7 AMELIORATIVE MEASURES

7.1 Description of ameliorative measures

A full description and justification of the measures proposed to mitigate any adverse effect of the action on the species and populations and ecological community including a compilation (in a single section of the statement) of those measures (Section 110 (2)(i) and Section 110 (3) (f)).

7.1.1 Long term management strategies

It has been noted that ongoing negotiations are being conducted between landholders, the RTA and DEC to conserve the majority of land to the east of the proposed alignment. As a result, long-term management strategies will need to take place in that area to ensure that the ecological characteristics therein are preserved for the long-term. Effective management of this area is essential and it appears likely that the land will be administered by the DEC. Such management should focus on the long-term management of the KSSW remnant, as well as the various threatened flora species recorded therein, particularly minimising further incursion into this area by illegal rubbish dumpers and arsonists.

7.1.2 Compensatory strategies

No compensatory strategies are envisaged to be affiliated with the Pelaw Main By-pass proposal (D. Stevenson, NPWS Threatened Species Conservation Officer pers. comm. during site inspection with HSO / RTA / Connell Wagner). However, recommendations outlined in Section 6.3 should be considered in light of the conservation significance of the study area previously identified.

7.1.3 Ongoing monitoring

No ongoing monitoring strategies have been proposed at this stage, although the potential for such is recognised and may be flagged in the future as part of conservation strategies for the remnant patch of KSSW. This should ideally be incorporated into the Recovery Planning process for KSSW.

7.1.4 Translocation

No translocation strategies have been recommended for any of the threatened flora species recorded along the alignment. It is recommended, however, that specimens of *A. bynoeana* that exist along the proposed alignment be available for collection for use in scientific studies (see Section 7.2 ‘Recommendations’).

It has also been recommended (primarily for the Squirrel Glider and threatened Microchiropteran bats) that a suitably qualified ecologist / wildlife consultant or carer be present during any removal of hollow-bearing trees to recover (and relocate) any animals potentially displaced by this removal of roosting / nesting habitat. Any other animals able to be recovered during the recommended pre-clearing surveys for nesting Speckled Warblers should also be relocated to suitable habitat areas.

7.2 Recommendations

The following recommendations have been formulated to minimise potential ecological impacts of the proposed road infrastructure. These include:

- Foremost, the formalisation of the reservation of land to the east of the road alignment as a conservation zone should be realised - predominantly for the protection of KSSW, the associated significant species that occur therein as well as areas of LHSGIF;

- The processes leading to the production of the Kurri Sand Swamp Woodland Recovery Plan (with a timeframe of a draft document completion by early 2006) should be taken into due consideration as the conservation significance of the land to the east of the proposed alignment is of utmost importance to the ongoing preservation and protection of this community;

- Pre-clearing surveys for potential nesting pairs of Speckled Warblers (and other species) should be undertaken along the road alignment and in habitat that will be isolated from the larger remnant (i.e. within the bushland to the west of the proposed alignment);

- Restrictions should be placed on clearing width along the alignment. Particular attention should be paid when in proximity to ecologically significant / sensitive areas such as within KSSW and within / alongside the creeklines;

- The use of an appropriate crossing of the creeklines should occur to protect the environmental sensitivity of these areas and maintain the viability of habitat for the Green-thighed Frog. Similar ecological input into the engineering process could also be of benefit to other ecologically sensitive parameters;

- Implementation of strict erosion, stormwater runoff, water quality and pollution control measures (particularly important as the creekline appears to be highly erodable), in particular to ensure the viability of habitat for the Green-thighed Frog;

- Minimisation of edge effects including rubbish dumping, machinery encroachment, spread of weeds, etc., particularly within proximity to ecologically significant/sensitive areas;

- Erection of nest boxes to compensate for the loss of tree hollows along the alignment (with the re-use of removed hollow limbs where possible);

- An opportunity to investigate the ecology of *Acacia bynoeana* will be available due to the removal of / impact upon a small number of plants along and adjacent to the alignment. It is therefore recommended that consideration be afforded to allowing for the collection and examination of these specimens prior to excavation. In particular, such experiments would gather information on the local reproductive ecology of the species (such as rootstock) and indications of responses to fire, which would be invaluable for effective management of conserved populations;

- Effective management of the proposed retained habitat to the east of the proposed road is paramount to the assessments made within this report. At this stage it

appears likely that much of the land will be administered by the DEC. Such management should focus on the large remnant stand of KSSW and the various threatened flora species recorded therein, particularly minimising further incursion into this area by illegal rubbish dumpers and arsonists;

