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Fauna Survey Methodologies

A1

The fauna survey methods outlined within this Appendix are techniques employed by *Travers bushfire & ecology*, based on industry standards as well as additional methods found to be effective for select fauna groups. The fauna survey techniques deployed for each specific site are outlined within the survey effort table in the main body of this report. The techniques selected will depend upon the site characteristics and extent of available habitat as well as restrictions such as available survey time and weather conditions.

If any additional or target survey techniques for fauna species are undertaken, beyond the methods outlined within this Appendix, the details of these will be described within the main body of this report.

1 Standard survey techniques

1.1 Diurnal birds

Diurnal birds are typically identified visually and / or by calls during diurnal surveys. Habitat searches to identify nests, feathers, eggs, or signs of foraging may be utilised more specifically for identifying threatened diurnal bird species.

Visual observations are made more accurate with the use of binoculars and where necessary or practical, with the use of a spotting scope. Binoculars are carried by the fauna surveyor at all times during nocturnal and diurnal fauna surveys. A birding field guide is always available in the field when required for verifications.

Calls are identified in the field by the fauna surveyor. If an unknown call is heard it is cross-matched to comprehensive bird call reference libraries taken into the field. A call library of birds occupying the NSW coastal areas is also stored into a mobile phone for a quick reference. This phone is carried into the field at all times and may be used for call-playback methods and recording calls for later analysis.

Diurnal bird census points may be undertaken at large sites where the total area may not be effectively covered during the survey period, or as a measure to ensure focused bird only survey.

1.2 Nocturnal birds

Searches for evidence of Owl roosts, key perches and potential Owl roosting / breeding hollows are made during diurnal site searches. Whitewash, feathers or regurgitated pellets give key information. Pellets are sent for analysis of contents to assist in identification where necessary.

The presence of nocturnal birds during the nocturnal period is first determined by quiet listening after dusk for calls by individuals emerging from diurnal roosts. Following this, and provided no calls are heard, call-playback techniques are employed for threatened species that have suitable habitat present.

Threatened nocturnal birds known to provide response to call-playback techniques include Masked Owl (*Tyto novaehollandiae*), Powerful Owl (*Ninox strenua*), Barking Owl (*Ninox connivens*), Sooty Owl (*Tyto tenebricosa*), Grass Owl (*Tyto capensis*), Black Bittern (*Ixobrychus flavicollis*), Australian Bittern (*Botaurus poiciloptilus*) and Bush Stone-curlew (*Burhinus grallarius*).

Each call is typically played for five minute periods with five minute intervals of quiet listening for a response. This is followed with spotlighting and periods of quiet listening throughout the nocturnal survey.

Separation distances between broadcasting stations during a single night of survey are advised for different species within survey guidelines. These include 1km between Owl calls and 3km between Bush Stone-curlew calls. Subsequent to this, separate broadcasting stations will be deployed on the same night where sites of significant size are surveyed. Separations for bitterns are not advised and these may be broadcast at a number of stations along suitable habitat areas.

Stag-watching will be undertaken where suitable large hollows for Owl nesting / roosting show signs of activity or are located within development areas. Stag-watching of nesting trees should be undertaken during the recognised nesting period for Owls with potential to occur.

1.3 Arboreal mammals

Arboreal mammals may be surveyed using Elliott type A, B and / or C traps, small and / or large hair tubes, spotlighting, call-playback techniques, scat searches or searches for other signs of activity.

Baiting and layout for Elliott trapping and hair tubing are typically incorporated into terrestrial trapping and hair tubing effort, unless where target survey is undertaken. Standard baiting and layout is therefore described in Section A1.3.2 below within terrestrial survey methods. Where gliders are targeted, the standard bait mix may be additionally laced with a nectarivor powder mix used for feeding captive birds. Where Brush-tailed Phascogales are targeted the standard bait mix may be additionally laced with an insectivore powder mix. Where Eastern Pygmy Possum is targeted, the bait mix will be more heavily laced with honey.

Elliott traps for arboreal captures are placed onto tree mounted platforms that are attached to the trunk 2-3m above the ground, at an incline to facilitate drainage during inclement weather. Plastic sleeves are placed around or over traps when there is a possibility of wet weather in the forecast. Arboreal hair tubes are attached to the trunk of trees using rubber bands with the tube entry facing down, preventing water entry.

For all arboreal traps and hair tubes a mixture of honey and water is sprayed onto the trunk up to 8m above the trap and around the trap as a lure. Where Eastern Pygmy Possum is targeted, a high concentrate honey water mix is also sprayed from the base of trunk up and along connective branches.

Arboreal traps and hair tubes are placed in trees selected to bias target species. These are often flowering or sap flow trees for gliders, rough-barked trees for the Brush-tailed Phascogale and Banksias for the Eastern Pygmy possum.

Where habitat is suitable, the presences of Koala (*Phascolactos cinereus*), Yellow-bellied Glider (*Petaurus australis*) and Squirrel Glider (*Petaurus norfolcensis*) may be targeted by call-playback techniques. Calls are played for five minute periods during nocturnal surveys. This is followed by quiet listening and spotlighting.

1.3.1 Koala survey

Koala survey is undertaken where the site is considered to provide potential habitat under the definitions of SEPP 44 - Koala Habitat Protection, or in the presence of feed trees listed in Appendix 1 of the Recovery Plan for the Koala. Habitat may also be defined according to locally prepared Koala Plans of Management.

SEPP 44 is applied to land within Local Government Areas (LGAs) listed under Schedule 1 of the Policy. Part 2 is applied to land which has an area of greater than 1ha or has, together with any adjoining land in the same ownership, an area of more than 1ha.

To determine Potential Koala Habitat (PKH) under the definitions of SEPP 44 an estimate of the percentage density of each tree species within vegetation communities is determined by averaging the percentage of stems counted. PKH is defined as land where at least 15% of the total number of trees in the upper or lower strata constitutes any of the tree species listed in Schedule 2 of the Policy.

Where Koala habitat is considered to be present, the site will be surveyed on foot, with known Koala food trees being inspected for signs of use. Trees are inspected for characteristic scratch and claw marks on the trunk and scats around the base of each tree. Koalas may also be targeted during nocturnal survey involving call-playback techniques and spotlighting.

For large sites, Koala search quadrats may be employed within portions of communities where feed trees are present at suitable densities. All Koala feed trees within quadrats are searched for signs of activity including characteristic claw marks on the trunk and faecal pellets around the base. Pellet searches are undertaken according to the tree base search methods described in *Phillips & Callaghan* (2008). Search quadrats are less labour intensive than the SAT techniques described below but may only be an initial survey effort to determine presence / absence.

Where any Koala activity is recorded the complete Spot Assessment Technique (SAT) described by *Phillips & Callaghan* (2008) may be undertaken as a measure of Koala activity. This technique may also be employed in the first instance as an indicator of presence / absence, particularly where a site has potential Koala activity based on previous records.

For any survey technique, the location and density of Koala droppings, if found, are documented.

1.4 Terrestrial mammals

Various traps may be used to survey for the presence of terrestrial mammals. These include Elliott trapping, medium and large cage trapping, small and large hair tubing and pitfall traps. Other survey methods for terrestrial mammals include the use of camera surveillance, spotlighting and activity searches.

Arboreal and terrestrial Elliott traps and hair tubes are placed in grids, or more commonly along trap-lines of 5-10 traps separated by distances of 20-50m, depending on site size and variation of habitat. Trap or hair tube sizes selected at each trap station may alternate or may have an emphasis on certain sizes according to target species.

Selection of terrestrial Elliott trap, cage trap, hair tube or pitfall trap locations has an emphasis on nearby foliage, runways, shelters and signs of activity.

Standard bait mix for all Elliott traps, medium cage traps and hair tubes is a mixture of rolled oats, honey and peanut butter. Standard bait mix may be supplemented with sardines in large hair tubes or cage traps to simultaneously target Spotted-tailed Quoll. Cage traps may also be baited solely with meat or roadkill to target Spotted-tailed Quoll. Where Potoroos or Bandicoots are targeted, truffle oil may be used to lace the standard bait mix or used on its own.

Where difficult to access, sensitive or extended trapping periods are undertaken, surveillance cameras can be used in terrestrial mammal surveys. The surveillance camera is mounted on a tree and directed towards a closed baited cage trap. Surveillance cameras may also be used to detect use or monitor activity at burrows, hollows, nests, etc.

During diurnal site searches, assessment is made of 'found' scats, markings, diggings, runways and scratches located. Any scats or pellets not readily identifiable (particularly predator scats) may be collected and sent to Barbara Triggs for identification of contents, hair or bone fragments.

1.5 Bats

Micro-chiropteran bats are surveyed by echolocation using Anabat detectors or trapped using harp (Constantine) traps, mist nets or trip lines. Microchiropteran bats are also surveyed by searches of subterranean habitats such as caves, tunnels or shafts where present, or by searching structures such as under bridges and abandoned buildings or wall / ceiling cavities, where entry is possible.

Anabat Mk 2 and SD-1 detectors are used in fixed passive monitoring positions and / or during active nocturnal monitoring. Active monitoring is used in conjunction with spotlighting or during stag-watching for greater accuracy of recorded call identification.

Bat call recordings are interpreted through Anabat V and Anabat CF Storage and Interface Module ZCAIM devices and analysed using Anabat 6 and Analook 3.3q computer software packages.

Harp traps and mist nets are placed along suitable 'flyways' such as along open narrow road / river corridors to maximise the likelihood of captures. Traps may be purpose set to capture bats emerging from roosts by being placed at the entry of tunnels / caves or draped over the edge of bridges. Trip lines are placed over water to trip low flying drinking bats into the water. These bats are collected as they swim to the waters edge.

Harp traps are checked during early nocturnal survey, as well as each morning. Mist nets and trip lines require constant monitoring. Captured bats are identified using field identification guides. Bats are released at the point of capture after dusk or placed under trunk bark / splits of nearby trees.

Mega-chiropteran bat species, such as Grey-headed Flying-fox, are surveyed by targeting flowering / fruiting trees during spotlighting activities and by listening to distinctive vocalisations. Suitable roosting habitat is searched for presence of small or large established camps during diurnal survey periods.

1.6 Amphibians

Amphibians are surveyed by vocal call identification, call-playback, spotlighting along the edge of water-bodies, pitfall trapping, funnel trapping, by driving along sealed roads near waterways, habitat searches and collection of tadpoles.

Calls are identified in the field by the fauna surveyor. For similar calling species, or if an unknown male call is heard, it is cross-matched to frog call reference libraries taken into the field. A call library of frogs occupying the NSW coastal areas is also stored into a mobile phone for a quick reference. This phone is carried into the field at all times and may be used for call-playback methods and recording calls for later analysis.

All threatened frog species may be targeted by use of call-playback techniques where suitable habitat exists, with some species more reliable than others in providing a response. Red-crowned Toadlet may also be targeted by clapping and loud retort along suitable habitat drainages in order to evoke a call response.

Any amphibians found are visually identified and, when required to be examined, are handled with latex gloves and kept moist until release. Any tadpoles requiring capture are collected with a scoop net and placed within a snap-lock clear plastic bag for analysis of colour and morphological features.

Amphibian survey yields best results during or following wet periods with seasonal breeding and subsequent male calling varying according each species. Targeted survey is thus undertaken in appropriate seasons.

1.7 Reptiles

Reptiles are surveyed opportunistically during diurnal site visit(s), but also by habitat searches, pitfall trapping, funnel trapping, by driving along roads on humid nights and by camera surveillance at burrows.

