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APPENDIX 1: RECOVERY PLANS

Approved Recovery Plans under the TSC Act 1995:

As at 15 October 2003.

Species	Common Name
Acacia pubescens	Downy Wattle
Allocasuarina portuensis	
Angiopterus evecta	Giant Fern
Amytornis textilis	Thick-billed Grasswren
Antechinomys laniger	Kultarr
Bertya sp. A Cobar-Coolabah	
Boronia granitica	Granite Boronia
Cercartetus concinnus	Western Pygmy Possum
Cyclopsitta diophthalma coxeni	Coxen's Fig Parrot
Egernia margaretae	Centralian Ranges Rock-skink
Elaeocarpus sp. Rocky Creek	Minyon Quandong
Eleocharis tetraquetra	Square-stem Spikerush
Emydura macquarii	Bellinger River Emydura
Epacris hamiltonii	
Eriocaulon carsonii	Salt Pipewort
Erythrotriorchis radiatus	Red Goshawk
Eulamprus leuraensis	Blue Mountains Water Skink
Gallirallus sylvestris	Lord Howe Island Woodhen
Genoplesium plumosum	
Genoplesium vernale	
Grevillea kennedyana	Flame Spider-flower
Grevillea obtusiflora ssp. *obtusiflora* and *ssp. Fecunda*	
Grevillea wilkinsonii	Tumut Grevillea
Hakea pulvinifera	
Leggadina forresti and *Pseudomys hermannsburgensis*	Forrest's Mouse and Sandy Inland Mouse
Leionema lachnaeoides	
Litoria castanea and *L. piperata*	Yellow-spotted Bell Frog and Peppered Frog
Litoria spenceri	Spotted Tree Frog
Lost Threatened Flora of SE NSW	Lost Threatened Flora of SE NSW
Manorina melanotis	Black-eared Miner
Neobatrachus pictus	Painted Burrowing Frog
Paralucia spinifera	Bathurst Copperwing Butterfly
Pedionomus torquatus	Plains Wanderer
Persoonia mollis ssp *maxima*	
Petaurus australis	Yellow-bellied Glider
Phebalium lachnaeoides (Leionema lach..)	
Placostylus bivaricosus	Lord Howe Island *Placostylus*
Potorus longipes	Long-footed Potoroo
Prostanthera junonis	Somersby Mintbush
Pseudomys apodemoides	Silky Mouse
Pseudomys bolami	Bolam's Mouse
Pseudophryne corroboree	Southern Corroboree Frog
Pterostylis gibbosa	Illawarra Greenhood Orchid
Pterostylis sp. 15 (Botany Bay)	Bearded Greenhood
Thersites mitchelliae	Mitchell's Rainforest Snail
Threatened Alpine Plant Species:	Anemone Buttercup, Feldmark Grass,

Ranunculus anemoneus, Erythranthera pumila, Carex raleghii & Euchiton nitidulus	Raleigh Sedge & Shining Cudweed
Wollemia nobilis	Wollemi Pine
Zeiria adenophora	Araluen Zieria
Zieria formosa,Z. buxijugam,Z. parrisiae	
Zieria lasiocaulis	
Zieria prostrata	

Populations
Warrumbungle Brush-tailed Rock-wallaby Endangered Population
Manly Point population of Little Penguin (*Eudyptula minor)*

Threat Abatement Plans
Predation by *Gambusia holbrooki* – The Plague Minnow
Predation by the Red Fox (*Vulpes vulpes*)

Draft Recovery Plans exhibited under the TSC Act 1995:

As at 15 October 2003.

Species	**Common Name**
Burhinus grallarius	Bush Stone-curlew
Burramys parvus	Mountain Pygmy Possum
Caladenia arenaria	
Caladenia concolor	Crimson Spider Orchid
Davidsonia jerseyana	Davidson's Plum
Eidothea hardeniana	Nightcap Oak
Eucalyptus recurva	Mongarlowe Mallee
Grevillea beadleana	
Grevillea caleyi	
Ninox connivens	Barking Owl
Pedionomus torquatus	Plains-wanderer
Phascolarctos cinereus	Koala
Peophila cincta cincta	Black-throated Finch
Prasophyllum affine	Jervis Bay Leek Orchid
Prasophyllum petilum	Tarengo Leek Orchid
Pseudomys oralis	Hastings River Mouse
Pterodroma leucoptera	Gould's Petrel
Sterna albifrons	Little Tern
Threatened Flora of Rocky Outcrops in South Eastern NSW	
Triplarina nowraensis	Nowra Heath-Myrtle

Populations
Hawkes Nest Tea Garden Endangered Koala Population (*Phascolarctos cinereus*)

Endangered Ecological Communities
Eastern Suburbs Banksia Scrub

Threat Abatement Plans
NIL

* = currently on exhibition

All the above approved and draft recovery plans and threat abatement plans can be viewed on the NPWS WebPage at www.npws.nsw.gov.au or purchased for $8.25 from the NPWS Head Office Information Centre.