- Further to the recommendation pertaining to appropriate management of the proposed conserved land to the east of the alignment, it may be appropriate that future ecological studies be undertaken within that area to gain a better understanding of the ecology of the area. Such studies could focus on the characteristics of KSSW, as this would be the largest formal conserved area of the community. More detailed information on the status of *A. bynoeana* could also be gathered, since it is not known to occur within Werakata National Park at the present time. Such ecological surveys would greatly contribute to the effective (informed) management practices recommended above;

- Avoidance of the use of wire-mesh fencing to ensure that the potential for collisions with threatened avifauna is minimised; and

- Fill for the road construction should be sourced locally from nutrient poor soils such as those that occur along the alignment. Nutrient rich soils may encourage the spread and growth of weeds and increase the nutrient content in adjacent vegetation and creekline.

8 ASSESSMENT OF SIGNIFICANCE OF LIKELY EFFECT OF PROPOSED ACTION

Given the findings of the field surveys and subsequent assessments, including application of Section 5A of the *EP&A Act 1979* (Seven Part Tests), discussions of local distribution and abundance, habitat utilisation, conservation status and ameliorative measures for each of the affected threatened species and EEC's, conclusions have been reached regarding the significance of the likely impact of the proposal.

The proposal has the potential to have a number of negative impacts on the threatened species and communities considered, as well as to native flora and fauna species in general. These include removing potential habitat resources for threatened and non-threatened fauna species, increasing habitat fragmentation, alteration of local movement patterns and distribution across the study area, increasing road mortality to moving/migrating individuals from vehicles, increasing entry points/routes for domestic and/or feral animals into the study area and pollution and erosion of waterbodies including changes to hydrological regimes.

It is considered that the foremost impact of the proposed Pelaw Main By-pass is likely to be that upon the KSSW EEC, given that it will dissect the largest known single stand of this community.

However, the following factors should, to an extent, counter the severity of these impacts such that the net impact may not be significant to local flora and fauna such that the long-term viability of biodiversity in the area will be compromised.

- The area through which the alignment passes has experienced anthropogenic disturbances such as clearing, rubbish dumping, track construction (including illegal formations) and altered fire regimes, which have led to a synergistic degradation of the habitats present.

- Any isolation of habitat is not considered to be significant, reducing the larger part of the forested remnant of the study area from 480ha (discounting cleared areas) to 396ha.

- The design of creek crossings should have account for the ecological sensitivity of those areas.

- A favourable conservation outcome should be achieved for a large portion of the study area that exists to the east of the proposed alignment. This area contains the vast majority of ecological attributes that are likely to be affected by the proposed road.

Assessment of Significance of Likely Effect on Threatened Species

Threatened species of most potential concern as a result of the current proposal are considered to be *Acacia bynoeana, Eucalyptus parramattensis* ssp. *decadens*, *Grevillea parviflora* ssp. *parviflora*, Speckled Warbler, Squirrel Glider, Green-thighed Frog, Swift Parrot and Regent Honeyeater, and to a lesser extent Brown Treecreeper, Black-chinned Honeyeater, Grey-crowned Babbler, Powerful Owl and threatened Microchiropteran bat species known from the vicinity. Although the impact to threatened flora species including *A. bynoeana, E. p. decadens* and *G. p*. *parviflora* can be more or less accurately quantified (due

to detailed counts of extant populations), some uncertainty in the impact assessment process persists in regard to the nature and extent of impacts to the remainder of threatened species considered, although assessments of the likely effects are directly related to those assessments previously mentioned. Notwithstanding, the recommendations outlined in Section 7.2 have been made to ensure that the viability of local populations of threatened species is not significantly compromised by the proposal.

In conclusion, this assessment has revealed that the development as proposed has the potential to impact upon three threatened flora species, two listed EEC's, and to a lesser extent, threatened fauna species. It has been determined that the significance of the set of potential impacts upon these ecological characteristics, whilst recognising the importance of the recommendations outlined above, should not be of the magnitude such that any local extinctions or significant compromising of existing ecological attributes would occur. Such a conclusion has given due consideration to achieving conservation outcomes for the majority of remnant ecological attributes within the study area by the formal conservation of land to the east of the alignment for environmental protection.

9 ADDITIONAL INFORMATION

9.1 Qualification and Experience

The relevant qualifications and experience of Harper Somers O'Sullivan ecologists (past and current) involved in the production of this report are included in Appendix I.