Habitat searches for reptiles are undertaken in likely localities such as under logs, rocky slabs on rock surfaces, under sheet debris, under bark exfoliations and leaf litter at the base of trees and along the edge of wetlands. Aspect and land surface thermal properties are considered to determine best search locations particularly along rocky escarpments.

During warmer months spotlighting may assist survey effort particularly during humid conditions.

1.8 Invertebrates

Target survey is undertaken for the Cumberland Plain Land Snail (*Meridolum corneovirens*) when in proximity to previous *Atlas of NSW Wildlife* records and particularly where its typical host vegetation community is present. The most appropriate areas of observed habitat are searched. Dense areas of leaf litter with likely moisture retaining properties are scraped using a three pronged rake. Logs, stumps, artificial refuse and rocks are also turned over. In large survey areas, search quadrats are undertaken evenly across highest quality habitat areas to estimate population size.

The top (spiral side), side (showing aperture) and underside (showing umbilicus) of snail specimens found are photographed and sent to Michael Shea of the Australian Museum Malacology Unit for confirmation of identification.

2 Habitat trees

Hollow-bearing tree surveys use a *Trimble* handheld GPS unit to log both field reference location as well as tree data. Data such as hollow types, hollow size, tree species, diameter at breast height, canopy spread and overall height are documented. A metal tag with the tree number is placed on the trunk for field relocation purposes. Other habitat features such as nests and significant sized mistletoe for foraging are also noted.

3 Survey effort table descriptors:

Target - Where effort is specifically concentrated towards an individual species. Selected target species will be identified within the survey effort table and where necessary described within the report.

Opportunistic - Where birds are identified by observation, call or indirect methods as the opportunity arises.

Habitat search - Where suitable areas of habitat for selected fauna groups such as frogs, reptiles and invertebrates are specifically searched.

Diurnal bird census point(s) - Bird surveys are undertaken within a specified area surrounding a point (or in a quadrat) for a specified amount of time. Size and time will be specified in the survey effort table. These are more typically undertaken across larger sites where the total area cannot be effectively covered during the survey period. Subsequently census points are selected to adequately represent each of the habitat areas present and particularly areas designated for proposed development. Often census points are commenced at locations where bird activity is noticeably high.

Spotting-scope outlook - A *Nikon* spotting scope with 16~47 zoom at x60 magnification on a mounted tripod is used for distant inspections of diurnal birds. This is undertaken at wetlands for viewing waterfowl and waders but also other difficult to access areas. It may also be used for inspecting activity at nests, hollows and combined with spotlight for a panoramic search in open areas.

Call-playback - This involves broadcasting recorded calls through a 15 watt Toa 'Faunatech' amplifier to evoke a response from species known to reply. Species selected for call-playback will be indicated in the survey effort table.

Spotlighting - Is carried out using a hand held 55 watt spotlight powered by a 12 volt rechargeable battery. This technique involves walking amongst the woodland areas, forest fringes, along roads, trails and fence lines so that a maximum number of trees can be observed. Spotlighting around water-bodies and particularly along the shallow fringes is used for finding frogs. Spotlighting is used in combination with binoculars or spotting scope for closer night inspections.

Stag-watching - Involves watching hollows in the dusk period approximately 15 minutes prior to dark until 30 minutes following dark. Placement of the observer on the ground allows for a silhouette of any emerging fauna to be seen against the lighter sky background such that a spotlight is not required, which would likely to disrupt emergence behaviour. Where any movement is observed, a spotlight may then be used for identification purposes.

Search quadrats - Are undertaken within a specified area surrounding a point (or in a quadrat) for a specified amount of time. These are more typically undertaken across larger sites where the total area cannot be effectively covered during the survey period. Subsequently quadrats are selected to adequately represent each of the suitable habitat areas present and particularly areas designated for proposed development. The use of this technique simply as an initial time-effective suitable indicator of presence / absence of Koalas has been discussed with Koala expert, Stephen Phillips.

Koala Spot Assessment Technique (SAT) - Method outlined by *Phillips & Callaghan* (2008) and accepted by the Australian Koala Foundation to determine Koala activity levels. Activity levels are calculated from the proportion of trees showing signs of Koala use as indicated by the presence of scats as well as site location within the state.

Elliott trapping - Using *Elliott* type A (33x10x10cm) and Type B (45x15x15cm), B and / or Type C traps for trapping small sized mammals. Trapping nights' effort will be indicated in the survey effort table. Trapping layout, trap sizes, baiting and trapping period will be outlined within the site specific methodology section.

Medium cage trapping - Using medium sized cage traps (17x17x45cm foldout cages with tread-plate mechanism or 22x25x58cm rigid cage with tread-plate mechanism) for trapping up to cat/bandicoot sized mammals. Trapping layout, target species, baiting and trapping period will be outlined within the site specific methodology section.

Large cage trapping - Using large sized cage traps (25x25x50cm foldout cages with pull lever (meat) mechanism, 28x28x60cm foldout cages with tread-plate mechanism or 30x30x70cm rigid cage with tread-plate mechanism) for trapping up to quoll sized mammals. Trapping layout, target species, baiting and trapping period will be outlined within the site specific methodology section.

Hair tubing - Using small (40mm diameter x 120mm long) and/or large (90mm diameter x 200mm long) PVC pipe sections for collecting mammal hair samples. At one end of each tube is an enclosed chamber where the bait is placed and capped. Small drill holes in the inside face of the chamber allow the smell of the bait to permeate out through the tube without allowing access to the bait. At the other open entry end, double-sided tape is attached around the inner rim so hair samples of animals entering the tube are collected. Hair samples collected are sent to Barbara Triggs for identification. Trapping layout, tube sizes, baiting and trapping period will be outlined within the site specific methodology section.

Pitfall trapping - Is used to survey for small terrestrial mammals, frogs, reptiles and invertebrates. Pitfall trapping involves the use of 15cm diameter and 60cm long PVC stormwater pipe sections placed vertically into pre dug holes. The pipe is placed and set firm with surrounding soil so that the top rim is level with the ground surface. Drift fences made of damp-proof-course 270mm wide are held tight and upright by wooden and steel pegs and run along the length of each trap-line. Drift fences are run over the middle of each pit in the trap line ensuring at least 5m of fencing is run along each side of each pit. Ground fauna passing beyond the pitfall transect are diverted towards the pits along the fence line.

Funnel trapping - Is used to survey mainly for frogs and reptiles. Funnel traps are 18cm x 18cm x 75cm long and constructed of shade cloth with an internal spring and wire frame in a similar design to yabby traps. At each end an inward facing funnel directs fauna through a 4cm hole and into the trap. Herpetofauna search the walls and corners for an exit and discover it difficult to re-find the internal exit hole. As with pitfall traps, funnel traps are used with drift fences that divert fauna towards the trap entry. At least 5m of fencing is run between each funnel trap which may be placed on either side of the fence. Trapping layout, target species, fence lengths and trapping period will be outlined within the site specific methodology section.

Passive Anabat monitoring - Involves leaving the bat recorder in a fixed mounted position to record call-sequences of passing bats. Recording locations are determined in order to represent different available foraging structures for various micro-chiropteran bat species. Dams, cleared flyways, high insect activity areas, forest edges and ecotones are particularly targeted.

Active Anabat monitoring - Is a method of active microbat recording during stag-watching or during complete nocturnal survey. Active monitoring involves an SD-1 recorder allied with a PDA for viewing call-sequences in real-time. When calls are heard the transducer microphone is actively directed towards the calling animal with the aid of a spotlight, so longer and clearer call sequences may be recorded. When calls of a potential threatened species are observed on the PDA screen a view by spotlight of the bat size and wing morphology is attempted for greater identification accuracy.

Active vehicle Anabat monitoring - Is a method of active microbat recording deployed when large distances need to be covered in a nocturnal survey period. A Hi-mic extension cable allows the transducer microphone to be placed on a bracket on the roof of a travelling vehicle so calls may be viewed whilst driving. The vehicle travels at no more than 40km/h to

prevent wind interference. When calls of a potential threatened species are observed on the dash mounted PDA screen active spotlighting is undertaken.

Harp trapping - Is used to capture microchiropteran bats. Harp traps have an aluminium frame with a two-bank 4.2m² area and calico capture bag set along the base area.

Mist netting - Is used to capture microchiropteran bats. The mist net capture area is 2.4m high and 9m wide and supported by two 3.5m poles which are braced with ropes and pegs. Design is a 0.08mm ultrafine nylon monofilament thread arranged in a 14x14mm mesh, with four horizontal capture pockets. These features are specific for the use to capture microchiropteran bat species and are provided from the only known supplier in Poland.

Trip lining - Is used to capture microchiropteran bats. Fishing line is strung tight on pegs in a zig-zag pattern across open water-bodies just above the water surface to trip drinking bats into the water.

Camera surveillance - Is used to monitor activity at burrows, hollows, etc. or to survey for species presence at baited stations. A Reconyx Hyperfire digital weatherproof camera is used with a passive infrared motion detector and a night-time infrared illuminator. The camera is mounted on a tree or tripod and takes three consecutive photo frames on the detection of movement up to 30m away or the detection of a heat/cold source different to the ambient temperature.

Weather conditions - Survey effort for each fauna group accounting for methods undertaken, duration, and weather conditions are provided in the survey effort table. Weather details are documented for all survey techniques and include:

- air temperature
- cloud cover
- rain (e.g. none, light drizzle, heavy drizzle, heavy rain)
- recent rain events (where relevant)
- wind strength e.g. calm, light (leaves rustle), moderate (moves branches), strong (moves tree crowns)
- wind direction
- moon (where relevant) (e.g. none, 1/4 moon, 1/2 moon, 3/4 moon, full moon)



Threatened & Migratory Species Habitat Assessment

A2

Table A2.1 provides an assessment of potential habitat within the subject site for state and nationally listed threatened flora species recorded within 10km on the Atlas of NSW Wildlife (OEH) or indicated to have potential habitat present within 10km on the EPBC Act Protected Matters Tool.