Key Threatening Processes under the TSC Act 1995:

As at 15 October 2003

- Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands
- Anthropogenic Climate Change
- Bushrock Removal
- Clearing of Native Vegetation
- Competition and grazing by the feral European Rabbit *Oryctolagus cuniculus*
- Competition from feral honeybees *Apis mellifera*
- High Frequency Fire Resulting in the Disruption of Life Cycle Processes in Plants and Animals and Loss of Vegetation Structure and Composition
- Infection of frogs by amphibian Chytrid casuing the disease Chytridiomycosis
- Infection of native plants by *Phytophthora cinnamomii*
- Infection by Psittacine (beak and feather) disease affecting endangered Psittacine species and populations
- Importation of Red Imported Fire Ants into NSW *Solenopsis invicta*
- Invasion of Native Plant Communities by *Chrysanthemoides monilifera*
- Invasion of native plant communities by exotic perennial grasses
- Loss and/or Degradation of Sites Used for Hill-Topping by Butterflies
- Predation by *Gambusia holbrooki* (Plague Minnow)
- Predation by the European Red Fox *Vulpes vulpes* (Linnaeus, 1758)
- Predation by the Feral Cat *Felis catus* (Linnaeus, 1758)
- Predation from the Ship Rat *Rattus rattus* on Lord Howe Island

These Key Threatening Processes are as described in the final determination of the Scientific Committee to list the key threatening process

Federal administratively approved plans under the repealed *Endangered Species Protection Act 1992* and the current *Environment Protection and Biodiversity Conservation Act 1999*:

The following recovery plans have been prepared in conjunction with the Australian Nature Conservation Agency (ANCA) (now Environment Australia). Under the NSW *Threatened Species Conservation Act 1995*, these plans are considered as working drafts and will go through the process as outlined in the TSC Act.

Species	Common name
Acrophyllum australe	
Allocasuarina defungens	
Allocasuarina glareicola	
Apatophyllum constablei	
Asterolasia elegans	
Cynanchum elegans	White Cynanchum
Elaeocarpus williamsianus	Hairy Quandong
Grevillea iaspicula	Wee Jasper Grevillea
Haloragodendron lucasii	
Kunzea rupestris	
Owenia cepiodora	
Persoonia nutans	
Pimelea spicata	Pink Pimelea
Rutidosis leptorhynchoides	Button Wrinklewort
Thesium australe	Austral Toadflax
Velleia perfoliata	
Zieria involucrata	

APPENDIX 2: SURVEY TECHNIQUES

The following field survey techniques have been developed to capture data on threatened species in a cost-effective manner, and to take into account currently used methods. **They are to be regarded as a minimum requirement under section 4.1 of the DGRs where these species are identified as subject species for the SIS.** Additional survey should be undertaken if it would be necessary to understanding the species distribution and use of the subject site and study area.

Surveys are to be conducted by persons suitably experienced in the location and identification of threatened species in the region, as well as similar species that these may be confused with. Surveyors must also be familiar with the types of habitats in which threatened species occur in the region. Relevant tertiary botanical or fauna or ecological qualifications are preferable but not essential if the above criteria are met.

1. Fauna

1.1 Determining Areas for Survey

An important component of a comprehensive survey is the initial stage of fauna habitat assessment. In situations where is it not possible and/or feasible to survey all areas, fauna habitat assessment is critical to determine the optimal areas to survey.

In this document, the recommended minimum survey effort is usually expressed as a percentage of the potential habitat to be sampled. The extent of the survey area may vary depending on the survey method and/or target fauna species. The sample effort and the extent of the survey area size should take into account the amount of habitat available within the study area.

The following process is recommended for determining preferred habitat and target species:

1) assess the type, extent and quality of faunal habitat in the study area through desktop study and field inspection;
2) review information relating to the occurrence or likely occurrence of fauna species in the study area;
3) select survey sites taking into account the ecological requirements of target fauna species and the outcomes of the fauna habitat assessment (as per Point 1 above) to determine optimal areas for survey.

Each of these stages is discussed in more detail below.

- **Fauna habitat assessment**

Aerial photographs, maps and reports relating to the study area should be reviewed to determine the type, extent and quality of fauna habitat in the study area for each subject species. Field inspections should be undertaken to supplement and verify information derived from the initial desktop assessment.

When assessing habitat quality and suitability, consideration should also be given to the extent, frequency, nature and duration of disturbance factors in the study area such as fire, weed invasion, logging, road construction, mining and grazing. The value of disturbed habitat to individual fauna species should not be discounted; disturbance response is species-specific and depends on the individual habitat requirements of fauna species.

