database.

### 2.8 Recent vertebrate records obtained by the HTRAG

Finally, additional records of trees with Koala scats and scratch marks and Yellow-bellied Glider sap-feeding trees were obtained from results of recent surveys conducted by HTRAG members (accompanied by experienced Koala researchers) throughout the site (Table 4).

## 3. Limitations

The major constraint on the investigation was the winter timing, which resulted in a number of species of frogs, reptiles, migratory birds and some microchiropteran bats being in torpor or absent from the site and consequently remaining undetected.

Weather conditions varied during the two periods of investigation but overall were not conducive to a comprehensive vertebrate survey.

The weather during the 28-29 May was generally cool and overcast, with some sunny patches during the days and low fog down to canopy level at night. Heavy rain showers preceded investigations on the day of the 28 May. The fog-drip in particular that occurred during both nights adversely affected spotlighting and call-playing efficiency.

During the period 26 June to 1 July, the weather was cold with heavy cloud and high winds early and late in the period, but with a few mainly sunny days in between. A frost occurred on the night of 28 June and rain fell on the nights of the 29 and 30 June.

Other factors adversely affecting the detection of vertebrate species during the survey period were shooting sessions at the adjoining shooting range during 27 (night) and 28 (day) June.

#### 4. Results

##### 4.1 Vertebrate habitats and habitat attributes

The site was located principally on flat to gently undulating ridge tops and small plateaux, with the edges sloping steeply down to adjoining gullies. Soils appeared relatively shallow and infertile, being mainly derived from sandstone, which outcropped on the slopes. However, lenses of deeper, more clayey and apparently more productive soils occurred on the plateaux and ridge tops, suggesting the presence of shale or another stratum of higher nutrient status than the sandstone.

The vegetation generally comprised relatively pristine old-growth dry sclerophyll forest that had been subject to high intensity but patchy fire in the past 3-4 years. The forest contained many mature and senescent trees supporting a high density and size range of trunk and branch hollows. A number of stags (standing dead trees) containing a variety of hollow sizes were also noted throughout the site. Dominant canopy tree species identified across the site were Blue-leaved Stringybark *Eucalyptus agglomerata*, Red Bloodwood *Corymbia gummifera*, Grey Gum, Yerchuk *E. consideriana*, Scribbly Gum *E. sclerophylla* and Sydney Peppermint *E. piperita*. This community represents the vegetation class termed “Sydney Hinterland Dry Sclerophyll Forests” (Keith 2004).

Grey Gum is a particularly important habitat tree for vertebrate fauna as it readily forms hollows that are used as shelter and breeding sites by a range of hollow-dependent species, produces nectar and exudates important to nectarivorous bird and marsupial species and is a designated Koala food tree under SEPP 44 (State Environmental Planning Policy No. 44 – Koala Habitat). The site and adjacent areas supported numerous Grey Gum stands and these appeared to be concentrated on the flatter terrain in areas with the greatest soil depth and clay content, representing the most productive areas in the landscape. A high proportion of these stands were located within the site and there were relatively few occurrences down-slope and in gullies.

The heathy understorey vegetation across the site appeared highly diverse and contained numerous species from the families Proteaceae and Epacridaceae that produce nectar attractive to small bird and mammal species. During investigations Hairpin Banksia *Banksia spinulosa*, an understorey dominant, was heavily in flower.

Many large logs were noted throughout the site but the majority of these appeared to have been burnt by the recent fire and probably do not provide optimum fauna habitat at the present time. Numerous sandstone outcrops with exfoliating rock habitat typically used by amphibians, reptiles and small mammals occurred around the edges of the site, although the majority fell outside its boundaries. A small dam supporting a dense growth of sedges *Eleocharis* sp. and providing breeding habitat for frog species was located in the north western corner of the site and frog habitat also occurred in the small streams in gullies adjacent to the site’s north western and south eastern boundaries.

#### 4.2 Total vertebrate species and significant species

A total of 53 vertebrate species was recorded in the site during the seven days and nights of observations and trapping, comprising 3 frog, 2 reptile, 34 bird and 14 mammal species (Appendix 1).

Two of these species, the Koala (recorded on the basis of 2 scats found at the base of a Grey Gum and a number of characteristic scratch-marks observed on Grey Gum trunks, Table 4, Figure 2) and the Yellow-bellied Glider (several individuals observed and heard and numerous sap-feeding incisions observed on Grey Gum trunks and branches, Tables 1 and 4, Figure 3) are listed as Threatened species under the NSW *Threatened Species Conservation (TSC) Act* 1995.