9.2 Other approvals required for the development or activity

9.2.1 Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)

The proposal has been included within a referral to the Department of Environment and Heritage (DEH) for assessment under the *EPBC Act 1999* for the wider HEZ project. This referral has been provided to the DEH in form of a Draft 'Public Environment Report (PER)' for the broader HEZ project (Harper Somers O'Sullivan 2006). This PER document was made available for public comment between the 27th February and 24th March 2006.

With regards to the study area, this was due to the presence of, and potential impacts upon, seven (7) matters of National Environmental Significance (NES), namely:

- *Eucalyptus parramattensis* ssp. *decadens* – 'Vulnerable' under the *EP&BC Act 1999;*
- *Eucalyptus glaucina* – 'Vulnerable' under the *EP&BC Act 1999;*
- *Grevillea parviflora* ssp. *parviflora* – 'Vulnerable' under the *EP&BC Act 1999;*
- *Acacia bynoeana* - 'Vulnerable' under the *EP&BC Act 1999;*
- *Lathamus discolor* (Swift Parrot) – 'Endangered' under the *EP&BC Act 1999;*
- *Xanthomyza phrygia* (Regent Honeyeater) – 'Endangered' under the *EP&BC Act 1999;* and
- *Pteropus poliocephalus* (Grey-headed Flying-fox) – 'Vulnerable' under the *EP&BC Act 1999.*

Additional information pertaining to *Rutidosis heterogama* (recorded within the HEZ but not within the study area subject to this SIS) has also been provided within the PER report. Furthermore, the status of *E.* sp. aff. *camfieldii* was also provided due to its close affinities with *E. camfieldii* (Heart-leaved Stringybark), listed as 'Vulnerable' under the *EP&BC Act 1999.*

Specific reference to other potential matters of NES, such as impacts upon listed Migratory Species, has also been included within this assessment report.

9.3 Licensing matters relating to the survey

Surveys were conducted under the following licensing matters:

- NSW NPWS Scientific Licence No. S10300 – Harper Somers O'Sullivan ecologists
- NSW NPWS Scientific Investigation Licence No. A2428 - Michael Roderick
- NSW NPWS Scientific Investigation Licence No. A2698 - Lucas Grenadier
- NSW NPWS Scientific Investigation Licence No. A2092 - Craig Anderson
- NSW NPWS Scientific Investigation Licence No. A2675 - Mark Evans
- Animal Research Authority (01/1142) issued by NSW Agriculture.

9.4 Section 110 (5) reports

All relevant reports and information available from the NPWS / DEC relating to the state-wide conservation status of the listed species, populations and ecological communities have been purchased / accessed in the production of this SIS.

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APPENDIX A: NPWS (DEC) DIRECTOR-GENERAL'S REQUIREMENTS

NSW
NATIONAL
PARKS AND
WILDLIFE
SERVICE
ABN 30 841 387 271

Mr Matt Somers
Director
Hardie Holdings
Level 4
251 Warf Road
NEWCASTLE NSW 2300

Our ref: 01/00478
DGR register

Dear Sir

RE: DIRECTOR-GENERAL'S REQUIREMENTS FOR A SPECIES IMPACT STATEMENT FOR – PROPOSED LINK ROAD HUNTER EMPLOYMENT ZONE

Thank you for your letter of 9th January 2003 requesting the Director-General's requirements for a species impact statement (SIS) for the proposal cited above.

The NPWS understands that this development application is one of a number of applications to be submitted for the construction of infrastructure to service the Hunter Employment Zone (HEZ). The proposed development is adjacent to the HEZ site, on land which supports a similar suite of threatened species and endangered ecological communities. Consequently, the NPWS has referred to results of flora and fauna assessments at the HEZ site in formulating the Director-General's requirements for this development proposal.

The purpose of a SIS is to:

- allow the applicant or proponent to identify threatened species issues and provide appropriate amelioration for adverse impacts resulting from the proposal;
- assist consent and determining authorities in the assessment of a development application under Part 4 or request for Part 5 approval under the *Environmental Planning and Assessment Act 1979* (EP&A Act);
- assist the Director-General of National Parks and Wildlife in deciding whether or not concurrence should be granted for the purposes of Parts 4 or 5 of the EP&A Act;
- assist the Director-General of National Parks and Wildlife or the Minister for the Environment when consulted for the purposes of Parts 4 or 5 of the EP&A Act; and
- assist the Director-General of National Parks and Wildlife in the assessment of Section 91 Licence applications lodged under the TSC Act.

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Definitions

The definitions given below are relevant to these requirements:

development has the same meaning as in the *Environmental Planning and Assessment Act 1979.*
activity has the same meaning as in the *Environmental Planning and Assessment Act 1979.*
proposal is the development, activity or action proposed
subject site means the area directly affected by the proposal.
study area is the subject site and any additional areas which are likely to be affected by the proposal, either directly or indirectly.
locality is the area within a 10 km radius of the subject site.
subject species means those threatened species which are known or considered likely to occur in the study area.