- **Information review**

This stage involves compiling records of protected and threatened fauna that are known or are considered likely to occur within the study area. The information sources identified in Section 3 of the DGRs are to be considered in determining suitable areas for surveying. In addition to these, other sources that should be referenced include:

- local fauna experts;
- local conservation, naturalist and wildlife rescue organisations (e.g. WIRES);
- flora and fauna reports associated with Development Applications, Reviews of Environmental Factors, Environmental Impacts Statements etc.; and
- known geographical distribution and broad habitat requirements of fauna species derived from current fauna references, for example monographs and journal articles.

- **Survey site selection**

The selection of survey sites should be a logical outcome of the preceding two stages and consideration of the preferred habitat of target species. To determine preferred habitat the availability of key habitat resources for individual target fauna species needs to be taken into account, for example, tree hollows, rock outcrops, presence of certain flora species, forest structure and disturbance history. This information can be derived from reference to the following sources:

- NPWS Threatened Species Profiles;
- current NPWS fauna models; and
- current fauna references, for example monographs and journal articles.

By identifying target species and their preferred habitat through the above process, surveys can be designed to focus on these areas as the optimal areas for survey.

The process undertaken to identify target species and optimal areas for survey should be summarised to enable external evaluation.

1.2 Frogs

Surveys for the Wallum Sedge Frog and Wallum Froglet should be undertaken in areas of suitable potential habitat in and adjacent to wetland areas.

- Spotlighting and listening for calls are to be conducted in areas of suitable potential habitat on warm, calm nights, particularly during or following rain.
- Surveys must not be undertaken in cold, windy conditions.
- Call playback is to be employed in conjunction with spotlighting during night surveys. Nights immediately following rainfall are optimal for frog call playback. Calls to be played for two minutes, followed by a five minute listening period. When an observer is unsure of a species' identification, the call responses are to be recorded to allow verification by a person familiar with the call of the target species.
- The Wallum Froglet also calls by day following rain. Listening for calls should be undertaken by day under appropriate weather conditions.
- A tadpole survey must be conducted at any temporarily flooded areas or suitable areas of water for tadpoles to inhabit. Special care must be taken to avoid or minimise impacts to tadpoles and their habitat. Tadpoles must be identified by a suitably experienced person.
- **Minimum survey effort: a minimum of one hour spotlighting and two playback sessions are to be undertaken on two separate nights, and a minimum of two ten minute diurnal call censuses on two separate days are to be undertaken targeting subject frog species in suitable areas of habitat in the study area. Surveys are to be undertaken between October and March.**

1.3 Reptiles

Reptile surveys are to be undertaken for the Stephen's Banded Snake, Pale-headed Snake, White-crowned Snake and the marine turtles. For the snake species:

- A minimum of two hours (diurnal) and two hours (nocturnal) must be spent specifically searching for reptiles. Surveys must be conducted between October and March inclusive. Nocturnal searches must be undertaken on warm, humid nights.
- Moveable shelter sites must be returned to their original position after investigation.
- Nocturnal, foot-based searches must be undertaken on tracks and around potential shelter sites (examination of waterbodies where frogs are active may be productive) for the following species:

i) Stephens Banded Snake: Nocturnal foot based searches of shelter sites, such as rocky outcrops, rock crevices, strangler fig hollows, the rocky edge of waterbodies where frogs are active, and senescent trees. Diurnal searches around shelter sites (such as buttressed trees, strangler figs and senescent trees.

ii) Pale-headed Snake: Nocturnal foot based searches of senescent trees. Examination of arboreal epiphytes and tree hollows on fallen trees. Diurnal searches around shelter sites (including careful removal and replacement of bark on senescent and dead trees).

iii) White-crowned Snake: Searches should comprise diurnal searches of shelter sites, for example lifting rotting logs and rocks partially embedded in soil or litter, and raking through deep leaf litter. Nocturnal foot based spotlighting should be undertaken on warm nights. Dry pitfall trapping should be used as per techniques outlines in Section 1.10. Dropboards (sheets of tin/fibro) can be placed as artificial shelter, left in the field for a minimum of ten nights and checked daily.

For the marine turtles, the assessment should include a survey of people who know and use the area regularly for any records of any of these species nesting on the adjacent beach. People who are to be contacted include: relevant Council officers, DEC officers (rangers and field staff), Marine Park Authority staff (rangers and field staff), NSW Fisheries etc.

1.4 Birds

Diurnal surveys are to be undertaken for the following species: Bush Hen, Brolga, Bush Stone-curlew, Black Bittern, Black-necked Stork, Little Tern, Pied Oystercatcher, Sooty Oystercatcher, Powerful Owl, Barking Owl, Grass Owl, Masked Owl, Sooty Owl, Swift Parrot, Regent Honeyeater, Glossy-Black Cockatoo, Osprey, Square-tailed Kite, White-eared Monarch, Barred Cuckoo-shrike, Collared Kingfisher, Brown Treecreeper, Grey-crowned Babbler, Black-chinned Honeyeater and the Emu population. Specific requirements are identified below.