Table A2.1 – Threatened flora habitat assessment

Scientific name DATABASE SOURCE	TSC Act	EPBC Act	Growth form and habitat requirements	Recorded on site (✓)	If not recorded onsite				Considered in 7 part test of significance (✓) Refer to Appendix 3
					Suitable habitat present (✓)	Nearby and / or high number of record(s) (✓) Notes 1, 2 & 3	Record(s) from recent years (✓) Notes 1, 2 & 3	Potential to occur	
<i>Acacia bynoeana</i> OEH EPBC	E1	V	Erect or spreading shrub to 0.3m high growing in heath and dry sclerophyll Open Forest on sandy soils. Often associated with disturbed areas such as roadsides. Distribution limits N-Newcastle S-Berrima.	x	✓	✓	✓	✓	✓
<i>Acacia gordonii</i> OEH	E1	E	Erect or spreading shrub 0.5-1.5m high growing in heath and dry sclerophyll forest on sandstone outcrops. Distribution limits N-Bilpin S-Faulconbridge.	x	x	-	-	x	x
<i>Acacia pubescens</i> OEH EPBC	V	V	Spreading shrub 1-4m high open sclerophyll growing in open forest and woodlands on clay soils. Distribution limits N-Bilpin S-Georges River.	x	✓	✓	✓	✓	✓

Scientific name DATABASE SOURCE	TSC Act	EPBC Act	Growth form and habitat requirements	Recorded on site (✓)	If not recorded onsite				Considered in 7 part test of significance (✓) Refer to Appendix 3
					Suitable habitat present (✓)	Nearby and / or high number of record(s) (✓) <i>Notes 1,2 & 3</i>	Record(s) from recent years (✓) <i>Notes 1,2 & 3</i>	Potential to occur	
<i>Allocasuarina glareicola</i> OEH EPBC	E1	E	Small shrub 1-2m high growing in open sclerophyll forest on lateritic soils derived from tertiary alluviums. Distribution limits Castlereagh NR region.	x	Marginal	✓	✓	Low	✓
<i>Dillwynia tenuifolia</i> OEH	V	-	Erect shrub 0.6-1m high. Grows in Woodlands and Open Forest on sandstone shale or laterite. Distribution limits N-Howes Valley S-Cumberland Plain.	x	✓	✓	✓	✓	✓
<i>Eucalyptus benthamii</i> OEH EPBC	V	V	Blue gum to 40m high. Wet forest on sandy alluvial soils. Distribution limits N-Yarramundi S-Bents Basin.	x	x	-	-	x	x
<i>Genoplesium baueri</i> EPBC	E1	E	A terrestrial orchid that grows in sparse sclerophyll forest and moss gardens over sandstone. Distribution limits N – Hunter Valley S – Nowra	x	x	-	-	x	x
<i>Grevillea juniperina</i> subsp. <i>juniperina</i> OEH	V	-	Erect to spreading shrub 0.5-1.5m tall. Grows on laterite and Tertiary alluvium. Distribution limits St Marys-Londonderry-Prospect.	x	✓	✓	✓	✓	✓
<i>Haloragis exalata</i> subsp. <i>exalata</i> EPBC	V	V	Shrub to 1.5m high. Grows in damp places near watercourses. Distribution limits N-Tweed Heads S-south of Eden.	x	x	-	-	x	x
<i>Leucopogon exolasius</i> OEH EPBC	V	V	Erect shrub to 2m high. Rocky hillsides and creek banks in Sydney Sandstone Gully Forest. Confined to Woronora and Georges Rivers and Stokes Creek.	x	x	-	-	x	x

Scientific name DATABASE SOURCE	TSC Act	EPBC Act	Growth form and habitat requirements	Recorded on site (✓)	If not recorded onsite				Considered in 7 part test of significance (✓) Refer to Appendix 3
					Suitable habitat present (✓)	Nearby and / or high number of record(s) (✓) <i>Notes 1, 2 & 3</i>	Record(s) from recent years (✓) <i>Notes 1, 2 & 3</i>	Potential to occur	
<i>Leucopogon fletcheri</i> subsp. <i>fletcheri</i> OEH	E1	-	Shrub to 1.8m high growing in woodland on lateritic soils. Distribution limits N-St Albans S-Springwood.	x	x	-	-	x	x
<i>Melaleuca deanei</i> OEH EPBC	V	V	Shrub to 3m high. Grows in heath on sandstone. Distribution limits N-Gosford S-Nowra.	x	x	-	-	x	x
<i>Micromyrtus minutiflora</i> OEH EPBC	E1	V	Spreading shrub to 2m high. Grows in dry sclerophyll forest dominated by Scribbly gums and Ironbarks on Tertiary Alluviums. Distribution limits Western part of Cumberland Plain.	x	x	-	-	x	x
<i>Pelargonium</i> sp. <i>Striatellum</i> EPBC	E1	E	Herb to 90cm tall which grows in damp places especially beside streams and lakes. Occasionally in swamp forest or associated with disturbance. Varied distribution from SE NSW to QLD.	x	x	-	-	x	x
<i>Persoonia hirsuta</i> OEH EPBC	E1	E	Erect to decumbent shrub. Grows in dry sclerophyll forest and woodland on Hawkesbury sandstone with infrequent fire histories. Distribution limits N-Glen Davis S-Hill Top.	x	x	-	-	x	x
<i>Persoonia nutans</i> OEH EPBC	E1	E	Erect to spreading shrub. Grows in dry sclerophyll forest and woodland on laterite and alluvial sands. Distribution limits Cumberland Plain.	x	Marginal	✓	✓	Low	✓

Scientific name DATABASE SOURCE	TSC Act	EPBC Act	Growth form and habitat requirements	Recorded on site (✓)	If not recorded onsite				Considered in 7 part test of significance (✓) Refer to Appendix 3
					Suitable habitat present (✓)	Nearby and / or high number of record(s) (✓) Notes 1, 2 & 3	Record(s) from recent years (✓) Notes 1, 2 & 3	Potential to occur	
<i>Pimelea curviflora</i> var. <i>curviflora</i> OEH EPBC	V	V	Woody herb or sub-shrub to 0.2-1.2m high. Grows on Hawkesbury sandstone near shale outcrops. Distribution Sydney.	x	x	-	-	x	x
<i>Pimelea spicata</i> OEH EPBC	E1	E	Decumbent or erect shrub to 0.5m high. Occurs principally in woodland on soils derived from Wianamatta Shales. Distribution limits N-Lansdowne S-Shellharbour.	x	Limited	x	✓	Very low	✓
<i>Pterostylis gibbosa</i> OEH EPBC	E1	E	Terrestrial orchid which occurs near Wollongong and in Hunter Valley in sclerophyll forest, sometimes with paperbarks.	x	x	-	-	x	x
<i>Pterostylis pulchella</i> OEH EPBC	V	V	Orchid species to 15cm tall, found on cliff faces at Fitzroy Falls, Belmore Falls, upper Bundanoon Creek and Minnamurra Falls. Flowers appear from February to May	x	x	-	-	x	x
<i>Pterostylis saxicola</i> OEH EPBC	E1	E	Terrestrial orchid. Grows in shallow sandy soil above rock shelves, usually near Wianamatta / Hawkesbury transition. Distribution limits N-Hawkesbury River S-Campbelltown.	x	x	-	-	x	x
<i>Pultenaea parviflora</i> OEH EPBC	E1	V	Erect shrub. Grows in dry sclerophyll forest at the intergrade between Tertiary Alluviums and Wianamatta Shales. Distribution limits Cumberland Plain.	x	Marginal	Lots of records but nearest if 5km away	-	-	-
<i>Rhizanthella slateri</i> OEH EPBC	V	E	Underground orchid that is poorly known. Grows in sclerophyll forests. Usually only seen if the soil is disturbed. Flowers in Oct – Nov.	x	x	-	-	x	x

Scientific name DATABASE SOURCE	TSC Act	EPBC Act	Growth form and habitat requirements	Recorded on site (✓)	If not recorded onsite				Considered in 7 part test of significance (✓) Refer to Appendix 3
					Suitable habitat present (✓)	Nearby and / or high number of record(s) (✓) <i>Notes 1, 2 & 3</i>	Record(s) from recent years (✓) <i>Notes 1, 2 & 3</i>	Potential to occur	
<i>Streblus pendulinus</i> EPBC	-	E	Tree or large shrub to 6m tall. Coastal species along watercourses in warmer rainforest area.	x	x	-	-	x	x
<i>Tetratheca glandulosa</i> OEI EPBC	V	V	Spreading shrub to 0.2m high. Sandy or rocky heath or scrub. Distribution limits N-Mangrove Mountain S-Port Jackson.	x	x	-	-	x	x
OEI	- Denotes species listed within 10km of the subject site on the <i>Atlas of NSW Wildlife</i>								
EPBC	- Denotes species listed within 10km of the subject site in the <i>EPBC Act</i> habitat search								
V	- Denotes vulnerable listed species under the relevant Act								
E or E1	- Denotes endangered listed species under the relevant Act								
NOTE:	1. This field is not considered if no suitable habitat is present within the subject site 2. 'records' refer to those provided by the <i>Atlas of NSW Wildlife</i> 3. 'nearby' or 'recent' records are species specific accounting for home range, dispersal ability and life cycle								

Table A2.2 provides an assessment of potential habitat within the subject site for state and nationally listed threatened fauna species recorded within 10km on the *Atlas of NSW Wildlife* (OEH) or indicated to have potential habitat present within 10km on the *EPBC Act* Protected Matters Tool.

Table A2.2 – Threatened fauna habitat assessment

COMMON NAME <i>Scientific Name</i> DATABASE SOURCE	TSC Act	EPBC Act	PREFERRED HABITAT <i>Distribution Limit</i>	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN 7 PART TEST (✓) (Refer to Appendix 3)
					Suitable Habitat Present (✓)	Nearby and/or high number of record(s) (✓) Notes 1,2 & 3	Record(s) from recent years (✓) Notes 1,2 & 3	Potential to occur	
Giant Burrowing Frog <i>Heleioporus australiacus</i> OEH EPBC	V	V	Inhabits open forests and riparian forests along non-perennial streams, digging burrows into sandy creek banks. <i>Distribution Limit: N-Near Singleton S-South of Eden.</i>	x	x	-	-	x	x
Red-crowned Toadlet <i>Pseudophryne australis</i> OEH	V	-	Prefers sandstone areas, breeds in grass and debris beside non-perennial creeks or gutters. Individuals can also be found under logs and rocks in non-breeding periods. <i>Distribution Limit: N-Pokolbin. S-near Wollongong.</i>	x	x	-	-	x	x
Green and Golden Bell Frog <i>Litoria aurea</i> OEH EPBC	E	V	Prefers the edges of permanent water, streams, swamps, creeks, lagoons, farm dams and ornamental ponds. Often found under debris. <i>Distribution Limit: N-Byron Bay S-South of Eden.</i>	x	✓	x	x	unlikely	✓

COMMON NAME <i>Scientific Name</i> DATABASE SOURCE	TSC Act	EPBC Act	PREFERRED HABITAT <i>Distribution Limit</i>	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN 7 PART TEST (✓) (Refer to Appendix 3)
					Suitable Habitat Present (✓)	Nearby and/or high number of record(s) (✓) Notes 1,2 & 3	Record(s) from recent years (✓) Notes 1,2 & 3	Potential to occur	
Littlejohn's Tree Frog <i>Litoria littlejohnii</i> EPBC	V	V	Found in wet and dry sclerophyll forest associated with sandstone outcrops at altitudes 280-1,000m on eastern slopes of Great Dividing Range. Prefers flowing rocky streams. <i>Distribution Limit: N-Hunter River S-Eden.</i>	x	x	-	-	x	x
Broad-headed Snake <i>Hoplocephalus bungaroides</i> EPBC	E	V	Sandstone outcrops, exfoliated rock slabs and tree hollows in coastal and near coastal areas. <i>Distribution Limit: N-Mudgee Park. S-Nowra.</i>	x	x	-	-	x	x
Blue-billed Duck <i>Oxyura australis</i> DEH	V	-	A completely aquatic species occurring mainly throughout the Murray-Darling basin in cool to warm temperate deep permanent freshwater lakes, lagoons and swamps with extensive reed-beds. <i>Distribution Limit: N-Tenterfield. S-Albury.</i>	x	✓	x	x	unlikely	✓
Freckled Duck <i>Stictonetta naevosa</i> DEH	V	-	Occurs mainly within the Murray-Darling basin and the channel country within large cool temperate to sub-tropical swamps, lakes and floodwaters with cumbungi, lignum or melaleucas. <i>Distribution Limit: N- Tenterfield. S-Albury.</i>	x	✓	x	x	unlikely	✓