All other definitions are the same as those contained in the TSC Act.

Matters which have been limited or modified

I consider that the following Section 110 matters need not be addressed by your SIS.

- Section 110(2)(e). This section is a replication of Section 110(2)(a).
- Section 110(2)(g) and 110(3)(d). The matters raised in these sections of the TSC Act have been clarified by the requirements below.

I consider that the following Section 110 matters need only be addressed where relevant:

- All reference to threat abatement plans. The *Predation by the Red Fox (Vulpes vulpes)* threat abatement plan may be relevant to this proposal.
- All reference to recovery plans. The draft recovery plan for the Yellow-bellied Glider (*Petaurus australis*), which is currently on public exhibition, is relevant to this proposal. The national recovery plan for the Swift Parrot may also be relevant should the action require approval from the Federal Minister for the Environment under Commonwealth legislation (refer to section 9.2 below).
- All reference to key threatening processes. The following key threatening processes may be relevant to this proposal:
  Clearing of native vegetation (as defined and described in the final determination of the Scientific Committee to list the key threatening process)
  High frequency fire resulting in the disruption of life cycle processes in plants and animals and loss of vegetation structure and composition
  Alteration to the natural flow regimes of rivers and streams and their floodplains and wetlands
  Infection of native plants by *Phytophthora cinnamomi*

Predation by *Gambusia holbrooki* Girard, 1859 (Plague Minnow or Mosquito Fish) (as described in the final determination of the Scientific Committee to list the threatening process)

Competition and grazing by the feral European Rabbit *Oryctolagus cuniculus (L.)*

Predation by the European Red Fox *Vulpes vulpes*

Predation by the Feral Cat *Felis catus*

Additional preliminarily determined key threatening processes which may soon be finally listed and are relevant to this proposal include:

Infection of frogs by amphibian chytrid fungus causing the disease chytridiomycosis

- All reference to critical habitat. There is currently no declared critical habitat in NSW that is relevant to this proposal.

The proponent should be aware that recovery plans may be approved, critical habitat may be declared and key threatening processes may be listed between the issue of these requirements and the granting of consent. If this occurs these additional matters will need to be addressed in the SIS and considered by the consent, determining or concurrence authority.

Matters to be Addressed

The TSC Act provides that the SIS must meet all the matters specified in Sections 109 and 110 of the TSC Act with the exception of those matters limited above. The requirements outlined in Sections 109 and 110 (excluding the matters limited above) have been repeated below (italics) along with the specific Director-General's Requirements for your proposal.

1 Form of the species impact statement

1.1 A species impact statement must be in writing (Section 109 (1))

1.2 A species impact statement must be signed by the principal author of the statement and by:

(a) the applicant for the licence, or

(b) if the species impact statement is prepared for the purposes of the Environmental Planning and Assessment Act 1979, the applicant for development consent or the proponent of the activity proposed to be carried out (as the case requires) Section 109(2))

2. Contextual information

2.1 Description of proposal, subject site and study area

A species impact statement must include a full description of the action proposed, including its nature, extent, location, timing and layout (Section 110 (1))

A full description of the action includes a description of all associated actions, including, but not restricted to: installation and maintenance of utilities, fire

protection zones, access and egress routes; and changes in surface water flows. These actions may occur on or off the subject land.

2.2 Provision of relevant plans and maps

A plan of the subject area, including the scale of the plan. An aerial photograph (preferably colour) of the locality (or reproduction of such a photograph) shall be provided, if possible. This aerial photograph should clearly show the subject site and the scale of the photograph.

A topographic map of the site and immediate surrounds at a scale of 1:25000 should be provided. This map should detail the location of the proposal and location of works on site. The map should also show forested and cleared areas in the immediate area and current activities/usage of this land including rural and agricultural.

A map of the locality, showing any locally significant areas for threatened species such as parks and reserves, and areas of high human activity such as townships, regional centres and major roads will also be provided. The location, size and dimensions of study area shall be provided.

2.3 Land tenure information

Information about the land tenure across the study area. Any limitations to sampling across the study area (eg denied access to private land) shall be noted.

3 Initial assessment

A general description of the threatened species or populations known or likely to be present in the area that is the subject of the action and in any area that is likely to be affected by the action (Section 110 (2)(a))

3.1 Identifying subject species

3.1.1 Assessment of available information

In determining these species (the subject species), consideration shall be given to the habitat types present within the study area, recent records of threatened species or populations in the locality and the known distribution of threatened species.