i) Bush Hen and Bush Stone-curlew: A ground search of the study area is to be conducted. Call playback should be used and random meanders elsewhere in study area. **Minimum of one hour diurnal survey on one day and two minutes of playback each half hour over two hours during one late evening in spring/summer.**

ii) Brolga, Black-necked Stork, Osprey and Black Bittern: Searches of wetland, riparian and grassland areas for birds and nests should be conducted. For the Black Bittern, areas amongst mangroves and she-oaks are to be targeted in particular.

iii) Little Tern, Pied Oystercatcher and Sooty Oystercatcher: The beach area between Dammerels Head and Diggers Point are to be searched, including the foredunes.

iv) Grass Owl: Ground searches for birds and indirect signs in areas of suitable potential habitat. Indirect signs of presence include droppings. Attempts must be made to flush animals from their shelters. Call playback must be undertaken at

dusk. **Minimum effort of 1 hour targeted survey, repeated on 3 separate days in the study area.**

v) Powerful Owl, Barking Owl, Sooty Owl and Masked Owl: Surveying for these species is to include spotlighting (section 1.5), call playback (Section 1.6), searches for pellets (Section 1.9) and searches for nests.

vi) Swift Parrot and Regent Honeyeater: Search of all winter flowering Eucalypt and Banksia plants in the study area. Searches must comprise both visual observation and listening for calls. Searches are to be undertaken mid-afternoon over three days (between May and September inclusive).

vii) Glossy Black Cockatoo: The ground under She-oak *Allocasuarina* spp. should be searched for evidence of chewed cones. Trees with heavy cone crops should be targeted in particular. Listening quietly for soft calls made during feeding, and for the sound of falling seed cones, can also be used to detect the presence of the species. If surveys are undertaken during the breeding season (March to August), adults should be watched in foraging areas and if possible, followed to locate the nest tree.

viii) Osprey and Square-tailed Kite: A visual inspection of all suitable trees is required for nests of Osprey and Square-tailed Kite. Where nests or potential nests of these species are found they should be recorded on an appropriately scaled map, and level of activity and use of the nest determined. Searches are best undertaken during their nesting season: between August and December for the Square-tailed Kite and between March and October for the Osprey.

ix) White-eared Monarch: Early morning searches in potential habitat.

x) Barred Cuckoo-shrike: Searches in potential habitat, including clearings in secondary regrowth, swamp woodlands and timber along watercourses, are to be conducted.

xi) Collared Kingfisher: Searches are to be undertaken in mangroves, along creeklines and in the paperbark vegetation. Searches are to include looking for termite nests, potentially used by the Collared Kingfisher for nesting.

xii) Grey-crowned Babbler, Black-chinned Honeyeater and Brown Treecreeper: Searches in potential habitat are to be undertaken, including areas of open woodland with tall shrubs and a groundcover of grass and forbs. Searches are to involve a combination of visual observation and listening for calls. Searches are to be undertaken early to mid-morning and mid-late afternoon over three days.

xiii) Generally: Random meanders through all habitat types in both the subject site and elsewhere within the study area are required. This survey should include the subject species and will cover the requirements for the Emu population. **Minimum of two hours each morning and afternoon on four days, once in summer and repeated in winter.**

1.5 Mammal and bird spotlight survey

Spotlight surveys are to target the following nocturnally active species: Squirrel Glider, Koala, Yellow-bellied Glider, Glossy-black Cockatoo, Powerful Owl, Sooty Owl, Barking Owl, Masked Owl, Grass Owl, Bush Stone-curlew, Bush Hen, Grey-headed Flying-fox, Black Flying-fox and Common Blossom Bat.

- During a walk spotlight, observers are to walk at approximately one km/hr, allowing intensive listening (for calls and movement) as an adjunct to visual detection.
- Survey must involve two observers using 50 watts spotlights.
- Windy, cold or rainy conditions are to be avoided.

- Optimal time for spotlighting is the initial 6 hours after dark.
- Spotlight surveys are to be conducted in conjunction with call playback for appropriate species. For each targeted species, spotlighting must be conducted within 100 m of a call playback site.
- The reptile species listed in Section 1.3 may be targeted during the spotlight surveys, in addition to the survey requirements discussed in that section.
- For the Common Blossom Bat, Grey-headed Flying-fox and Black Flying-fox searches are to target fruiting and flowering plant species.
- **Minimum survey effort: A minimum of two hours on each of three separate nights (two nights in summer and one outside summer) is to be spent on spotlighting in terrestrial habitats within the subject site. A further two nights are to be spent in the remainder of the study area. Spotlighting may comprise either 4x100m transects or 400 m of random meanders, sampling all relevant habitat types in the study area.**

1.6 Mammal and bird call playback

Call playback shall be used to target the following species: Powerful Owl, Sooty Owl, Barking Owl, Masked Owl, Grass Owl, Bush Stone-curlew, Bush Hen, Glossy Black Cockatoo, Koala, Yellow-bellied Glider and Squirrel Glider.