COMMON NAME <i>Scientific Name</i> DATABASE SOURCE	TSC Act	EPBC Act	PREFERRED HABITAT <i>Distribution Limit</i>	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN 7 PART TEST (✓) (Refer to Appendix 3)
					Suitable Habitat Present (✓)	Nearby and/or high number of record(s) (✓) Notes 1,2 & 3	Record(s) from recent years (✓) Notes 1,2 & 3	Potential to occur	
Black-necked Stork <i>Ephippiorhynchus asiaticus</i> OEI	E	-	Occurs in tropical to warm temperate terrestrial wetlands, estuarine and littoral habitats such as mangroves, tidal mudflats, floodplains, open woodlands, irrigated lands, bore drains, sub-artesian pools, farm dams and sewerage ponds. <i>Distribution Limit: N-Tweed Heads. S-Nowra.</i>	x	✓	x	x	unlikely	✓
Australasian Bittern <i>Botaurus poiciloptilus</i> OEI EPBC	E	E	Found in or over water of shallow freshwater or brackish wetlands with tall reedbeds, sedges, rushes, cumbungi, lignum and also in ricefields, drains in tussocky paddocks, occasionally saltmarsh, brackish wetlands. <i>Distribution Limit: N-North of Lismore. S-Eden.</i>	x	✓	✓	x	unlikely	✓
Black Bittern <i>Ixobrychus flavicollis</i> OEI	V	-	Found in shadowy, leafy waterside trees such as callistemons, casuarinas, paperbarks, eucalypts, mangroves and willows along tidal creeks, freshwater and brackish streams and ponds, sheltered mudflats and oyster slats. <i>Distribution Limit: N-Tweed Heads. S-South of Eden.</i>	x	✓	✓	x	unlikely	✓
Spotted Harrier <i>Circus assimilis</i> OEI	V	-	Utilises grassy plains, crops and stubblefields; saltbush, spinifex associations; scrublands, mallee, heathlands; open grassy woodlands. <i>Distribution Limit: N-Tweed Heads. S-South of Eden.</i>	x	✓	x	✓	✓	✓

COMMON NAME <i>Scientific Name</i> DATABASE SOURCE	TSC Act	EPBC Act	PREFERRED HABITAT <i>Distribution Limit</i>	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN 7 PART TEST (✓) (Refer to Appendix 3)
					Suitable Habitat Present (✓)	Nearby and/or high number of record(s) (✓) <i>Notes 1,2 & 3</i>	Record(s) from recent years (✓) <i>Notes 1,2 & 3</i>	Potential to occur	
Little Eagle <i>Hieraaetus morphnoides</i> OEH	V	-	Utilises plains, foothills, open forests, woodlands and scrublands; river red gums on watercourses and lakes. <i>Distribution Limit - N-Tweed Heads. S-South of Eden.</i>	x	✓	✓	✓	✓	✓
Square-tailed Kite <i>Lophoictinia isura</i> OEH	V	-	Utilises mostly coastal and sub-coastal open forest, woodland or lightly timbered habitats and inland habitats along watercourses and mallee that are rich in passerine birds. <i>Distribution Limit: N-Goondiwindi. S-South of Eden.</i>	x	✓	✓	✓	✓	✓
Black Falcon <i>Falco subniger</i> OEH	V	-	Inhabits plains, grasslands, foothills, timbered watercourses, wetland environs, crops; occasionally over towns and cities. <i>N-Tweed Heads. S-South of Eden</i>	x	✓	✓	x	unlikely	✓
Bush Stone-curlew <i>Burhinus grallarius</i> OEH	E	-	Utilises open forests and savannah woodlands, sometimes dune scrub, savannah and mangrove fringes. <i>Distribution Limit: N-Border Ranges National Park. S-Near Nowra.</i>	x	✓	x	x	Not likely	x
Comb-crested Jacana <i>Irediparra gallinacean</i> OEH	V	-	Floating vegetation of deep and permanent vegetation-choked tropical and warm temperate wetlands and dams. Occasionally feeds along muddy wetland margins. <i>Distribution Limit: N-Tweed Heads. S-Ku-ring-gai Chase National Park.</i>	x	✓	x	x	Not likely	x

COMMON NAME <i>Scientific Name</i> DATABASE SOURCE	TSC Act	EPBC Act	PREFERRED HABITAT <i>Distribution Limit</i>	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN 7 PART TEST (✓) (Refer to Appendix 3)
					Suitable Habitat Present (✓)	Nearby and/or high number of record(s) (✓)	Record(s) from recent years (✓)	Potential to occur	
Australian Painted Snipe <i>Rostratula australis</i> DEH EPBC	E	E	Most numerous within the Murray-Darling basin and inland Australia within marshes and freshwater wetlands with swampy vegetation. <i>Distribution Limit: N-Tweed Heads. S-South of Eden.</i>	x	✓	x	x	Not likely	x
Curlew Sandpiper <i>Callidris ferruginea</i> DEH	E	-	Mainly coastal, but many inland feeding along tidal mudflats, salt marsh, salt fields, fresh, brackish or saline wetlands and sewerage ponds. <i>Distribution Limit: N-Tweed Heads. S-South of Eden.</i>	x	✓	✓	x	unlikely	✓
Black-tailed Godwit <i>Limosa limosa</i> DEH	V	-	Regular summer migrant that forages along tidal mudflats, estuaries, sandspits, shallow river margins, sewerage ponds, inland on large shallow fresh or brackish waters. <i>Distribution Limit: N-Tweed Heads. S-South of Eden.</i>	x	✓	x	x	Not likely	x
Gang-gang Cockatoo <i>Callocephalon fimbriatum</i> DEH	V	-	Prefers wetter forests and woodlands from sea level to > 2,000m on the Great Dividing Range, timbered foothills and valleys, timbered watercourses, coastal scrubs, farmlands and suburban gardens. <i>Distribution Limit: mid north coast of NSW to western Victoria.</i>	x	x	-	-	x	x

COMMON NAME <i>Scientific Name</i> DATABASE SOURCE	TSC Act	EPBC Act	PREFERRED HABITAT <i>Distribution Limit</i>	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN 7 PART TEST (✓) (Refer to Appendix 3)
					Suitable Habitat Present (✓)	Nearby and/or high number of record(s) (✓) Notes 1,2 & 3	Record(s) from recent years (✓) Notes 1,2 & 3	Potential to occur	
Glossy Black-Cockatoo <i>Calyptorhynchus lathamii</i> OEH	V	-	Open forests with <i>Allocasuarina</i> species and hollows for nesting. <i>Distribution Limit: N-Tweed Heads. S-South of Eden.</i>	x	x	-	-	x	x
Little Lorikeet <i>Glossopsitta pusilla</i> OEH	V	-	Inhabits forests, woodlands; large trees in open country; timbered watercourses, shelterbeds, and street trees. <i>Distribution Limit: N-Tweed Heads. S-South of Eden.</i>	x	✓	✓	✓	low	✓
Swift Parrot <i>Lathamus discolor</i> OEH EPBC	E	E	Inhabits eucalypt forests and woodlands with winter flowering eucalypts. <i>Distribution Limit: N-Border Ranges National Park. S-South of Eden.</i>	x	✓	x	x	low	✓
Turquoise Parrot <i>Neophema pulchella</i> OEH	V	-	Inhabits coastal scrubland, open forest and timbered grassland, especially ecotones between dry hardwood forests and grasslands. <i>Distribution Limit: N-Near Tenterfield. S-South of Eden.</i>	x	✓	x	x	Not likely	x
Superb Parrot <i>Polytelis swainsonii</i> OEH EPBC	V	V	Inhabits open woodland and riverine forests of inland NSW. <i>Distribution Limit: N-Near Walgett. S-South of Deniliquin.</i>	x	✓	x	x	Not likely	x

COMMON NAME <i>Scientific Name</i> DATABASE SOURCE	TSC Act	EPBC Act	PREFERRED HABITAT <i>Distribution Limit</i>	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN 7 PART TEST (✓) (Refer to Appendix 3)
					Suitable Habitat Present (✓)	Nearby and/or high number of record(s) (✓)	Record(s) from recent years (✓)	Potential to occur	
Barking Owl <i>Ninox connivens</i> OEH	V	-	Inhabits principally woodlands but also open forests and partially cleared land and utilises hollows for nesting. <i>Distribution Limits: N-Border Ranges National Park. S-Eden.</i>	x	✓	✓	x	low	✓
Powerful Owl <i>Ninox strenua</i> OEH	V	-	Forests containing mature trees for shelter or breeding and densely vegetated gullies for roosting. <i>Distribution Limits: N-Border Ranges National Park. S-Eden.</i>	x	✓	✓	✓	low	✓
Masked Owl <i>Tyto novaehollandiae</i> OEH	V	-	Open forest and woodlands with cleared areas for hunting and hollow trees or dense vegetation for roosting. <i>Distribution Limit: N-Border Ranges National Park. S-Eden.</i>	x	✓	x	x	Not likely	x
Sooty Owl <i>Tyto tenebricosa</i> OEH	V	-	Tall, dense, wet forests containing trees with very large hollows. <i>Distribution Limit: N-Border Ranges National Park. S-South of Eden.</i>	x	x	-	-	x	x
Eastern Bristlebird <i>Dasyornis brachypterus</i> EPBC	E	E	Coastal woodlands, dense scrubs and heathlands, especially where low heathland borders taller woodland or dense tall tea-tree. <i>Distribution Limit: N-Tweed Heads. S-South of Eden.</i>	x	x	-	-	x	x

COMMON NAME <i>Scientific Name</i> DATABASE SOURCE	TSC Act	EPBC Act	PREFERRED HABITAT <i>Distribution Limit</i>	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN 7 PART TEST (✓) (Refer to Appendix 3)
					Suitable Habitat Present (✓)	Nearby and/or high number of record(s) (✓) Notes 1,2 & 3	Record(s) from recent years (✓) Notes 1,2 & 3	Potential to occur	
Speckled Warbler <i>Chthonicola sagittata</i> OEH	V	-	Found in temperate eucalypt woodland and open forest including forest edges, wooded farmland and urban areas with mature eucalypts. <i>Distribution Limit: N-Urbanville. S-Eden.</i>	x	✓	✓	✓	✓	✓
Painted Honeyeater <i>Grantiella picta</i> OEH	V	-	A nomadic bird occurring in low densities within open forest, woodland and scrubland feeding on mistletoe fruits. Inhabits primarily Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests. <i>Distribution Limit: N-Boggabilla. S-Albury with greatest occurrences on the inland slopes of the Great Dividing Range.</i>	x	✓	✓	x	Not likely	x
Black-chinned Honeyeater <i>Melithreptus gularis gularis</i> OEH	V	-	Found in woodlands containing box-ironbark associations and River Red Gums, also drier coastal woodlands of the Cumberland Plain and Hunter Richmond and Clarence. <i>Distribution Limit: N-Cape York Pen. Qld. S-Victor H. Mt Lofty Ra & Flinders Ra. SA.</i>	x	✓	x	x	unlikely	✓
Regent Honeyeater <i>Xanthomyza phrygia</i> OEH EPBC	E4A	E	Found in temperate eucalypt woodland and open forest including forest edges, wooded farmland and urban areas with mature eucalypts. <i>Distribution Limit: N-Urbanville. S-Eden.</i>	x	✓	x	x	unlikely	✓