**TABLE 1 Results from locations surveyed by standard call playback sequences, 28-29 May and 27-28 June 2008**

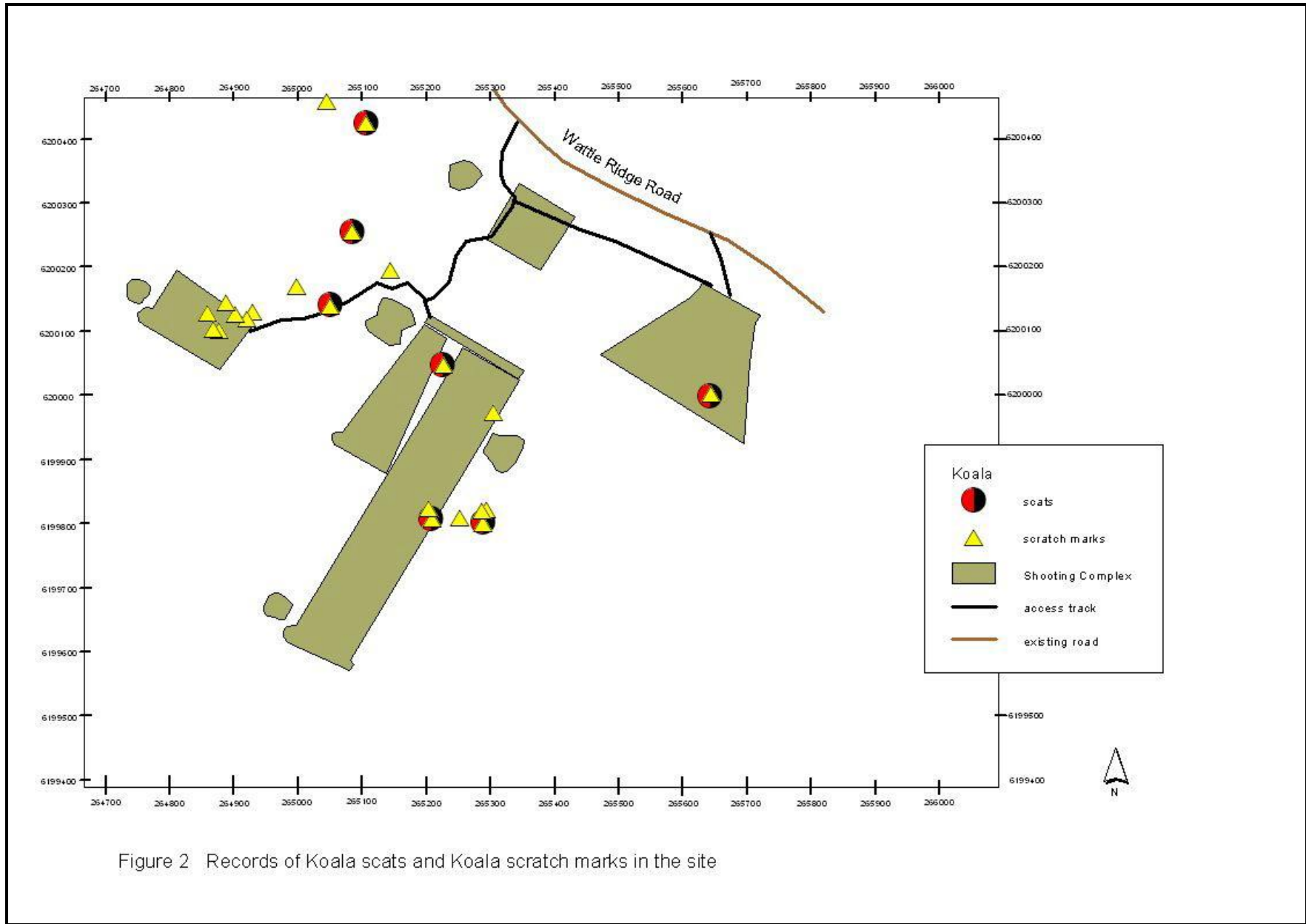
		AMGs (GDA66)		
location	date	Easting	Northing	results
1	28.5.'08	265455	6199906	adult Yellow-bellied Glider came in, no vocal response; Sugar Glider responded vocally
1	29.5.'08	265455	6199906	nil, GHD call playback being undertaken in area
2	29.5.'08	265202	6199857	2 Yellow-bellied Gliders came in partially, responded vocally
3	29.5.'08	265218	6200155	2 Sugar Gliders responded
1	27.6.'08	265455	6199906	nil, shooting noise at adjacent range
4	27.6.'08	265255	6200236	Yellow-bellied Glider calling prior to call playback, did not respond to call playback
5	28.6.'08	265175	6200317	Southern Boobook and Sugar Glider responded, Yellow-bellied Glider called later from 200m to north