- An initial listening period of 10 minutes is to be undertaken, then each call to be played for five minutes followed by a listening period of at least five minutes. After the last broadcast call, at least 10 minutes are to be spent listening. Calls are to be played from a good quality portable recorder and amplified through a nine volt megaphone.
- Windy and rainy conditions are to be avoided for bird call playback. Where surveys are undertaken in these adverse conditions it must be noted.
- Call playback for Squirrel Gliders are to be conducted between September and March (inclusive). This method is indicative rather than definitive for the identification of the Squirrel Glider.
- Call playback for Koalas is to be conducted between August and January (inclusive).
- Call playback for Bush Stone-curlew is to be combined with a slow walk to flush birds and to search for nests. A dusk census must precede call playback for this species. In addition to the standard playback, two minutes of playback each half hour over two hours late one evening in spring-summer is to be conducted. Playback should be conducted at 500 m intervals within suitable habitat.
- Call playback for Glossy Black Cockatoo may be more successful during breeding season (March to August).
- **Minimum survey effort: A minimum of two playback sessions (for each target species) on two separate nights is to be undertaken in the study area.**

1.7 Hairtubes

Hairtubes shall be used to target the following species: Brush-tailed Phascogale, Eastern Chestnut Mouse and Common Planigale.

- Hairtube size is to be appropriate for the target species.
- Hairtubes are to be set a minimum of 20m apart in a grid pattern.
- The grid should aim to sample a representative range of suitable habitats.

- Hairtubes are to be baited alternately with a meat bait and a 'vegetarian' (eg. peanut butter, rolled oats and honey) bait.
- For the Brush-tailed Phascogale, hairtubes must be placed in all vegetation types and baited with a meat based product eg chicken wings, "blood and bone", tinned sardines.
- All hair samples must be forwarded to a person suitably experienced in hair analysis.
- **Minimum survey effort: A minimum of four transects with ten hairtubes in each transect should be set within the subject site. At least ten additional hairtubes are to be set in an additional transect within the study area. Hairtubes are to remain set for a minimum of 10 consecutive nights.**

1.8 Mammal trapping

Elliott traps shall be used to target species the following species: Squirrel Glider, Brush-tailed Phascogale, Eastern Chestnut Mouse and Common Planigale.

- Traps are to be baited with baits suitable for the target species eg the traps for the Common Planigale must contain vegetarian baits.
- Traps are to be checked daily, preferably early morning.
- Traps must be set for a minimum of 5 nights.
- Traps should be located to maximise chances of detection, i.e in areas the target species is most likely to frequent. Placement of traps should also aim to maximise coverage within suitable habitat.
- **Traps are to be the appropriate size for detecting the target species and are to include Elliott A, Elliott B and Elliott E, type traps.**
- **Traps are to be set at ground level and in trees within the subject site.**
- **Any modifications to traps are to be documented with details provided of the modification, its purpose and potential limitations to detecting non-target species.**
- Tree mounted Elliott traps (size B) must be used to survey for Brush-tailed Phascogale and Squirrel Glider in potential habitat.
  - Traps are to be located a minimum of 20 m and a maximum of 50 m apart and should be opened for a minimum of 250 trap nights (2 traplines each with 25 traps for five nights).
  - Trapdoors of "B" Elliott traps may need adjustment to ensure animals are not able to pull them open and escape or be injured (incurring tail stripping etc).
  - Traps are to be baited with peanut butter, rolled oats and honey. A diluted honey mixture should be sprayed on trees around mounted traps.
  - Traps are to be set on tree trunks or major branches.
  - Traps for Squirrel Glider are to be located in areas with a diverse tall shrub layer in flower, especially *Banksia* spp.
- Ground-based Elliott trapping must be used to survey for Eastern Chestnut Mouse and Common Planigale in potential habitat.
  - Standard Elliott traps (size A) should be used to sample for small terrestrial mammals and for targeted survey of Eastern Chestnut Mouse *Pseudomys gracilicaudatus*.
  - Elliott traps (size E) are to be used to target the Common Planigale, although pitfall trapping (Section 1.10) is the primary method of detecting this species.
  - Two trap sites should be located per habitat type, preferably in separate vegetation patches.
  - For the Eastern Chestnut Mouse, a minimum of 125 trap nights (25 traps for 5 nights), at a minimum distance of 10m and a maximum distance of 50 m apart.

- For the Common Planigale, a minimum of 125 trap nights (25 traps for 5 nights), at a minimum distance of 10m and a maximum distance of 50 m apart.

1.9 Scat, tracks, diggings and other signs survey

Scat, tracks and diggings surveys shall be used to target the following species: Powerful Owl, Sooty Owl, Barking Owl, Masked Owl, Grass Owl, Emu, Koala, Brush-tailed Phascogale, Yellow-bellied Glider, Eastern Chestnut Mouse and Common Planigale.