Databases such as the NPWS Atlas of NSW Wildlife, Australian Museum and Royal Botanic Gardens should be consulted to assist in compiling the list. It should be noted that if the NPWS Atlas is the only database which is referred to, due to data exchange agreements, the data provided by the NPWS will only include that which the NPWS is a custodian for. In many cases this may only be a small subset of the data available. Other databases must also be consulted to create a comprehensive list of subject species.

The following species shall be considered for inclusion in the list of subject species:

Threatened Species

Scientific Name	Common Name	Status
Fauna		
Hamirostra melanosternon	Black-breasted Buzzard	V
Lophoictinia isura	Square-tailed Kite	V
Ninox strenua	Powerful Owl	V
Ninox connivens	Barking Owl	V
Tyto novaehollandiae	Masked Owl	V
Tyto tenebricosa	Sooty Owl	V
Calyptorhynchus lathami	Glossy Black Cockatoo	V
Lathamus discolor	Swift Parrot	E1*
Neophema pulchella	Turquoise Parrot	V
Grantiella picta	Painted Honeyeater	V
Xanthomyza phrygia	Regent Honeyeater	E1*
Clemacteris picumnus victoriae	Brown Treecreeper	V
Melithreptus gularis gularis	Black-chinned Honeyeater	V
Pyrrholaemus sagittata	Speckled Warbler	V
Pomatostomus temporalis temporalis	Grey-crowned Babbler	V
Stagonopleura guttata	Diamond Firetail	V
Petaurus australis	Yellow-bellied Glider	V
Petaurus norfolcensis	Squirrel Glider	V
Dasyurus maculatus	Tiger Quoll	V
Phascolarctos cinereus	Koala	V
Planigale maculata	Common Planigale	V
Chalinolobus dwyeri	Large-eared Pied Bat	V
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V
Miniopterus australis	Little Bent-wing Bat	V
Miniopterus schreibersii	Common Bent-wing Bat	V
Mormopterus norfolkensis	East Coast Freetail Bat	V
Myotis adversus	Large-footed Myotis	V
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	V
Scoteanax rueppellii	Greater Broad-nosed Bat	V
Pteropus poliocephalus	Grey-headed Flying Fox	V*
Litoria aurea	Green and Golden Bell Frog	E1*
Litoria brevipalmata	Green-thighed Frog	V
Hoplocephalus bitorquatus	Pale-headed Snake	V
Hoplocephalus stephensii	Stephens Banded Snake	V
Flora		
Acacia bynoeana		E1*
Callistemon linearifolius		V
Eucalyptus parramattensis subsp. *decadens*		V*
Eucalyptus glaucina		V*
Grevillea parviflora subsp. *parviflora*		V*

Tetratheca juncea	V*

* Indicates species that are listed on the Schedules to the *Environment Protection and Biodiversity Conservation (EPBC) Act* 1999

Endangered populations
None

Endangered ecological communities
Kurri Sand Swamp Woodland
Hunter Lowland Redgum Forest

Regionally significant vegetation communities which occur on the site should also be considered. This includes the Lower Hunter Spotted Gum-Ironbark Forest, which provides important habitat for a number of threatened species and is described in NPWS (2000).

(This list is not exhaustive. One of the roles of a SIS is to determine which species may be utilising a development site given the limitations of existing databases.)

4 Survey

4.1 Requirement to survey

A fauna and flora survey is to be conducted in the study area. Targeted surveys shall be conducted for all subject species determined in accordance with Section 3 above. Previous surveys and assessments may be used to assist in addressing this requirement. Species of taxonomic uncertainty shall be confirmed by a recognised authority such as the Australian Museum or National Herbarium at the Royal Botanic Gardens, Sydney.

4.2 Documentation of survey effort and technique

4.2.1 Description of survey techniques and survey sites

Survey technique(s) should be described and a reference given, where available, outlining the survey technique employed.

Survey site(s) should be identified on a clearly keyed map. The size, orientation and dimensions of quadrat or length of transect should be clearly noted for each type of survey technique undertaken. Full AMG grid references for the survey site(s) should be noted.

4.2.2 Documenting survey effort and results

Attachment 1 provides survey proformas for use by field staff when applying a range of standard fauna survey techniques. Digital copies of these proformas are available by electronic mail. Please contact the nominated contact officer below.

These proformas should be used by field staff when undertaking fauna surveys and completed data sheets are to be included as an appendix to the SIS.