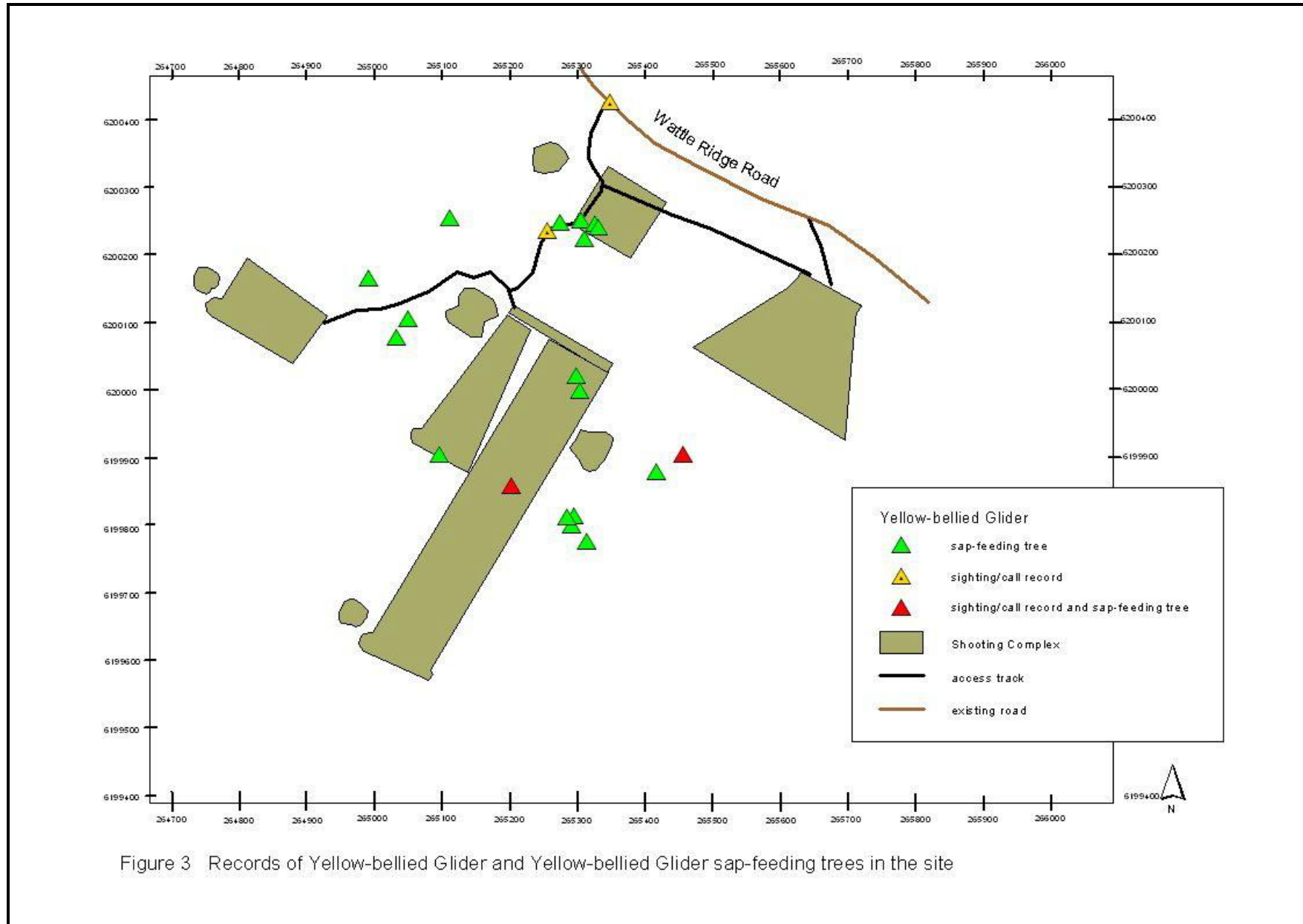
The total numbers of trees with Koala scats and scratch marks and Yellow-bellied Glider sap-feeding incision scars obtained from Landmark and HTRAG surveys are listed in Table 4 and shown in Figures 2 and 3. The majority of Yellow-bellied Glider sap-feeding incision scars were healed over (old) although three trees with active incisions (weeping sap) were found (Table 4). Incisions were mostly horizontal in configuration although there were a few with the more characteristic v-shape.

No other Threatened species (*TSC Act*) were detected in or adjacent to the site, including those targeted by call playback, although two conservation priority species, the Superb Lyrebird *Menura novaehollandiae* and Spotted Quail-thrush *Cinclosoma punctatum* (DECC 2007a), were recorded.