- Systematic searches, opportunistic searches (along roads, tracks etc) and searches in the course of undertaking other survey work are to be used to target scats, tracks and diggings of the above species.
- All predator scats and owl pellets are to be collected for analysis to determine prey species. Scats and pellets must be forwarded to a person suitably experienced in their analysis.
- Candidate scats from non-predators, and in particular from small to medium-sized macropods, should be collected and forwarded to a person suitably experienced in their analysis.
- **Minimum survey effort: a minimum of 3 hours should be spent on this survey technique within the subject site and an additional hour in the study area.**

1.10 Pitfall Trapping

Pitfall trapping is to be undertaken for the Common Planigale and the White-crowned Snake. Pitfall trapping is the most reliable technique for detecting the Common Planigale.

- Each pitfall line should contain a minimum of 5 pits, a minimum of 5 m apart, joined by drift fencing.
- At least 1 pitfall line should be placed in each habitat type and in each vegetation patch containing potential habitat for targeted species.
- As a guide, 20 litre buckets with a diameter of 310mm and depth of 405mm should be used as pits.
- Suitable shelter material should be placed in the base of pitfalls.
- If rain is likely during the trapping period, pit traps should be fitted with lids.
- Pits are to be filled in after use.
- Wet pitfalls are not permitted except with the permission of the Animal Care and Ethics Committee.
- **Minimum survey effort: 3 pitfall lines, to remain open for at least four consecutive nights, checked at least daily.**

1.11 Megachiropteran Surveys

1.11.1 Common Blossom Bat survey

- Surveys to be conducted in areas where appropriate food plants are in blossom, eg. *Banksia* spp., *Melaleuca* spp. And *Eucalyptus* spp.
- Surveys must include the use of mist nets.
- This species can be difficult to identify by spotlighting, and although it can be detected using harp traps, the capture rate is usually low.

- **Minimum survey effort: surveys to use at least four 10 m long mist nets opened on at least three moonless nights during winter and spring within the subject site. These should be located between the appropriate food plants and potential roost locations and areas along drainage lines. Nets must be observed while open.**
- **The person undertaking the mist netting must be suitably experienced in the use of the method and hold the appropriate mist netting licence.**

1.11.2 Grey-headed Flying-Fox and Black Flying-fox

The following shall be used to target flying fox species:

- A desktop study is to be undertaken to determine nearest known camp site.
- A diurnal survey is to be undertaken to determine if a flying fox camp site is likely to occur in the study area and the extent of foraging habitat.
- If a camp site is nearby or a significant area of foraging habitat is identified, further surveys are to be conducted in areas where appropriate food plants are in blossom.
- Listen on dusk and evening for calls.
- Spotlighting survey is to be undertaken in areas of potential foraging habitat and suitable habitat.
- These species can be targeted during mammal and bird spotlighting surveys. The location of any animals detected and information on foraging habitat is to be provided.

1.12 Microchiropteran bat surveys

Ultrasonic call recording

The following methodologies are to be undertaken for all microchiropteran bat survey:

- Surveys are to be conducted on fine, calm nights (adverse weather conditions eg. wind, fog, rain and/or low temperatures should be avoided).
- Sites to be spaced throughout the study area and survey different habitats.
- Surveys to be conducted between October and late March.
- In habitat suitable for *Myotis adversus*, ultrasonic call recording should also be conducted for 30 minutes, commencing at dusk.
- **Minimum survey effort: a minimum of one hour of ultrasonic recording (30 minutes immediately following dusk and 30 minutes several hours after dusk) on each of three separate nights (two nights in summer and one night outside summer) should be undertaken in the study area, covering all potential microchiropteran habitat types.**

Harp Trapping

Harp traps shall be set for the microchiropteran bat species.

- Harp traps must be set before dusk.
- Harp traps to be set across creeks and across potential flyways. Supplementary screening (such as branches or hessian) may be used where necessary to increase the chance of trap success.
- Windy, cold and rainy weather conditions should be avoided.
- **Minimum survey effort: a minimum of nine harp trap/nights are to be undertaken in the study area, comprising a minimum of three harp traps for a**

minimum of three nights (two nights in summer and one night outside summer, preferably spring).

Roosting sites

Where threatened bat species are recorded within the development site, a reasonable effort is to be made to identify any roost sites present within the development area. This may be achieved by identification of potential roost sites, and subsequent investigation by either combination stag watching and targeted ultrasonic recording at dusk or examination of accessible caves and basal tree hollows for evidence of bat presence. Roost surveys are to be undertaken between October and late March.

1.13 Koala

The aims of any Koala *P. cinereus* survey should be

- to identify and map Koala habitat;
- to gather information on habitat usage and the status of Koala populations in the study area; and
- to determine the locations of Koala movement corridors likely to be (further) dissected by the proposal, as evidenced by road kills and occurrence of known/potential habitat.