The time invested each time a survey technique is applied shall be summarised in the SIS, based on completed proformas. eg - Number of person hours/transect, duration of call playback, number of nights traps set.

It is not sufficient to aggregate all time spent on all survey techniques. Effort must be expressed each time a survey technique is applied.

Personnel details including name of surveyor(s) and contact phone number. The person who identified records (eg, anabat, hair tubes, scat analysis) should also be identified.

Environmental conditions during the survey should be noted at the commencement of each survey technique.

4.3 Specific survey requirements

In addition to any general surveys carried out to assess the above subject species, specific surveys should be undertaken for the following threatened species. The techniques and timing of these surveys should be commensurate with the biology/ecology of these species in order to maximise the likelihood and accuracy of detection.

Kurri Sand Swamp Woodland and *Eucalyptus parramattensis* subsp. *decadens*

The site for the proposed link road supports the largest remaining intact remnant of Kurri Sand Swamp Woodland. This remnant also retains links with other smaller remnants to the east and north of Kurri Kurri. Preliminary ground truthing of this remnant (Biosis 2001) indicated that the community was in good condition. Further surveys/assessments should be conducted to refine this existing mapping and determine the extent and condition of the community across the site. Ecotonal areas should also be identified and the results mapped and included in the SIS. The distribution and abundance of *E. parramattensis* subsp. *decadens* within this EEC should also be surveyed and the information incorporated into the above mapping.

Grevillea parviflora subsp. *parviflora*

Surveys for this species on adjoining land at the HEZ indicate that it is a common understorey species in two main vegetation communities, Kurri Sand Swamp Woodland and Lower Hunter Spotted Gum-Ironbark Woodland (Harper Somers 2002). Both of these communities occur on the proposed link road site. Consequently, targeted surveys for *G. parviflora subsp. parviflora* are required to determine the distribution/abundance of this species across the site and within the broader study area. These surveys should be undertaken during the main flowering period for the species (between July to December and April to May) when it is most conspicuous and should incorporate areas which represent potential habitat for the species, as described in the draft Threatened Species Information and EIA Guidelines for *Grevillea parviflora* subsp. *parviflora*. Survey methods should be rigorous and the results should be mapped and included

in the SIS. These results should also be discussed in the light of investigations into the rhizomatous nature of this species, which were proposed for plants to be destroyed during the construction of the stage 1 road infrastructure at the HEZ.

Callistemon linearifolius

C. linearifolius is patchily distributed across the adjacent HEZ site, as well as within Werakata National Park. In places, it occurs as a common understorey species within Lower Hunter Spotted Gum Ironbark Forest (Harper Somers 2002). Consequently, targeted surveys should be undertaken for this species in suitable habitat at the link road site to determine its distribution and abundance both along the proposed road route, as well as more generally across the site. The results should be mapped and discussed in relation to the results from the ecological constraints mapping at the HEZ site.

Woodland birds (Brown Treecreeper, Black-chinned Honeyeater, Grey-crowned Babbler, Diamond Firetail and Speckled Warbler)

The adjacent HEZ site provides important foraging and breeding habitat for various species of woodland bird such as the Brown Treecreeper, Grey-crowned Babbler and Black-chinned Honeyeater (Harper Somers 2002, Ecotone 2002). Consequently, targeted surveys should be undertaken at the proposed link road site by an appropriately qualified person/s in suitable habitat, under appropriate conditions and during periods of high bird activity to determine whether any of these species are present and, if so, how the site is being used by these species. Surveys should be undertaken using formal census methods such as sample plot counts described in the CRA vertebrate fauna surveys (NPWS 1997), as well as opportunistic observations. These surveys should incorporate behavioural observations (foraging, breeding, roosting etc.) to obtain information about how these species are using habitat at the site and should be undertaken over 2 seasons. The results of previous survey work can be used, as well as any other recent historical records compiled by local ornithological groups. Sampling times should reflect the nature of the vegetation (the denser the vegetation the longer the sampling times) and the results should be mapped and included in the SIS.

Swift Parrot and Regent Honeyeater

Both of these species are seasonal migrants that move through the area and are known to use similar habitat to that which is present at the link road site. Visual and auditory surveys should be conducted between April and October targeting areas at the site which support winter-flowering eucalypts. Survey techniques should match those discussed above for the woodland birds in relation to sampling times and conditions. Sample plot counts should use the standard 20 minute search per 1 hectare area with the distribution of plots reflecting the nature of the habitat being sampled. These species forage over a large area each day and it may take several visits to the site to record their presence. Individuals within the site, flying overhead and in adjacent areas should be recorded and the abundance of birds present should be reported. The results of any earlier surveys of the site by local ornithological groups and other recent historical records can be used to augment this assessment. Using all of the above information, specific trees that represent important foraging resources for these birds should be identified and the results mapped and included in the SIS.