COMMON NAME <i>Scientific Name</i> DATABASE SOURCE	TSC Act	EPBC Act	PREFERRED HABITAT <i>Distribution Limit</i>	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN 7 PART TEST (✓) (Refer to Appendix 3)
					Suitable Habitat Present (✓)	Nearby and/or high number of record(s) (✓)	Record(s) from recent years (✓)	Potential to occur	
Varied Sittella <i>Daphoenositta chrysoptera</i> DEH	V	-	Open eucalypt woodlands / forests (except heavier rainforests); mallee, inland acacia, coastal tea-tree scrubs; golf courses, shelterbelts, orchards, parks, scrubby gardens. <i>Distribution Limit: N-Border Ranges National Park. S-South of Eden.</i>	x	✓	✓	✓	✓	✓
Scarlet Robin <i>Petroica boodang</i> DEH	V	-	Found in foothill forests, woodlands, watercourses; in autumn-winter, more open habitats: river red gum woodlands, golf courses, parks, orchards, gardens. <i>Distribution Limit: N-Tweed Heads. S-South of Eden.</i>	x	✓	x	x	unlikely	✓
Flame Robin <i>Petroica phoenicea</i> DEH	V	-	Summer: forests, woodlands, scrubs, from sea-level to c. 1800 m. Autumn-winter: open woodlands, plains, paddocks, golf courses, parks, orchards. <i>Distribution Limit: N northern NSW tablelands. S-South of Eden.</i>	x	✓	x	x	unlikely	✓
Star Finch <i>Neochmia ruficauda</i> DEH EPBC	E4	E	Occurs mainly in tall rank streamside grass and rushes within warm temperate to tropical swamps and woodlands. <i>Distribution Limit: N-Tweed Heads. S-Campbelltown(?)</i>	x	✓	x	x	Not likely	x

COMMON NAME <i>Scientific Name</i> DATABASE SOURCE	TSC Act	EPBC Act	PREFERRED HABITAT <i>Distribution Limit</i>	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN 7 PART TEST (✓) (Refer to Appendix 3)
					Suitable Habitat Present (✓)	Nearby and/or high number of record(s) (✓)	Record(s) from recent years (✓)	Potential to occur	
Spotted-tailed Quoll <i>Dasyurus maculatus</i> DEH EPBC	V	E	Dry and moist open forests containing rock caves, hollow logs or trees. <i>Distribution Limit: N-Mt Warning National Park. S-South of Eden.</i>	x	x	-	-	x	x
Koala <i>Phascolarctos cinereus</i> DEH EPBC	V	V	Inhabits both wet and dry eucalypt forest on high nutrient soils containing preferred feed trees. <i>Distribution Limit: N-Tweed Heads. S-South of Eden.</i>	x	✓	x	x	Not likely	x
Yellow-bellied Glider <i>Petaurus australis</i> DEH	V	-	Tall mature eucalypt forests with high nectar producing species and hollow bearing trees. <i>Distribution Limit- N-Border Ranges National Park. S-South of Eden.</i>	x	x	-	-	x	x
Squirrel Glider <i>Petaurus norfolcensis</i> DEH	V	-	Mixed aged stands of eucalypt forest & woodlands including gum barked & high nectar producing species & hollow bearing trees. <i>Distribution Limit: N-Tweed Heads. S-Albury.</i>	x	✓	x	x	Not likely	x
Brush-tailed Rock-wallaby <i>Petrogale penicillata</i> EPBC	E	V	Found in rocky gorges with a vegetation of rainforest or open forests to isolated rocky outcrops in semi-arid woodland country. <i>Distribution Limit: N-North of Tenterfield. S-Bombala.</i>	x	x	-	-	x	x

COMMON NAME <i>Scientific Name</i> DATABASE SOURCE	TSC Act	EPBC Act	PREFERRED HABITAT <i>Distribution Limit</i>	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN 7 PART TEST (✓) (Refer to Appendix 3)
					Suitable Habitat Present (✓)	Nearby and/or high number of record(s) (✓) Notes 1,2 & 3	Record(s) from recent years (✓) Notes 1,2 & 3	Potential to occur	
Grey-headed Flying-fox <i>Pteropus poliocephalus</i> OEI EPBC	V	V	Found in a variety of habitats including rainforest, mangroves, paperbark swamp, wet and dry open forest and cultivated areas. Forms camps commonly found in gullies and in vegetation with a dense canopy. <i>Distribution Limit: N-Tweed Heads. S-Eden.</i>	x	✓	✓	✓	✓	✓
Yellow-bellied Sheath-tail-bat <i>Saccolaimus flaviventris</i> OEI	V	-	Rainforests, sclerophyll forests and woodlands. <i>Distribution Limit: N-North of Walgett. S-Sydney.</i>	x	✓	x	x	unlikely	✓
East-coast Freetail Bat <i>Micronomus norfolkensis</i> OEI	V	-	Inhabits open forests and woodlands foraging above the canopy and along the edge of forests. Roosts in tree hollows, under bark and buildings. <i>Distribution Limit: N-Woodenbong. S-Pambula.</i>	✓	-	-	-	-	✓
Large-eared Pied Bat <i>Chalinolobus dwyeri</i> OEI EPBC	V	V	Warm-temperate to subtropical dry sclerophyll forest and woodland. Roosts in caves, tunnels and tree hollows in colonies of up to 30 animals. <i>Distribution Limit: N-Border Ranges National Park. S-Wollongong.</i>	x	x	-	-	x	x

COMMON NAME <i>Scientific Name</i> DATABASE SOURCE	TSC Act	EPBC Act	PREFERRED HABITAT <i>Distribution Limit</i>	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN 7 PART TEST (✓) (Refer to Appendix 3)
					Suitable Habitat Present (✓)	Nearby and/or high number of record(s) (✓) <i>Notes 1,2 & 3</i>	Record(s) from recent years (✓) <i>Notes 1,2 & 3</i>	Potential to occur	
Eastern Falsistrelle <i>Falsistrellus tasmaniensis</i> DEH	V	-	Recorded roosting in caves, old buildings and tree hollows. <i>Distribution Limit: N-Border Ranges National Park. S-Pambula.</i>	x	marginal	✓	x	low	✓
Eastern Bentwing-bat <i>Miniopterus orianae oceansis</i> DEH	V	-	Prefers areas where there are caves, old mines, old buildings, stormwater drains and well-timbered areas. <i>Distribution Limit: N-Border Ranges National Park. S-South of Eden.</i>	✓	-	-	-	-	✓
Large-footed Myotis <i>Myotis macropus</i> DEH	V	-	Roosts in caves, mines, tunnels, buildings, tree hollows and under bridges. Forages over open water. <i>Distribution limits: N-Border Ranges National Park. S-South of Eden.</i>	✓	-	-	-	-	✓
Greater Broad-nosed Bat <i>Scoteanax rueppellii</i> DEH	V	-	Inhabits areas containing moist river and creek systems, especially tree lined creeks. <i>Distribution Limit: N-Border Ranges National Park. S-Pambula.</i>	✓	-	-	-	-	✓
Cumberland Plain Land Snail <i>Meridolum corneovirens</i> DEH	E	-	Inhabits remnant eucalypt woodland of the Cumberland Plan. Shelters under logs, debris, clumps of grass, around base of trees and burrowing into loose soil. <i>Distribution Limit: Cumberland Plain of Sydney Basin Region.</i>	✓	-	-	-	-	✓

COMMON NAME <i>Scientific Name</i> DATABASE SOURCE		TSC Act	EPBC Act	PREFERRED HABITAT <i>Distribution Limit</i>	RECORDED ON SITE (✓)	IF NOT RECORDED ON-SITE				CONSIDERED IN 7 PART TEST (✓) (Refer to Appendix 3)
						Suitable Habitat Present (✓)	Nearby and/or high number of record(s) (✓) <i>Notes 1, 2 & 3</i>	Record(s) from recent years (✓) <i>Notes 1, 2 & 3</i>	Potential to occur	
Macquarie Perch <i>Macquaria australasica</i> EPBC		V (FM Act 1994)	E	Occurs in south east Australia at moderate to high altitudes in rivers and reservoirs. Historical records show the species was widespread and abundant in the upper reaches of the Lachlan, Murrumbidgee and Murray Rivers and their tributaries. Allen (1989) states that introduced populations are present in Nepean River and water supply dams in the Sydney area. Occurs in lakes and flowing streams, usually in deep holes.	x	✓	x	x	unlikely	✓
Australian Greyling <i>Prototroctes maraena</i> EPBC		Part 2, Section 19 – Protected Fish (FM Act 1994)	V	Clear, moderate to fast flowing water in the upper reaches of rivers (sometimes to altitudes above 1,000m). Typically found in gravel bottom pools. Often forming aggregations below barriers to upstream movement (e.g. weirs, waterfalls).	x	x	-	-	x	x
OEH	- Denotes species listed within 10km of the subject site on the <i>Atlas of NSW Wildlife</i>									
EPBC	- Denotes species listed within 10km of the subject site in the <i>EPBC Act</i> habitat search									
V	- Denotes vulnerable listed species under the relevant Act									
E	- Denotes endangered listed species under the relevant Act									
NOTE:	1. This field is not considered if no suitable habitat is present within the subject site									
	2. 'records' refer to those provided by the <i>Atlas of NSW Wildlife</i>									
	3. 'nearby' or 'recent' records are species specific accounting for home range, dispersal ability and life cycle									

Table A2.3 provides an assessment of potential habitat within the subject site for nationally *protected* migratory fauna species recorded within 10km on the EPBC Act Protected Matters Tool. Nationally *threatened* migratory species are considered in Table A2.2.

Table A2.3 – Migratory fauna habitat assessment

COMMON NAME <i>Scientific Name</i>	PREFERRED HABITAT <i>Migratory Breeding</i>	Suitable Habitat Present (✓)	Recorded on Site (✓)	COMMENTS
White-bellied Sea Eagle (<i>Haliaeetus leucogaster</i>)	Coasts, islands, estuaries, inlets, large rivers, inland lakes, reservoirs. <i>Sedentary; dispersive.</i>	✓	✓	An adult White-bellied Sea Eagle was heard yapping to the north of the study area and then later observed in flight along Rickabys Creek. The study area was searched and no large raptor nest was found present. Foraging habitat for this species will remain consistent.
White-throated Needletail (<i>Hirundapus caudacutus</i>)	Airspace over forests, woodlands, farmlands, plains, lakes, coasts, towns; companies forage often along favoured hilltops and timbered ranges. <i>Breeds Siberia, Himalayas, east to Japan. Summer migrant to eastern Australia.</i>	✓	x	-
Rainbow Bee-eater (<i>Merops ornatus</i>)	Open woodlands with sandy, loamy soil; sandridges, sandspits, riverbanks, road cuttings, beaches, dunes, cliffs, mangroves, rainforest, woodlands, golf courses. <i>Breeding resident in northern Australia. Summer breeding migrant to south east and south west Australia.</i>	✓	x	-
Black-faced Monarch (<i>Monarcha melanopsis</i>)	Rainforests, eucalypt woodlands; coastal scrubs; damp gullies in rainforest, eucalypt forest; more open woodland when migrating. <i>Summer breeding migrant to coastal south east Australia, otherwise uncommon.</i>	x	x	-
Satin Flycatcher (<i>Myiagra cyanoleuca</i>)	Heavily vegetated gullies in forests, taller woodlands, usually above shrub-layer; during migration, coastal forests, woodlands, mangroves, trees in open country, gardens. <i>Breeds mostly south east Australia and Tasmania over warmer months, winters in north east Qld.</i>	x	x	-

COMMON NAME <i>Scientific Name</i>	PREFERRED HABITAT <i>Migratory Breeding</i>	Suitable Habitat Present (✓)	Recorded on Site (✓)	COMMENTS
Rufous Fantail (<i>Rhipidura rufifrons</i>)	Undergrowth of rainforests / wetter eucalypt forests / gullies; monsoon forests, paperbarks, sub-inland and coastal scrubs; mangroves, watercourses; parks, gardens. On migration, farms, streets buildings. Breeding migrant to south east Australia over warmer months. Altitudinal migrant in north east NSW in mountain forests during warmer months.	x	x	-
Great Egret (<i>Ardea alba</i>)	Shallows of rivers, estuaries; tidal mudflats, freshwater wetlands; sewerage ponds, irrigation areas, larger dams, etc. Dispersive; cosmopolitan.	✓	✓	Great Egret was observed foraging along the shallows of Rickabys Creed during survey. No likely nesting areas will be impacted and foraging habitat will remain consistent in the locality, particularly where the species was recorded.
Cattle Egret (<i>Ardea ibis</i>)	Stock paddocks, pastures, croplands, garbage tips, wetlands, tidal mudflats, drains. Breeds in summer in warmer parts of range including NSW.	✓	x	-
Latham's Snipe (<i>Gallinago hardwickii</i>)	Soft wet ground or shallow water with tussocks and other green or dead growth; wet parts of paddocks; seepage below dams; irrigated areas; scrub or open woodland from sea-level to alpine bogs over 2,000m; samphire on saltmarshes; mangrove fringes. Breeds Japan. Regular summer migrant to Australia. Some overwinter.	✓	x	-
Fork-tailed Swift (<i>Apus pacificus</i>)	Aerial: over open country, from semi-arid deserts to coasts, islands; sometimes over forests, cities. Breeds Siberia, Himalayas, east to Japan south east Asia. Summer migrant to east Australia. Mass movements associated with late summer low pressure systems into east Australia. Otherwise uncommon.	✓	x	-



7 Part Test of Significance

A3

Council is required to consider the impact of the proposed facility upon threatened species, populations and / or EECs from any development or activity via the process of a 7 part test of significance. The significance of the assessment is then used to determine the need for a more detailed SIS.