Survey for Koalas *P. cinereus* should include the following components:

- **Information review**

This should include:

i) interviews with adjoining landowners, other local residents, wildlife carers (e.g. WIRES), community groups (e.g. Friends of the Koala), Australian Koala Foundation and local Councils;
ii) obtaining and collating locations of Koala *P. cinereus* road kills, sightings and rescues;
iii) a NPWS Atlas of NSW Wildlife database search; and
iv) a literature review of any relevant studies for the locality including, but not restricted to: Koala Management Plans, Reviews of Environmental Factors, Environmental Impact Statements and university theses and reports.

- **Habitat assessment**

The vegetation of the study area should be mapped to identify habitat that is known to support Koalas *P. cinereus,* or has the potential to support Koalas *P. cinereus*. The flora species utilised by Koalas *P. cinereus* as a food source will vary depending on the location, but may include the following preferred habitat trees which are listed on Schedule 2 of State Environmental Planning Policy #44 'Koala Habitat Protection':

Forest Red Gum	*Eucalyptus tereticornis*
Tallowwood	*E. microcorys*
Scribbly Gum	*E. signata*
Swamp Mahogany	*E. robusta.*

Koalas *P. cinereus* are also known to utilise the following species on the NSW north coast; however, it is unlikely that all the listed species are utilised in all areas in which they occur:

Blackbutt	*E. pilularis*
Flooded Gum	*E. grandis*
Grey Gum	*E. biturbinata*
Grey Ironbark	*E. siderophloia*
Narrow-leaved Red Gum	*E. seeana*
Red Mahogany	*E. resinifera*

Small-fruited Grey Gum	*E. propinqua*
Sydney Bluegum	*E. saligna*
Brush Box	*Lophostemon confertus*
Pink Bloodwood	*Corymbia intermedia*
Spotted Gums	*C. maculata*
	C. henryi
Forest Oak	*Allocasuarina torulosa*
Black Sheoak	*Allocasuarina littoralis*
Broad-leaved Paperbark	*Melaleuca quinquenervia*

(where it fringes Swamp Mahogany *E. robusta* forest)

- **Field survey:**

Field survey within areas of potential habitat should include daytime scat, scratch and sighting searches, night spotlight searches and transects, listening for Koala *P. cinereus* calls and Koala *P. cinereus* call playback. Potential habitat comprises vegetation containing the Koala *P. cinereus* browse species identified for the local area with reference to the previous list, and habitat identified as a result of the information review. All potential Koala *P. cinereus* habitat should be surveyed at least once.

In situations where the information review does not produce historical records of Koalas *P. cinereus* and none of the listed browse species are present, searches for Koalas *P. cinereus* should be incorporated in other general survey techniques, for example, spotlighting, scat searches.

The following methods should be used to assess the presence or absence of Koala *P. cinereus* in potential habitat:

i) A walking transect should be undertaken to assess the presence/absence of Koala *P. cinereus* in potential Koala *P. cinereus* habitat. As a general rule, for each 100 m walked, the leaf litter within approximately 1m of the base of 10 potential browse trees should be searched for Koala scats by one person for a minimum of one minute. In contiguous habitat (defined as >10ha), 5 trees/100m should be surveyed, whereas in habitat patches <10ha in area, 10 trees/100m should be surveyed using a transect line which maximises coverage of the patch.

ii) Where possible, trees selected for inspection should be >30cm dbh.

iii) When a Koala *P. cinereus* is sighted, or Koala *P. cinereus* scats are found beneath a tree, grid references for the tree where the scats were found, or in which the Koala *P. cinereus* was seen, should be recorded and their locations identified on an appropriately scaled map (1:25,000 or better). The type of tree where the scats were found or, in which the Koala *P. cinereus* was seen, should also be recorded.

iv) Further searches of trees in close proximity (within 500m of the sighting) should be undertaken to determine the extent of Koala *P. cinereus* usage of the habitat.

v) Koala *P. cinereus* activity levels can be expressed as a percentage of the total number of trees at the base of which one or more scats were found, multiplied by the total number of trees searched in the study area.

vi) Koala *P. cinereus* call playback should be used during the breeding season (between August and December).

vii) The positive identification of Koala *P. cinereus* scratch marks on trees is problematic, particularly scratches on rough barked species. Nonetheless, potential Koala *P. cinereus* scratch marks should be recorded.

- **Reporting:** Survey methods and effort should be detailed. Areas where field surveys were undertaken, and information derived from field surveys, such as Koala *P. cinereus* records obtained, locations of trees with Koala *P. cinereus* scats and potential and known Koala *P. cinereus* habitat should be detailed on a map of 1:25,000 scale or larger.

  The report should document the outcomes of the information review, habitat assessment and the results of field survey, including radio tracking. An analysis of Koala *P. cinereus* habitat usage in the area should also be included.