Green-thighed Frog

The species has been recorded along ephemeral creek lines in the eastern portion of the HEZ site (Harper Somers 2002). These records are very significant, however no specific habitat surveys for Green-thighed Frog were subsequently undertaken across the HEZ site for the stage 1 road infrastructure SIS, so it is unclear how much suitable habitat exists at the HEZ or what proportion of this habitat is protected in Werakata National Park or the 7(b) habitat protection zone. An assessment of the likely extent of Green-thighed Frog habitat across the link road site should be undertaken based on habitat where the species has been recorded at the HEZ, to assess the potential direct and indirect impacts of the proposal on this species. This assessment should also consider the extent of the likely Green-thighed Frog habitat in the broader study area and should refer to the results of ecological constraints mapping at the HEZ site. A catchment map depicting the spatial extent of the known and likely habitat of the Green-thighed Frog in relation to the proposed link road should be prepared and included in the SIS.

5 Assessment of likely impacts on threatened species and populations

Section 5 needs only be addressed if threatened species or endangered populations are likely to be affected.

Assessment of impacts should include the assessment of indirect impacts and those of associated activities, including, but not restricted to: installation and maintenance of utilities, fire protection zones, access and egress routes; and changes in surface water flows. These actions or impacts may occur on or off the subject land.

Assessment of impacts should also include impacts from the provision of fire protection zones. If, as part of the development, there will be a requirement to provide fuel free and/or fuel reduced zones in retained bushland, the impacts of this on any threatened species, populations or endangered ecological communities must be addressed as part of the impacts of the overall proposal. Proponents should also consider recommendations in 'Planning for Bushfire Protection' (PlanningNSW 2002) and consider the use of perimeter roads as an option for providing fuel free zones and reducing impacts on retained vegetation.
From the information provided it would appear that impact on threatened species is likely to particularly arise from:

Direct impacts

The clearing of vegetation associated with the link road proposal will result in:

- further fragmentation of habitat and an incremental decline in its quality and extent;
- disruption of key wildlife corridors and the creation of barriers to faunal movement and plant dispersal;
- loss of state, regionally and locally significant vegetation;
- loss of breeding, roosting and foraging habitat for threatened fauna and a reduction in their local abundance and distribution; and
- increased fauna mortality due to road kills.

Indirect impacts

In the longer term, the development will lead to the further degradation of remnant habitat at the site and the associated loss of threatened species/ecological communities due to:

- changes in the hydrological regime resulting from altered surface flows and groundwater levels;
- deterioration in water quality resulting from stormwater runoff;
- further changes to the natural fire regime;
- increased susceptibility to competition, disease, predation, insect attack and other disturbances due to increased access and a reduction in vegetative cover; and
- cumulative impacts from further development on adjacent lands.

5.1 Assessment of species likely to be affected

An assessment of which threatened species or population known or likely to be present in the area are likely to be affected by the action (Section 110(2)(c))

This requirement is asking you to refine your list of subject species and populations (given the outcome of survey and analysis of likely impacts) in order to identify which threatened species or endangered populations may be affected and the nature of the impact

The remaining requirements in this section need only be addressed for those species which are likely to be affected by the proposal.

5.2 Discussion of local and regional abundance

An estimate for the local and regional abundance of those species or populations (Section 110 (2)(d))

5.2.1 Discussion of other known local populations

A discussion of other known populations in the locality shall be provided. The long term security of other habitats shall be examined as part of this discussion. The relative significance of the subject site for threatened species or endangered population in the locality shall be discussed.

5.2.2 Discussion of habitat utilisation

An estimate of the numbers of individuals utilising the area and how these individuals use the area (eg residents, transients, adults, juveniles, nesting, foraging) and discussion of the significance of these individuals to the viability of the threatened species or endangered population in the locality.

5.2.3 Description of vegetation

The vegetation present within the study area and the area covered by each vegetation community should be mapped and described. Include reference to the

vegetation classification system used (eg Specht). Classification must have regard to both structural and floristic elements.

5.2.2 Discussion of corridors

If movement corridors for threatened species or endangered populations are present within the subject site, the impact of the proposal on these areas shall be discussed.

5.3 Assessment of habitat

A full description of the type, location, size and condition of the habitat (including critical habitat) of those species and populations and details of the distribution and condition of similar habitats in the region (Section 110 (2)(f))

5.3.1 Description of habitat values

Specific habitat features shall be described (eg frequency and location of stags, hollow bearing trees, culverts, rock shelters, rock outcrops, crevices, caves, drainage lines, soaks etc) and the density of understorey vegetation and groundcover.