#### 4.3 Species recorded by call playback

Only one bird and two mammal species responded to call playback, the Southern Boobook *Ninox novaeseelandiae*, Sugar Glider *Petaurus breviceps* and Yellow-





bellied Glider (Table 1). The locations of the Sugar Glider and Yellow-bellied Glider records are shown in Figures 1 and 2 respectively.

#### 4.4 Species recorded by small terrestrial mammal trapping

Two native mammal species, the Agile Antechinus *Antechinus agilis* and Bush Rat *Rattus fuscipes*, were trapped on the Elliott trap transects (Table 2). Total captures for the 4 nights were 16 Agile Antechinus and 24 Bush Rats.

**TABLE 2 Results from small terrestrial mammal trapping transects, 27 June- July 2008**

date	28 June		29 June		30 June		1 July	
species	<i>R. fuscipes</i>	<i>A. agilis</i>	<i>R. fuscipes</i>	<i>A. agilis</i>	<i>R. fuscipes</i>	<i>A. agilis</i>	<i>R. fuscipes</i>	<i>A. agilis</i>
	age/sex* wt g	age/sex* wt g	age/sex* wt g	age/sex* wt g	age/sex* wt g	age/sex* wt g	age/sex* wt g	age/sex* wt g
trap no.								
A3		adf 20					juv 46	
A6						adm 39		adm 36
A7	adf 90		juv 41				juv 42	
A8					imm 43		adm 130	
A9							adf 96	
A10			adf 102		adm 128			adm 53
A11							imm 51	
A14						adf 26		adf 27
A16								adm 40
A20							adf 99	
A24	imm 70		sadf 69					
A25							immf 71	
A40							adm 133	
B5				adm 40	adm 102			adf 25
B6	imm 61				immf 67			adm 42
B9						adm 44		adf 21
B10						adf 24		
B11			adf 128			adm 42	adf 130	
B16								adm 38
B23					adf 95			
B24	adf 86				adm 116		adf 100	
B34								adm 38
total	4	1	4	1	6	5	10	9
age/sex*: ad – adult, sad – subadult, imm – immature, juv – juvenile, m – male, f – female								

#### 4.5 Species recorded by microchiropteran bat trapping

A total of five microchiropteran bat species were captured by harp traps, comprising the Eastern Horseshoe Bat *Rhinolophus megaphyllus*, Little Forest Bat *Vespadelus*

**TABLE 3 Results from microchiropteran bat trapping, 28-30 June 2008**

date/trap	species				
	<i>Rhinolophus megaphyllus</i>	<i>Vespadelus vulturnus</i>	<i>Vespadelus darlingtoni</i>	<i>Chalinolobus morio</i>	<i>Nyctophilus gouldi</i>
29 June/ trap 1*		ad. male fa 28.5mm wt 3.5g			
29 June/ trap 2*			ad. male fa 34.5mm wt 5.5g	ad. male fa 37.5mm wt 7.5g	
30 June/ trap 1	ad. male fa 49.3mm wt 9.5g	ad. male fa 29.0mm wt 3.5g			ad. female fa 41.8 wt 10.0g
30 June/ trap 2		ad. male fa 28.8mm wt 4.0g			
		ad. female fa 28.4mm wt 4.0g	ad. male fa 35.4mm wt 6.0g		
1 July/ trap 1		nil			
1 July/ trap 3*		ad. male fa 28.1mm wt 3.5g			
		ad. female fa 31.2mm wt 4.0g			
		ad. male fa 28.8mm wt 3.5g			
total	1	7	2	1	1
*trap locations, AMGs (GDA66) harp trap 1 E 265278, N 6200333 harp trap 2 E 265371, N 6200019 harp trap 3 E 265317, N 6200333					

*vulturnus*, Large Forest Bat *Vespadelus darlingtoni*, Chocolate Wattled Bat *Chalinolobus morio* and Gould's Long-eared Bat *Nyctophilus gouldi* (Table 3).

The most numerous species trapped was the Little Forest Bat, with two individuals of the Large Forest Bat and single individuals each of the Eastern Horseshoe Bat, Chocolate Wattled Bat and Gould's Long-eared Bat captured.

#### 4.6 Scat and sign searches

A number of records of Koala scats at the bases of Grey Gums, and numerous records of Koala scratch marks and Yellow-bellied Glider sap-feeding incision scars on Grey Gum trunks were obtained throughout the site by Landmark and HTRAG searches. These are compiled in Table 4 and the locations shown in Figures 2 and 3.