The following 7 part test of significance relies on the ecological assessment provided in Sections 3 and 4 of this report and should be read as such.

Flora and fauna investigations and habitat assessments of the study area have resulted in the identification of suitable habitat for the following threatened species and populations with varying potential to occur. Species recorded or with a considered potential to occur have been noted. The potential for any direct or indirect impacts on these species has also been considered and noted.

Threatened flora

Scientific Name	TSC Act	Potential to occur	Potential Impact
<i>Acacia bynoeana</i>	E1	✓	Direct impact on potential habitat areas – Cumberland Plain Woodland vegetation
<i>Acacia pubescens</i>	V	✓	Direct impact on potential habitat areas – Cumberland Plain Woodland vegetation
<i>Allocasuarina glaireicola</i>	E1	low	Direct impact on potential habitat areas – Cumberland Plain Woodland vegetation, River-flat Eucalypt Forest
<i>Dillwynia tenuifolia</i>	V	✓	Direct impact on potential habitat areas – Cumberland Plain Woodland vegetation
<i>Grevillea juniperina</i> subsp. <i>juniperina</i>	V	✓	Direct impact on potential habitat areas – Cumberland Plain Woodland vegetation
<i>Persoonia nutans</i>	E1	low	Direct impact on potential habitat areas – Cumberland Plain Woodland vegetation
<i>Pimelea spicata</i>	E1	very low	Direct impact on potential habitat areas – Cumberland Plain Woodland vegetation
<i>Pultanea parviflora</i>	E1	low	Direct impact on potential habitat areas – Cumberland Plain Woodland vegetation

Threatened fauna

Common Name	TSC Act	Potential to occur	Potential Impact
East-coast Freetail Bat	V	recorded	Minimal direct impact on foraging areas
Eastern Bentwing-bat	V	recorded	Minimal direct impact on foraging areas
Large-footed Myotis	V	recorded	Minimal direct impact on foraging areas
Greater Broad-nosed Bat	V	recorded	Minimal direct impact on foraging areas
Cumberland Plain Land Snail	E	recorded	None anticipated
Spotted Harrier	V	✓	Direct impact on potential foraging areas
Little Eagle	V	✓	Direct impact on potential foraging areas
Square-tailed Kite	V	✓	None anticipated

Common Name	TSC Act	Potential to occur	Potential Impact
Speckled Warbler	V	✓	Direct impact on potential foraging/nesting areas
Varied Sittella	V	✓	Direct impact on potential foraging areas
Grey-headed Flying-fox	V	✓	None anticipated
Little Lorikeet	V	low	None anticipated
Swift Parrot	E	low	None anticipated
Barking Owl	V	low	None anticipated
Powerful Owl	V	low	None anticipated
Eastern Falsistrelle	V	low	None anticipated
Green and Golden Bell Frog	E	unlikely	None anticipated
Blue-billed Duck	V	unlikely	None anticipated
Freckled Duck	V	unlikely	None anticipated
Black-necked Stork	E	unlikely	Direct impact on potential foraging areas
Australasian Bittern	E	unlikely	None anticipated
Black Bittern	V	unlikely	None anticipated
Black Falcon	V	unlikely	Direct impact on potential foraging areas
Curlew Sandpiper	E	unlikely	None anticipated
Black-chinned Honeyeater	V	unlikely	None anticipated
Regent Honeyeater	E4A	unlikely	None anticipated
Scarlet Robin	V	unlikely	None anticipated
Flame Robin	V	unlikely	None anticipated
Yellow-bellied Sheath-tail-bat	V	unlikely	None anticipated
Macquarie Perch	V (FM Act)	unlikely	None anticipated

Endangered populations

- None for fauna
- *Keraudrenia corrolata* var. *denticulata* in the Hawkesbury Local Government Area

Endangered ecological communities

- Cumberland Plain Woodland
- River-Flat Eucalypt Forest on Coastal Floodplains
- Swamp Oak Floodplain Forest
- Freshwater Wetland on Coastal Floodplains

The 7 part test of significance is as follows:

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

The direct impacts of the proposal within the subject site are considered as:

- Removal of some regrowth woodland EEC (Cumberland Plain Woodland) in the western portion of the study area
- Trampling impacts on remnant and regrowth vegetation for proposed paintball activities in the western and southern portion of the study area
- Direct impacts on potential habitat areas for threatened flora species within Cumberland Plain Woodland vegetation
- Subsequent removal of threatened fauna species foraging habitat
- Disturbance of wading bird and water fowl foraging areas during inundated periods

- Disturbance and dissection of Cumberland Plain Land Snail habitat for provision of a site entry road.

The potential indirect impacts of the proposal from the subject site are considered as:

- Edge effects such as weed incursions into the quality CPW areas
- Reduced cross-site movements by small bird species such as passerines.
- Increased human presence and spill-over effects into adjacent natural habitats.

With consideration to the relative direct and indirect impacts on all threatened species with varying potential to occur, it is considered that the proposal is unlikely to disrupt the life cycle for any of these listed species such that a viable local population would be placed at risk of extinction. Species recorded present during survey, previously recorded nearby or with high potential to occur and requiring further discussion given potential impacts are further discussed in detail below.

Summary of threatened species recorded

No threatened flora species were detected during the survey undertaken. The following threatened fauna were observed however.

Cumberland Plain Land Snail (*Meridolum corneovirens*)

Meridolum corneovirens is wholly restricted to western Sydney and is primarily associated with the Cumberland Plain and Castlereagh Woodland vegetation types (Clark 2009). The species occasionally occurs along the edges of Coastal River Flat Forest, where it meets either of the above forest types. *M. corneovirens* occurs generally in areas characterised by moist soils together with growths of various species of lichen. This species is known to shelter under logs, other debris, and in leaf litter or around the base of trees where exfoliations occur. Where conditions permit it will bury into loose soil especially under logs and around the bases of large trees (Clark (2009).

Spatial autocorrelation analysis indicates that *M. corneovirens* populations are highly structured at very short distances (2 m) and that the radius of a genetic neighbourhood is approximately 350 m (Clark & Richardson 2002).

Searches for *M. corneovirens* throughout the study area during survey found that the quality Cumberland Plain Woodland patches closest to Racecourse Road appear to provide the most suitable habitat areas. This was evident by the higher number of snail shells recorded, the absence of exotic weeds and the absence of exotic snail species. Sometimes *M. corneovirens* may be recorded in disturbed open landscapes near to suitable woodland remnants however exotic snails were found to dominate these areas where the playing field and facilities are proposed. Subsequently no *M. corneovirens* have been recorded within the subject site.

An access to the site off Racecourse Road is required as part of the proposal and this will bisect this habitat strip of CPW. Therefore it is recommended that this access is located where the existing access road and entry gate is provided so that no additional habitat fragmentation occurs. The paving of this access may make passage by snails less suitable, therefore habitat on either side is to be enriched by the placement of logs for additional shelter opportunities. Due to the age of this woodland strip no mature trees or logs currently exist. The placement of logs is to be undertaken under the direction of a fauna ecologist to ensure their suitability.

Provided that the CPW strip along Racecourse Road and the adjacent connective strip are maintained and enriched as habitat for *M. corneovirens* and are not utilised as part of playing fields and ongoing trampling etc, then the proposal is not likely to cause any significant impact on this species.

Large-footed Myotis (*Myotis macropus*)

The Large-footed Myotis inhabits rainforests and open forests predominantly foraging along creeklines and over waterbodies where it takes insects and small fish from on and just below the water's surface (Richards 1995). The Large-footed Myotis roosts in tree hollows, caves, mines, under bridges, in tunnels and occasionally buildings (Richards 1995). This species was recorded foraging over Wyee Creek adjacent to the old pistol club area (Figure 1). The subject site provides suitable roosting, breeding and foraging habitat for this species.

It is considered that the study area provides suitable foraging but low potential roosting or breeding opportunities. Foraging habitat is mostly over open waterbodies present due to the species specialist foraging behaviour and this includes Rickabys Creek and adjacent inlets, wetlands and dams. Roosting and breeding habitat, if present, would be represented only as hollows, as no caves, bridges or other potential artificial roosting structures are present.

Hollows were observed in very low density across the study area with very few small hollows noted. The proposal also does not appear to include any tree removal so there is unlikely any impact on roosting/breeding habitat for this species. Foraging habitat is however present within the most southern playing field area represented by the dam and adjacent overflow areas. The species was recorded foraging at this dam during survey but also at the other Anabat station along Rickabys Creek.

The removal or fencing in of the dam in the playing field area is not likely to cause any excessive removal of foraging habitat given the nearby expansive foraging habitat available along Rickabys Creek as well as other large dams in the locality. Therefore the proposal is not likely to cause a significant impact to this species such that a local population would be placed at risk of extinction.

Greater Broad-nosed Bat (*Scoteanax rueppellii*)

The Greater Broad-nosed Bat inhabits a variety of habitats including moist gullies in mature coastal forest, rainforest, open woodland, *Melaleuca* swamp woodland, wet and dry sclerophyll forests, cleared paddocks with remnant trees and tree lined creeks in open areas (Churchill 2008). The Greater Broad-nosed Bat predominantly forages within open forest, woodlands, along vegetated creeklines and small river systems (Hoye and Richards 1995). This species roost in tree hollows, cracks and fissures in trunks and dead branches, under exfoliating bark as well as the roof of old buildings (Churchill 2008, Hoye & Richards 1995).

The Greater Broad-nosed Bat feeds on large slow flying beetles and moths (Dwyer 1965; Vestjens and Hall 1977). This species is a slow flier and generally hunts for insects over understorey vegetation as well as foraging along the interface of clearings and paddocks with forested areas and along tree-lined creeks (Richards 1988).

It is considered that the study area provides suitable foraging but low potential roosting or breeding opportunities. Foraging habitat is represented throughout the study area but is likely more concentrated along creeks and woodland edges. Roosting and breeding habitat, if present, would be represented only as hollows, as no structures are present.

The proposal does not appear to include any tree removal so there is unlikely any impact on roosting/breeding habitat for this species. The proposal is also unlikely to significantly alter foraging behaviour. Therefore the proposal is not likely to cause a significant impact to this species such that a local population would be placed at risk of extinction.