1.14 Invertebrates:

The following methodology is to be undertaken for the Australian Fritillary Butterfly:

- A minimum of two hours of targeted survey is to be undertaken in areas on the subject site mapped as containing areas of the larval food plant, *Viola betonicifolia*.
- This survey is to include looking at the leaves of the larval food plant, *Viola betonicifolia*, for eggs, larvae, pupae and butterflies. During all the traverses on the site, adult butterflies are to be searched for.

2. Flora:

2.1 General requirements:

Species that are unfamiliar to the surveyor must be collected and identified or verified by a relevant herbarium (eg. NSW National Herbarium, Coffs Harbour Regional Botanic Gardens Herbarium) or a suitably experienced person. A desktop study using appropriate reference material and 1:25,000 aerial photography should be conducted prior to the field survey to identify and delineate the range of habitats present in the study area.

2.2 Field Methodology

- Targeted surveys are to be undertaken in areas identified as suitable potential habitat for subject species.
- Search effort should be determined by the species:
  - life form (annual, biennial, perennial)
  - distribution within its habitat (ie occurs as scattered individuals or clumps of plants or a continuous spread of plants across the site);
  - potential for small or large population size, if present on site (may be determined by disturbance history eg time since last fire);
  - cryptic nature (ie whether it is large or small, has leaves, can only be seen when flowering etc);
  - likely to occur in each habitat; and
  - habitat and the ease to detect the species in it (eg dense and poor visibility requires greater survey effort and the successional or climax nature of habitat may mean that a species is present in the seedbank but is not extant at the time of the survey).
- Areas of potential habitat in the study area for the subject species are to be identified and mapped for each species.
- A "random meander" search (Cropper 1993; Given 1994) is to be conducted in the study area. The "random meander" search involves traversing the study area in a

random manner, visiting the full range of habitats identified in the desktop review. The meander must cover enough ground area to detect the most cryptic species targeted if present, eg all habitat of the smallest species should be visible and sighted at the completion of the meander. The location/s of the meanders are to be mapped and the time spent recorded.

- Quadrats may be undertaken in addition to the random meander, and if undertaken could also be sufficient for ecological community survey requirements.
- The timing of the threatened flora surveys should take into account flowering periods of the threatened flora species being surveyed.
    - *Zieria prostrata* – Flowering period – Spring
    - *Sophora tomentosa* – Flowering period – Winter
    - *Chamaesyce psammogeton* - Flowering period – thought to be summer
    - *Quassia* sp. *B* (Moonee Creek) - Flowering period – November-December
    - *Phaius australis* - Flowering period – September-October
    - The above species have no particular seasonal requirements for survey although detection of these species and their subsequent identification is considered to simplify validation when specimens used include flowers and fruit/capsules.

Minimum survey effort: a minimum of 10 hours of flora survey must be conducted throughout the study area.

3. Endangered Ecological Communities

- A minimum of 4 quadrats, 20 m x 20 m are to be undertaken in the study area.
- A full floristic composition is to be provided.
- Cover abundance is to be estimated for all plant species recorded.
- Weed invasion is to be recorded both floristic and abundance.

4. Data recording requirements

In addition, to the data requested elsewhere in these Director-Generals requirements, the following information is to be recorded for surveys conducted in the study area.

Data recorded during surveys must be provided on NPWS data recording cards to DEC GIS Division for entry on the NSW Wildlife Atlas, and include information for all fields listed on these cards.

3.1 Fauna and flora surveys

i) Survey technique (eg. spotlight, call playback, random meander, etc and is to include the length and duration).

ii) Date of survey.

iii) Survey location AMG to nearest 100m.

iv) Locality description.

v) Evidence (scratching, sighting, scat etc)

vi) Survey point or transect marked on a 1:25,000 map.

vii) Survey start times and finish times.

viii) Threatened species recorded.

3.2 Fauna survey

i) Observation type, ie. species heard, observed, scat record, track, hair, ultrasonic detection etc. Where the record is based on bat ultrasonic detection, scat or hair record, the reliability of the record is to be provided (eg. definite, probable, possible). Name of person conducting hair or bat ultrasonic analysis.

ii) Call playback surveys: list calls of species played.

iii) Trapping surveys: list any baits used, details of modifications to traps used, any techniques used to encourage and not deter fauna from entering traps etc.

iv) Climate condition (record at commencement of each survey at each site):

a) Temperature.

b) Wind: 0 = calm; 1 = light, leaves rustle; 2 = moderate, moves branches; 3 = strong, impedes progress.

c) Rain: 0 = rain during survey; 1 = evidence of rain in last 24 hours; 2 = no evidence of rain in last 24 hours.

d) Night light: 1 - very dark, no moon + cloud; 2 = dark; quarter moon or moon with heavy cloud; 3 - detail seen, moon and clear sky; 4 = bright, half moon or more and no cloud.

v) microhabitat requirements targeted during survey

3.3 Flora survey

i) Name of person (or herbarium) conducting identification.

ii) Number of individuals of threatened taxa at a site (indicate whether count or estimate).

iii) Size of population (in ha).

iv) Whether taxa is flowering or fruiting.