**TABLE 4** Records of Koala scats found at the bases of Grey Gums and Koala scratch marks and Yellow-bellied Glider sap-feeding incision scars found on the trunks of Grey Gums, 28 and 29 May and 27 and 29 June 2008

Grey Gum no.	date	AMGs (GDA66)		Koala scats	Koala scratch marks	Yellow-bellied Glider sap-feeding incisions, age	recorder*
		Easting	Northing				
1	24.5.'08	265223	6200052	+			HTRAG
2	24.5.'08	265281	6199803	+			HTRAG
3	24.5.'08	265223	6200052		+		HTRAG
4	24.5.'08	265205	6199832		+		HTRAG
5	24.5.'08	265247	6199821		+		HTRAG
6	24.5.'08	265280	6199837		+		HTRAG
7	24.5.'08	265290	6199841		+		HTRAG
8	24.5.'08	265281	6199803		+		HTRAG
9	24.5.'08	265289	6199809			old	HTRAG
10	24.5.'08	265277	6200247			old	HTRAG
11	24.5.'08	265326	6200244			old	HTRAG
12	24.5.'08	265326	6200242			old	HTRAG
13	29.5.'08	265053	6200150	2	+		DRM
14	29.5.'08	265455	6199906			active + recent	DRM
15	29.5.'08	265096	6199909			old	DRM
16	29.5.'08	265041	6200076			old	DRM
17	29.5.'08	265053	6200107			old	DRM
18	29.5.'08	265291	6200022			old	DRM
19	29.5.'08	265293	6199814			old	DRM
20	29.5.'08	265421	6199873			old	DRM
21	29.5.'08	265202	6199857			active + old	DRM
22	June	265652	6199998	+			HTRAG
23	June	265652	6200001		+		HTRAG
24	June	265650	6199997		+		HTRAG
25	June	265650	6199994		+		HTRAG
26	June	265651	6199995		+		HTRAG
27	June	265652	6199998		+		HTRAG
28	June	265652	6200001		+		HTRAG
29	June	265652	6199998		+		HTRAG
30	15.6.'08	265081	6200257	4			HTRAG
31	15.6.'08	265110	6200435	+			HTRAG
32#	15.6.'08	265207	6199810	20+			HTRAG
33	15.6.'08	265081	6200257		+		HTRAG
34	15.6.'08	265077	6200500		+		HTRAG
35	15.6.'08	265081	6200257		+		HTRAG
36	15.6.'08	265110	6200435		+		HTRAG
37	15.6.'08	265142	6200186		+		HTRAG
38	15.6.'08	265000	6200167		+		HTRAG
39	15.6.'08	265207	6199810		+		HTRAG
40	15.6.'08	265309	6199978		+		HTRAG

cont. TABLE 4

**Records of Koala scats found at the bases of Grey Gums and Koala scratch marks and Yellow-bellied Glider sap-feeding incision scars found on the trunks of Grey Gums, 28 and 29 May and 27 and 29 June 2008**

Grey Gum no.	date	AMGs (GDA66)		Koala scats	Koala scratch marks	Yellow-bellied Glider sap-feeding incisions, age	recorder*
		Easting	Northing				
41	15.6.'08	265115	6200256			old	HTRAG
42	15.6.'08	265300	6200002			old	HTRAG
43	15.6.'08	265313	6199784			old	HTRAG
44	27.6.'08	265294	6199810			old	DRM
45	27.6.'08	265294	6199810			old	DRM
46	29.6.'08	264860	6200128		+		DRM
47	29.6.'08	264870	6200106		+		DRM
48	29.6.'08	264875	6200104		+		DRM
49	29.6.'08	264887	6200148		+		DRM
50	29.6.'08	264902	6200130		+		DRM
51	29.6.'08	264919	6200124		+		DRM
52	29.6.'08	264930	6200133		+		DRM
53	29.6.'08	265307	6200228			active + old	DRM
54	29.6.'08	265305	6200251			old	DRM
55	29.6.'08	264990	6200170			old	DRM
* DRM – D.R.Milledge, Landmark; HTRAG – Hill Top Residents Action Group							
# <i>E. piperita</i> and <i>E. gummifera</i> , not <i>E. punctata</i>							

#### 4.7 Other vertebrate faunal findings

The bird assemblage of the site was typical of that of the Sydney sandstone region, with characteristic species such as the White-throated Treecreeper *Cormobates leucophaea*, Variegated Fairy-wren *Malurus lamberti*, Chestnut-rumped Heathwren *Hylacola pyrrhopygia*, Red Wattlebird *Anthochaera caruncula*, White-eared Honeyeater *Lichenostomus leucotis* and White-cheeked Honeyeater *Phylidonyris niger* relatively common and widespread.

In addition to the Agile Antechinus, Sugar Glider, Little Forest Bat and Bush Rat, common mammals throughout the site were the Common Wombat *Vombatus ursinus* and Swamp Wallaby *Wallabia bicolor*.

The Red Fox *Vulpes vulpes* was the only introduced vertebrate species recorded, with individuals observed and heard calling along Wattle Ridge Road adjacent to the site.