East-coast Freetail-bat (*Micronomus norfolkensis*)

The East-coast Freetail Bat forages above the canopy of open forests and woodlands and in clearings at forest edges, feeding on small insects (Allison, Hoyer & Law 2008). This species is thought to roost predominantly in tree hollows but also under loose bark and occasionally in houses and outbuildings (Allison, Hoyer & Law 2008). Until recent findings of a roost within mangroves, all known natural roosts had occurred within hollow spouts of large mature eucalypts. The species is often found close to dams and waterholes. The East-coast Freetail Bat species will utilize paddock trees and isolated remnant vegetation when in proximity to larger forest remnants (Allison, Hoyer & Law 2008).

This is a highly mobile species and local habitat would not be exclusive to the subject site. Hoyer et. al (2008) suggest that despite a female recorded 6km from its roost, this species generally forages within a few kilometres of roosts.

PhD student Anna McConville from the University of Newcastle recently has undertaken a more formal and detailed analysis to investigate landscape habitat use by this species. She found that cleared and semi-cleared landscapes were found to have higher activity levels than urban or forested landscapes. Riparian sites were also found to have high activity levels.

It is considered that the study area provides suitable foraging but low potential roosting or breeding opportunities. Foraging habitat is represented throughout the study area. Roosting and breeding habitat, if present, would be represented only as hollows, as no structures are present.

The proposal does not appear to include any tree removal so there is unlikely any impact on roosting/breeding habitat for this species. The proposal is also unlikely to significantly alter foraging behaviour as open foraging areas within the playing fields, if fenced, are otherwise well represented in the local surrounds. Therefore the proposal is not likely to cause a significant impact to this species such that a local population would be placed at risk of extinction.

Eastern Bentwing-bat (*Miniopterus orianae oceanensis*)

The Eastern Bentwing-bat forages above and below the canopy within open forests and woodlands, feeding on small flying insects, predominantly moths (Dwyer 1995). The Eastern Bentwing-bat is known to roost in a range of habitats including stormwater channels, under bridges, occasionally in buildings, old mines and, in particular, caves (Dwyer 1995). Caves are an important resource for this species, particularly for breeding where maternity caves must have suitable temperature, humidity and physical dimensions to permit breeding (Dwyer 1995). Roost sites in tree hollows have not been reported within the literature reviewed.

This species has not been identified as utilising culverts for maternity roosts. Maternity roosts rather are occupied by up to 100 000 females with only 12 maternity roosts known throughout the complete range (Hoyer & Hall 2008).

It is considered that the study area provides suitable foraging habitat but no potential roosting opportunities exist. Foraging habitat is otherwise well represented in the local surrounds. Therefore the proposal is not likely to cause a significant impact to this species such that a local population would 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***

There are no endangered fauna populations within the Hawkesbury LGA.

Keraudrenia corrolata var. *denticulata* in the Hawkesbury Local Government Area - endangered population listing, is the only specific endangered flora populations listing for this LGA.

Keraudrenia corrolata var. *denticulata* has been recorded in tall open forest with *Eucalyptus deanei* in a gully above the floodplain, and on road verges. All occurrences in the Hawkesbury Local Government Area are associated with the endangered River-flat Eucalypt Forest on Coastal Floodplains.

There are collections from Colo River area between Lower Portland and Morans Rock and near Gees Lagoon. Known subpopulations are very small.

The attributes generally required for this species are absent from the site. Whilst River-flat Eucalypt Forest vegetation is present in the eastern and southern portion of the study area, the typical *Eucalyptus deanei* is absent, along with semi-shelteredness of adjacent sandstone areas.

Therefore, it is considered that the action proposed is not likely to have an adverse effect on the life cycle of these species that constitute the endangered populations such that a viable local population of these species is likely to be placed at risk of extinction.

- c) *In the case of a critically endangered or 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***

Four (4) EECs were located onsite, namely;

- Cumberland Plain Woodland
- River-flat Eucalypt Forest on Coastal Floodplains
- Swamp Oak Floodplain Forest
- Freshwater Wetlands on Coastal Floodplains

Cumberland Plain Woodland occurs in the western and northern portions of the study area with a canopy of *Eucalyptus tereticornis* and *Eucalyptus moluccana*. There may be an occasional sub-canopy of *Melaleuca decora* which becomes more prevalent on the lower lying areas that grade into River-flat Eucalypt Forest. The mid-storey has been impacted by previous clearing, previous grazing and weed invasion. Several prickly shrubs such as *Daviesia* and *Bursaria* are present, along with non-prickly shrubs such as *Acacia* and *Dodonaea*.

Much of the remnant Cumberland Plain Woodland is of moderate condition with existing resilience to regenerate. Some young regrowth areas may be classed as low condition under a biometric assessment where the canopy does not meet minimum requirements and the ground layer contains greater than 50% exotic species cover.

The proposal requires removal of regrowth vegetation (generally under 6m tall and with almost 100% shrubs as opposed to Eucalypts) in the western portion of the study area for buildings, however the playing fields do not require vegetation removal. It is expected that the ground layer may be slashed on occasion and that no trees will be required to be removed. The frequency of use will determine the rate of impacts on site which is largely trampling, leading to soil compaction, localised erosion, and a slow decrease in regeneration capacity.

The extent of Cumberland Plain Woodland within the study area that will be fully conserved in the northern portion of the study area which is approximately 6ha, connected directly to an uninterrupted patch of a further 8.5ha. There is small break in the vegetation connectivity to the west for Racecourse Road of approximately 15-20m, by 15m across the race track and by 35m across the power line easement to the north. Vegetation on the other side of these breaks is again Cumberland Plain Woodland.

There is almost no direct removal of vegetation proposed for the site, with the exception of regrowth CPW in the western portion of the study area for proposed buildings / services. The small amount of impacted vegetation by buildings, services, access and fields is very low in comparison to that being retained within the study area and immediately adjacent. As such, the proposal will not likely cause a significant impact upon this community such that its extent is placed at risk of local extinction.

River-flat Eucalypt Forest on Coastal Floodplains (RFEF) is present within the eastern and southern portion of the study area, dominated by *Eucalyptus tereticornis* with very occasional *Angophora floribunda*. There is also a sub-canopy of *Melaleuca decora* throughout a large proportion of this community.

Daviesia species, *Acacia falcata* and *Zornia dyctiocarpa* occur much less frequently within this EEC.

It is highly likely that the majority of this EEC falls within the 1 in 100 year flood line.

Areas of RFEF are present within the proposed playing fields. No direct removal of vegetation is expected or would be limited to providing fencing around each field. Some vegetation will be impacted through trampling which causes some compaction of soil and reduces the ability to regenerate over time.

The impacts of the proposal are small and over a long time period. The removal of grazing activities and understorey management along Rickabys Creek will allow for natural regeneration of this EEC to continue in perpetuity.

As such, the proposal will not likely cause a significant impact upon this community such that its extent is placed at risk of local extinction.

Swamp Oak Floodplain Forest occurs in two (2) small patches amongst the River-flat Eucalypt Forest, again, most likely within the 1 in 100 year flood line. Both patches combined are less than 0.5 ha. One (1) patch is outside of the proposed playing fields therefore it is considered that the likely indirect impacts within this area would be minimum. The other smaller patch is within the playing fields. As there is no proposed clearing of vegetation, the impacts of the proposal are limited to possible trampling and a slow decline of regeneration capacity. It is highly unlikely that the proposal will cause a significant impact upon this community such that its extent is placed at risk of local extinction.

Freshwater Wetlands EEC occurs along the edge of Rickabys Creek on the eastern boundary of the study area and includes pockets of *Phragmites*, *Juncus*, *Ludwigia*, *Bolboschoenus*, *Persicaria*, *Typha* and other aquatic species just off the main creek line that are semi-permanent to permanently inundated. These areas are also likely to be a part of the SREP 20 wetland no. 145. The proposed playing fields are located outside of this EEC complex. It is therefore considered that the proposal is unlikely to have an adverse effect on the extent of this ecological community such that its local occurrence is likely to be placed at risk of extinction.

ii. *Is likely to substantially and adversely modify the composition such that its local occurrence is likely to be placed at risk of extinction,*

The proposed playing fields will not remove vegetation but may see modification over time due to ongoing trampling of vegetation. The degree of modification that could be caused is not quantified but would be expected to affect primary ground and shrub layers. Modification of vegetation within remnant areas will not be undertaken in a deliberate manner such as underscrubbing but more indirectly and over a long time frame through trampling and soil compaction, reducing the ability of the vegetation to regenerate. Given the presence of large extents of vegetation adjacent and within the study area not affected by the proposal, the modification over the long term is small. If the remnant vegetation was maintained in the same manner as the past, the outcome would be similar given that the site may be mown or grazed on occasion, not allowing mid-storey regeneration.

It is unlikely that the proposal will adversely modify the composition of any ecological community such that its local occurrence is likely to be placed at risk of extinction.

d) *In relation to the habitat of threatened species, populations or ecological community:*

It is considered that the habitat attributes of the subject site provide known or potential habitat for *Acacia bynoeana*, *Acacia pubescens*, *Allocasuarina glaireicola*, *Dillwynia tenuifolia*, *Grevillea juniperina* subsp. *juniperina*, *Persoonia nutans*, *Pimelea spicata*, *Pultenaea parviflora*, Cumberland Plain Woodland, River-flat Eucalypt Forest on Coastal Floodplains, Swamp Oak Floodplain Forest, Freshwater Wetlands on Coastal Floodplains, East-coast Freetail Bat, Eastern Bentwing-bat, Large-footed Myotis, Greater Broad-nosed Bat, Cumberland Plain Land Snail, Spotted Harrier, Little Eagle, Square-tailed Kite, Speckled Warbler, Varied Sittella, Grey-headed Flying-fox, Little Lorikeet, Swift Parrot, Barking Owl, Powerful Owl, Eastern Falsistrelle, Green and Golden Bell Frog, Blue-billed Duck, Freckled Duck, Black-necked Stork, Australasian Bittern, Black Bittern, Black Falcon, Curlew Sandpiper, Black-chinned Honeyeater, Regent Honeyeater, Scarlet Robin, Flame Robin, Yellow-bellied Sheath-tail-bat and Macquarie Perch.

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

The subject site is in the vicinity of 19ha. The proposed buildings and playing fields are located upon or surround approximately 6ha of vegetation, the majority of which will remain intact with a reduced viability of future regeneration.

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

The proposal is located predominantly within the existing cleared portions of the study area and will not likely include any tree removal. The proposal will not also likely disturb fauna behaviour to the extent that any of the surrounding quality remnants will become isolated for use.

Therefore, it is considered that known habitat for a threatened species, population or ecological community within the local area and region is unlikely to become isolated or fragmented as a result of the proposal.

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

In respect to threatened fauna species recorded or with potential to occur the proposed area of impact is not likely of high quality, of any breeding importance or central to the home range requirements of any species such that behaviour or ecology of these species will be significantly altered in any way.

All vegetation on site is regrowth as there are few trees with large girths and a lack of hollows.

The proposed playing fields occur in areas where there has been past clearing and disturbances where mid-storey vegetation is limited. Previous management regimes and clearance mean that the potential for threatened species is less than in more natural environs.

No threatened flora species were observed during the botanical survey.

Whilst the proposal covers a relatively large area, the type of impact expected upon vegetation (and consequently EECs) is expected to be minimal with a slow overall degradation over time of vegetation within the playing fields given the lessened opportunities to regenerate.