## 5. Discussion

### 5.1 Site habitat values

Results from the winter field investigation show that the site of the proposed Hill Top Regional Shooting Complex supports relatively undisturbed old-growth forest with a high level of hollow development and widespread stands of Grey Gum (as indicated by the records shown in Figures 2 and 3). Grey Gum provides important food, shelter and breeding resources for a range of vertebrate species. The site comprises an area of flatter terrain and higher productivity in a generally rugged, low fertility landscape and consequently represents an area of high quality habitat for fauna at the local level.

### 5.2 Site significance for conservation priority species

Two Threatened species (*TSC Act*), the Koala and Yellow-bellied Glider, are known to occur in the site, with records (Tables 1 and 4, Figures 2 and 3) indicating that it supports resident populations of both species.

Two bird species occurring in the site, the Superb Lyrebird and Spotted Quail-thrush, are considered of conservation significance and healthy populations of a number of other forest-dependent bird and mammal species are present.

Consideration of the site's habitat attributes together with records of Threatened species (*TSC Act*) from adjacent areas (DEC 2004a, DECC 2007a, b, c and d) suggest that in addition to the Koala and Yellow-bellied Glider, twelve other Threatened species are likely to occur in the site. These comprise the:

- Giant Burrowing Frog *Heleioporus australiacus*
- Red-crowned Toadlet *Pseudophryne australis*
- Broad-headed Snake *Hoplocephalus bungaroides*
- Gang-gang Cockatoo *Callocephalon fimbriatum*
- Glossy Black-cockatoo *Calyptorhynchus lathami*
- Powerful Owl *Ninox strenua*
- Masked Owl *Tyto novaehollandiae*
- Sooty Owl *Tyto tenebrosa*
- Eastern Pygmy-possum *Cercartetus nanus*
- Eastern Freetail-bat *Mormopterus norfolkensis*
- Eastern Bentwing-bat *Miniopterus schreibersii*
- Long-eared Pied Bat *Chalinolobus dwyeri*

Records of the Gang-gang Cockatoo, Glossy Black-cockatoo and Powerful Owl exist within 2.5km of the site (NPWS Wildlife Atlas database) and records supplied by wildlife carers and naturalists show that the Broad-headed Snake and Eastern Pygmy-possum both occur locally. These five species, together with the Giant Burrowing Frog and Eastern Freetail-bat are considered the Threatened species most likely to be recorded in the site by further field investigations, particularly if comprehensive targeted surveys are conducted during summer months and additional surveys are undertaken during autumn-winter.

### 5.3 Site context and corridor value

The site is embedded in a substantial tract of native vegetation and is centred in an area that has been identified as providing a significant east-west faunal movement pathway (corridor) between sandstone plateaux in the Nattai and Nepean areas

(DECC 2007b). Specifically, the area is likely to link important Koala populations in the Wollondilly and Nepean catchments.

The site also provides significant habitat on a north-south axis in the identified southern Blue Mountains to Woronora Plateau pathway (DECC 2007b).

#### **6. Potential impacts from construction of the proposed Regional Shooting Complex**

Construction of the proposed regional shooting complex would result in the loss and degradation of over 40ha of productive old-growth forest containing a high density and diversity of hollow-bearing trees (recognised as a Key Threatening Process under the *TSC Act*), representing a “habitat hot-spot” in the local landscape.

Construction would also result in the destruction of the habitat of Threatened species, as an examination of Figures 2 and 3 shows that many Grey Gums that are known Koala and Yellow-bellied Glider food trees will be lost. These trees, as well as other Grey Gums that will be destroyed across the site, provide important food and shelter resources for many additional vertebrate species. The impact of the loss of sap-feeding trees on the local Yellow-bellied Glider colony will probably result in its extinction due to the concentration of feed trees in the area of the Shooting Complex.

Disturbance due to construction and subsequent activities associated with operation of the shooting complex are likely to have a severe disruptive effect on the behavioural patterns of sensitive, cryptic species including the Koala and other Threatened species, such as the large forest owls, that are likely to use the site. The Yellow-bellied Glider, if not lost due to feed tree destruction, would also be detrimentally affected by gunshot noise. Other cryptic species likely to be lost as the result of cumulative noise and disturbance effects include birds such as the Bronzewing pigeons and Spotted Quail-thrush and several species of microchiropteran bats.

In addition to direct disturbance, construction would result in permanent fragmentation of a currently intact area, allowing incursions by environmental weed and introduced mammal species and in particular the Red Fox (recorded adjacent to the site, above). “Predation by the Red Fox *Vulpes vulpes*” is listed as a Key Threatening Process under the *TSC Act*.

#### **7. GHD Faunal Assessment**

The GHD fauna assessment (GHD 2007) of the site and surrounding habitats is manifestly inadequate because:

- it failed to include any standard targeted surveys for herpetofauna, small to medium-sized mammals (CWR species, Burbidge and McKenzie 1989) or microchiropteran bats;
- the standard methods that were employed were inadequate and despite the claim to the contrary, did not conform to DEC (2004b) guidelines (for example, large owl call playback was confined to one night whereas DEC recommend 3 nights for a 50% probability of detection for the Powerful Owl and 4 nights for the same chance of detection for the Masked Owl);
- it failed to include any seasonal surveys;
- it demonstrated that the personnel involved in field survey had little experience or knowledge of local and regional fauna species and communities

(no CVs or relevant previous studies were appended), with only 20 vertebrate species recorded over a five day period (Landmark recorded 38 species in 1.5 days, Appendix 1);

- it claimed to have recorded Fletcher’s Frog *Lechriodus fletcheri*, a terrestrial species not known to occur south of Sydney, calling from a tree hollow in the site;
- it failed to detect the relatively high density of Sugar Gliders across the site, a potential prey base for the large forest owls (particularly the Powerful and Masked Owls);
- it failed to undertake any landscape context analysis, misleadingly characterising the site as a small part of a much larger area of relatively homogeneous habitat when it appears to represent a locally significant area of relatively high productivity in a low fertility landscape (“habitat hot-spot”); and
- it failed to provide an adequate quantitative assessment of impacts on habitat attributes within the development footprint (for example, losses of hollow-bearing trees and Grey Gums, requirements for asset protection from bushfires) and did not consider potential off-site impacts on significant species (for example sedimentation of adjacent creeks).

## **8. Recommendations**

Before any decision is made on the use of the site for a proposed Regional Shooting Complex it is recommended that further systematic targeted surveys be undertaken to enable the site’s vertebrate faunal values to be accurately described and the potential impacts of the Shooting Complex adequately assessed. Specifically, targeted surveys should be carried out during summer months for Threatened (*TSC Act*) frog, reptile, migratory birds and microchiropteran bat species. More comprehensive surveys should be undertaken in autumn and winter for large forest owl, arboreal marsupial and small to medium-sized terrestrial mammal species.

A comprehensive vertebrate habitat assessment should also be undertaken to complement targeted Threatened species surveys, particularly to assess impacts on key habitat attributes such as Koala and Yellow-bellied Glider feed trees and Grey Gums generally.

## **References**

- Burbidge, A.A. and McKenzie, N.L. 1989.** Patterns in the modern decline of Western Australia’s vertebrate fauna: Causes and conservation implications. *Biol. Cons.* 50: 143-198.
- DEC. 2004a.** The vertebrate fauna of the Nattai and Bargo Reserves. Biodiversity Survey Priorities Program. Unpubl. report. Department of Environment and Conservation, Hurstville, NSW.
- DEC. 2004b.** Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities. Working Draft. Department of Environment and Conservation, Hurstville, NSW.
- DECC. 2007a.** *Threatened and pest animals of Greater Southern Sydney.* Department of Environment and Climate Change, Hurstville, NSW.

- DECC. 2007b.** *Background report. Terrestrial vertebrate fauna of the Greater Southern Sydney Region. Vol. 1.* Department of Environment and Climate Change, Hurstville, NSW.
- DECC. 2007c.** *Fauna of conservation concern and priority pest species. Terrestrial vertebrate fauna of the Greater Southern Sydney Region. Vol. 2.* Department of Environment and Climate Change, Hurstville, NSW.
- DECC 2007d.** *The fauna of the Warragamba Special Area. Terrestrial vertebrate fauna of the Greater Southern Sydney Region. Vol. 3.* Department of Environment and Climate Change, Hurstville, NSW.
- GHD. 2007.** Southern highlands regional shooting complex ecological assessment. Unpubl. report to NSW Department of Sport and Recreation. GHD Pty Ltd, Sydney, NSW.
- Keith, D.A. 2004.** *Ocean Shores to Desert Dunes: The Native Vegetation of New South Wales and the ACT.* NSW National Parks and Wildlife Service, Sydney, NSW.