In consideration of EEC vegetation in a local context, connectivity to adjacent vegetated areas, conservation of portions of vegetation within the northern part of the study area, the proposal is considered suitable in the location. The overall 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 is low.

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

The site has not been identified as critical habitat within the provisions of the TSC Act. Therefore this matter does not require any further consideration at this time.

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

Draft state recovery plans have been prepared for the following threatened species with potential habitat within the subject site:

- Barking Owl (*Ninox connivens*) (NPWS 2003)
- Green and Golden Bell Frog (*Litoria aurea*) (DEC 2005)

Approved state recovery plans have been prepared for the following threatened species with potential habitat within the subject site:

- *Acacia pubescens* (NPWS 2003)
- Koala (*Phascolarctos cinereus*) (DEC 2008)
- Large Forest Owls ((Powerful Owl (*Ninox strenua*), Sooty Owl (*Tyto tenebricosa*) and Masked Owl (*Tyto novaehollandiae*)) (DEC 2006).
- *Persoonia nutans* (DEC 2006)
- *Pimelea spicata* (DEC 2004)
- Cumberland Plain Recovery Plan (DECCW 2010)

It is considered that the proposed development is generally consistent with the objectives or actions of the above-mentioned draft and approved recovery plans.

Vegetation on site is not part of the priority conservation lands which have been mapped under the Cumberland Plain 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.

A key threatening process is defined in the *TSC Act* as a process that threatens, or could threaten, the survival or evolutionary development of species, populations or ecological communities.

The current list of key threatening processes under the *TSC Act*, and whether the proposed activity is recognised as a threatening process, is shown below.

Listed key threatening process (as described in the final determination of the Scientific Committee to list the threatening process)	Is the development or activity proposed of a class of development or activity that is recognised as a threatening process?		
	Likely	Possible	Unlikely
Alteration of habitat following subsidence due to longwall mining			✓
Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands			✓
Anthropogenic Climate Change			✓
Bushrock removal			✓
Clearing of native vegetation	✓		
Competition and habitat degradation by feral goats			✓
Competition and grazing by the feral European Rabbit (<i>Oryctolagus cuniculus</i>)		✓	
Competition from feral honeybees			✓
Death or injury to marine species following capture in shark control programs on ocean beaches			✓
Entanglement in, or ingestion of anthropogenic debris in marine and estuarine environments			✓
Forest Eucalypt dieback associated with over-abundant psyllids and bell miners			✓
High frequency fire resulting in the disruption of life-cycle processes in plants and animals and loss of vegetation structure and composition			✓

Listed key threatening process (as described in the final determination of the Scientific Committee to list the threatening process)	Is the development or activity proposed of a class of development or activity that is recognised as a threatening process?		
	Likely	Possible	Unlikely
Herbivory and environmental degradation caused by feral deer			✓
Importation of red imported fire ants into NSW			✓
Infection by <i>Psittacine circoviral</i> (beak and feather) disease affecting endangered psittacine species and populations			✓
Infection of frogs by amphibian chytrid causing the disease chytridiomycosis			✓
Introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae		✓	
Infection of native plants by <i>Phytophthora cinnamomi</i>		✓	
Introduction of the large earth bumblebee (<i>Bombus terrestris</i>)			✓
Invasion and establishment of exotic vines and scramblers			✓
Invasion and establishment of Scotch Broom (<i>Cytisus scoparius</i>)			✓
Invasion and establishment of the Cane Toad (<i>Bufo marinus</i>)			✓
Invasion, establishment and spread of <i>Lantana camara</i>			✓
Invasion of native plant communities by bitou bush & boneseed <i>Chrysanthemoides monilifera</i>			✓
Invasion of native plant communities by exotic perennial grasses	✓		
Invasion of native plant communities by African Olive (<i>Olea europaea</i> subsp. <i>cuspidata</i>)			✓
Invasion of the Yellow Crazy Ant (<i>Anoplolepis gracilipes</i>)			✓
Loss of Hollow-bearing trees		✓	
Loss and/or degradation of sites used for hill-topping by butterflies			✓
Predation and hybridisation by feral dogs (<i>Canis lupus familiaris</i>)			✓
Predation by the European Red Fox (<i>Vulpes vulpes</i>)		✓	
Predation by the Feral Cat (<i>Felis catus</i>)			✓
Predation by Plague Minnow or Mosquito Fish (<i>Gambusia holbrooki</i>)			✓
Predation by the Ship Rat (<i>Rattus rattus</i>) on Lord Howe Island			✓
Predation, habitat degradation, competition & disease transmission from Feral pigs (<i>Sus scrofa</i>)			✓
Removal of dead wood and dead trees		✓	

The above key threatening processes have been considered in reference to the proposal. It was considered that the proposal may contribute to a small degree to a number these processes as described below. It was not considered that the proposal will have a large or significant impact on any of the following key threatening processes. Some mitigation measures have been listed under each process to minimise or reduce such impacts upon those processes.

Summary of “likely” or “possible” Key Threatening Processes

This section identifies what mitigation measures can be implemented to address threatening processes.

Clearing of native vegetation

A small amount of regrowth woodland may be cleared for the provision of buildings off Racecourse Road. All vegetation removal and/or modification contributes overall to this key threatening process.

A vegetation management plan could benefit the conservation of vegetation within the study area through removal of understorey maintenance and grazing, removal of noxious and environmental weeds, and allowing cleared edges of remnant or regrowth woodland to regenerate.

Competition and grazing by the feral European rabbit

It is expected that the proposed development will increase or decrease the potential for rabbit invasion. Rabbit management and control such as through exclusion fencing, destruction of warrens and target “Pindone” baiting is recommended as a standard protocol.

*Infection of native plants by *Phytophthora cinnamomi**

The proposal may temporarily increase the risk of fungal infection on site as it may be spread via vehicular movement and relocation of soil and vegetation. Consequently standard *Phytophthora cinnamomi* protocol applies to the cleaning of all plant, equipment, hand tools and work boots prior to delivery onsite to ensure that there is no loose soil or vegetation material caught under or on the equipment and within the tread of vehicle tyres. Any equipment found to contain soil or vegetation material is to be cleaned in a quarantined work area or wash station and treated with anti-fungal pesticides.

Introduction and establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae

‘Myrtle Rust’ may be spread via machinery, animals and humans as well as by environmental factors such as wind. The presence of machinery and construction works is likely to slightly increase the potential for spread of this newly listed key threatening process. Similar protocols as to *Phytophthora cinnamomi* should be applied.

Invasion of native plant communities by exotic perennial grasses

The use of ‘paddocks’ for the proposed activities will likely see a reduction in groundcover due to trampling, or favour the growth of exotic grasses such as Kikuyu and Narrow-leafed Carpet Grass.

Loss of hollow-bearing trees

No hollow-bearing trees are expected to be removed or otherwise impacted by the proposal.

Predation by the European red fox

It is expected that the proposed development will provide an opportunity to manage the area with regard to European red fox invasion. European red fox management is encouraged for the retained vegetated areas of the subject site.

Removal of dead wood and dead trees

The proposal may require the removal of deadwood and in this case would be recognised as a threatening process. Threatened fauna species with potential habitat within the subject site and likely dependent on dead wood include Cumberland Plain Land Snail and Green and Golden Bell Frog. Of these species the Cumberland Plain Land Snail has been recorded within the study area but not within the proposed playing fields and the Green and Golden Bell Frog is unlikely to occur within the study area. Any deadwood removed from the playing field area should be relocated into the surrounding Cumberland Plain Woodland areas to supplement quality habitat areas. Given the low quality habitat present within the proposed playing fields, the removal of dead wood is not considered likely to impact on threatened species or the biodiversity of the local area.



National - Significant Impact Criteria

A4

Under the *EPBC Act* an action will require approval from the Australian Government Environment Minister if the action has, will have, or is likely to have, a significant impact on a matter of national environmental significance. The following significant impact criteria were sourced from the *EPBC Act* Policy Statement 1.1 (May 2006):

CRITICALLY ENDANGERED AND ENDANGERED SPECIES

Significant impact criteria

An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

- Lead to a long-term decrease in the size of a population;
- Reduce the area of occupancy of the species;
- Fragment an existing population into two or more populations;
- Adversely affect habitat critical to the survival of a species;
- Disrupt the breeding cycle of a population;
- Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;
- Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat;
- Introduce disease that may cause the species to decline; or
- Interfere with the recovery of the species.

>> What is a population of a species?

A 'population of a species' is defined under the *EPBC Act* as an occurrence of the species in a particular area. In relation to critically endangered, endangered or vulnerable threatened species, occurrences include but are not limited to:

- a geographically distinct regional population, or collection of local populations; or
- a population, or collection of local populations, that occurs within a particular bioregion.

>> What is habitat critical to the survival of a species or ecological community?

'Habitat critical to the survival of a species or ecological community' refers to areas that are necessary:

- For activities such as foraging, breeding, roosting, or dispersal;
- For the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators);
- To maintain genetic diversity and long term evolutionary development; or
- For the reintroduction of populations or recovery of the species or ecological community.

Such habitat may be, but is not limited to: habitat identified in a recovery plan for the species or ecological community as habitat critical for that species or ecological community; and/or

habitat listed on the Register of Critical Habitat maintained by the Minister under the EPBC Act.

VULNERABLE SPECIES

Significant impact criteria

An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:

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

>> What is an important population of a species?

An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- Key source populations either for breeding or dispersal;
- Populations that are necessary for maintaining genetic diversity; and/or
- Populations that are near the limit of the species range.

CRITICALLY ENDANGERED AND ENDANGERED ECOLOGICAL COMMUNITIES

Significant impact criteria

An action is likely to have a significant impact on a critically endangered or endangered ecological community if there is a real chance or possibility that it will:

- Reduce the extent of an ecological community;
- Fragment or increase fragmentation of an ecological community, for example by clearing vegetation for roads or transmission lines;
- Adversely affect habitat critical to the survival of an ecological community;
- Modify or destroy abiotic (non-living) factors (such as water, nutrients, or soil) necessary for an ecological community's survival, including reduction of groundwater levels, or substantial alteration of surface water drainage patterns;
- Cause a substantial change in the species composition of an occurrence of an ecological community, including causing a decline or loss of functionally important species, for example through regular burning or flora or fauna harvesting;
- Cause a substantial reduction in the quality or integrity of an occurrence of an ecological community, including, but not limited to:
 - assisting invasive species, that are harmful to the listed ecological community, to become established; or
 - causing regular mobilisation of fertilisers, herbicides or other chemicals or pollutants into the ecological community which kill or inhibit the growth of species in the ecological community; or
- Interfere with the recovery of an ecological community.

MIGRATORY SPECIES

Significant impact criteria

An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:

- Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species;
- Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species; or
- Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

>> What is important habitat for a migratory species?

An area of 'important habitat' for a migratory species is:

- a) Habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species; and/or
- b) Habitat that is of critical importance to the species at particular life-cycle stages; and/or
- c) Habitat utilised by a migratory species which is at the limit of the species range; and/or
- d) Habitat within an area where the species is declining.

>> What is an ecologically significant proportion?

Listed migratory species cover a broad range of species with different life cycles and population sizes. Therefore, what is an 'ecologically significant proportion' of the population varies with the species (each circumstance will need to be evaluated). Some factors that should be considered include the species' population status, genetic distinctiveness and species specific behavioural patterns (for example, site fidelity and dispersal rates).

>> What is the population of a migratory species?

'Population', in relation to migratory species, means the entire population or any geographically separate part of the population of any species or lower taxon of wild animals, a significant proportion of whose members cyclically and predictably cross one or more national jurisdictional boundaries including Australia.