**APPENDIX 1 VERTEBRATE SPECIES RECORDED IN THE SITE OF  
THE PROPOSED HILL TOP REGIONAL SHOOTING  
COMPLEX, 28-29 MAY AND 26 JUNE-1 JULY 2008**

<b>AMPHIBIANS</b>	<b>3 species</b>
MYOBATRACHIDAE	
Common Eastern Froglet <i>Crinia signifera</i>	
HYLIDAE	
Bleating Tree Frog <i>Litoria dentata</i>	
Whistling Tree Frog <i>Litoria verreauxii</i>	
<b>REPTILES</b>	<b>2 species</b>
GEKKONIDAE	
Lesueur's Velvet Gecko <i>Oedura lesueurii</i>	
SCINCIDAE	
Copper-tailed Skink <i>Ctenotus taeniolatus</i>	
<b>BIRDS</b>	<b>34 species</b>
COLUMBIDAE	
Common Bronzewing <i>Phaps chalcoptera</i>	
Brush Bronzewing <i>Phaps elegans</i>	
CACATUIDAE	
Sulphur-crested Cockatoo <i>Cacatua galerita</i>	
PSITTACIDAE	
Crimson Rosella <i>Platycercus elegans</i>	
CUCULIDAE	
Fantailed Cuckoo <i>Cacomantis flabelliformis</i>	
STRIGIDAE	
Southern Boobook <i>Ninox novaeseelandiae</i>	
HALCYONIDAE	
Laughing Kookaburra <i>Dacelo novaeguineae</i>	
MENURIDAE	
Superb Lyrebird <i>Menura novaehollandiae</i>	
CLIMACTERIDAE	
White-throated Treecreeper <i>Cormobates leucophaeus</i>	
MALURIDAE	
Superb Fairy-wren <i>Malurus cyaneus</i>	
Variiegated Fairy-wren <i>Malurus lamberti</i>	
PARDALOTIDAE	
Spotted Pardalote <i>Pardalotus punctatus</i>	
Striated Pardalote <i>Pardalotus striatus</i>	
White-browed Scrubwren <i>Sericornis frontalis</i>	
Chestnut-rumped Heathwren <i>Hylacola pyrrhopygia</i>	
Brown Thornbill <i>Acanthiza pusilla</i>	
Striated Thornbill <i>Acanthiza lineata</i>	

cont. **APPENDIX 1 VERTEBRATE SPECIES RECORDED IN THE SITE OF  
THE PROPOSED HILL TOP REGIONAL SHOOTING  
COMPLEX, 28-29 MAY AND 26 JUNE-1 JULY 2008**

MELIPHAGIDAE

Red Wattlebird *Anthochaera caruncula*  
Lewin's Honeyeater *Meliphaga lewinii*  
Yellow-faced Honeyeater *Lichenostomus chrysops*  
White-eared Honeyeater *Lichenostomus leucotis*  
White-cheeked Honeyeater *Phylidonyris niger*  
Eastern Spinebill *Acanthorhynchus tenuirostris*

PSOPHODIDAE

Spotted Quail-thrush *Cinclosoma punctatum*

PACHYCEPHALIDAE

Golden Whistler *Pachycephala pectoralis*  
Grey Shrike-thrush *Colluricincla harmonica*

DICRURIDAE

Grey Fantail *Rhipidura fuliginosa*

ARTAMIDAE

Grey Butcherbird *Cracticus torquatus*  
Grey Currawong *Strepera versicolor*

PETROICIDAE

Eastern Yellow Robin *Eopsaltria australis*

CORVIDAE

Australian Raven *Corvus coronoides*

ZOSTEROPIDAE

Silvereye *Zosterops lateralis*

HIRUNDINIDAE

Welcome Swallow *Hirundo neoxina*

ESTRILDIDAE

Red-browed Finch *Neochmia temporalis*

**MAMMALS**

**14 species**

DASYURIDAE

Agile Antechinus *Antechinus agilis*

PHASCOLARCTIDAE

\***Koala** *Phascolarctos cinereus*

VOMBATIDAE

Common Wombat *Vombatus ursinus*

PETAURIDAE

\***Yellow-bellied Glider** *Petaurus australis*

Sugar Glider *Petaurus breviceps*

MACROPODIDAE

Swamp Wallaby *Wallabia bicolor*

MOLOSSIDAE

White-striped Freetail-bat *Tadarida australis*

cont. **APPENDIX 1 VERTEBRATE SPECIES RECORDED IN THE SITE OF  
THE PROPOSED HILL TOP REGIONAL SHOOTING  
COMPLEX, 28-29 MAY AND 26 JUNE-1 JULY 2008**

VESPERTILLIONIDAE

Eastern Horseshoe Bat *Rhinolophus megaphyllus*

Little Forest Bat *Vespadelus vulturnus*

Large Forest Bat *Vespadelus darlingtoni*

Chocolate Wattled Bat *Chalinolobus morio*

Gould's Long-eared Bat *Nyctophilus gouldii*

MURIDAE

Bush Rat *Rattus fuscipes*

CANIDAE

Red Fox *Vulpes vulpes*

\* species listed as Threatened under the NSW *Threatened Species Conservation Act 1995*