The condition of the habitat within the study area shall be discussed, including the prevalence of introduced species, species of weeds present and an estimate of the total weed cover as a percentage of each vegetation community, whether trampling or grazing is apparent, effects of erosion, prevalence of rubbish dumping, history of resource extraction or logging and proximity to roads.

Details of the subject site's fire history (eg frequency, time since last fire, intensity) and the source of fire history (eg observation, local records), shall be provided.

5.4 Discussion of conservation status

> *For each species or population likely to be affected, details of its local, regional and State-wide conservation status,...[and]... its habitat requirements ... (Section 110(2)(c))*

Assessment should include reference to the threatening processes which are generally accepted by the scientific community as affecting the species or population and are likely to be caused or exacerbated by the proposal. Assessment should also include reference to any draft recovery plans (See Attachment 2) which may be relevant to the proposal.

5.5 Description of feasible alternatives

> *A description of any feasible alternatives to the action that are likely to be of lesser effect and the reasons justifying the carrying out of the action in the manner proposed, having regard to the biophysical, economic and social*

considerations and the principles of ecologically sustainable development (Section 110(2)(h))

Where a Statement of Environmental Effects, Environmental Impact Statement or Review of Environmental Factors deals with these matters, the SIS may refer to the relevant section of the SEE, EIS or REF.

6 Assessment of likely impacts on endangered ecological communities

Section 6 need only be addressed when endangered ecological communities are likely to be affected.

Assessment of impacts should include the assessment of indirect impacts and those of associated activities, including, but not restricted to: installation and maintenance of utilities, fire protection zones, access and egress routes; and changes in surface water flows. These actions or impacts may occur on or off the subject land.

Assessment of impacts should also include impacts from the provision of fire protection zones. If, as part of the development, there will be a requirement to provide fuel free and/or fuel reduced zones in retained bushland, the impacts of this on any threatened species, populations or endangered ecological communities must be addressed as part of the impacts of the overall proposal. Proponents should also consider recommendations in 'Planning for Bushfire Protection' (PlanningNSW 2002) and consider the use of perimeter roads as an option for providing fuel free zones and reducing impacts on retained vegetation.

From the information provided for the proposed link road development it would appear that impact on endangered ecological communities is likely to particularly arise from:

Direct impacts

The clearing of vegetation associated with the link road will result in:

- the loss of state, regionally and locally significant vegetation;
- the disruption of vegetated corridors and the creation of barriers to plant dispersal; and
- further isolation of an endangered ecological community and a consequent reduction in its long-term viability.

Indirect impacts

In the longer term, the development will lead to the further degradation of an endangered ecological community at the site due to:

- changes in the hydrological regime resulting from altered surface flows and groundwater levels;
- deterioration in water quality resulting from stormwater runoff;
- increased susceptibility to disease, insect attack and other disturbances due to increased access;
- further changes to the natural fire regime;
- cumulative impacts from further development on adjacent lands.

6.1 Assessment of endangered ecological communities likely to be affected

A general description of the ecological communities present in the area that are the subject of the action and in any area that is likely to be affected by the action (Section 110(3)(a))

6.2 Assessment of habitat

A full description of the type, location, size and condition of the habitat of the ecological communities and details of the distribution and condition of similar habitats in the region (Section 110 (3)(c))

6.2.1 Description of disturbance history

If the site shows signs of disturbance, details should be provided of the site's disturbance history and an assessment should be made of the ability of the ecological communities to recover to a pre-disturbance condition

6.2.2 Extent of habitat removal

The location, nature and extent of habitat removal or modification which may result from the proposed action including the cumulative loss of habitat from the study area (including all proposed DAs and those areas in the subject area already with development consent or identified for development) and the impacts of this on the viability of the endangered ecological communities in the locality.

This shall include an assessment of the proportion of the endangered ecological communities to be affected by the proposal, in relation to the total extent of the endangered ecological communities, and the impact of this on the viability of the endangered ecological communities in the locality.

6.3 Discussion of conservation status

For each ecological community present, details of its local, regional and State-wide conservation status...[and]... its habitat requirements...(Section 110(3)(b))

Assessment should include reference to the threatening processes which are generally accepted by the scientific community as affecting the endangered ecological community and are likely to be caused or exacerbated by the proposal. Assessment should also include reference to any draft recovery plans (See Attachment 2) which may be relevant to the proposal.

6.3.1 Significance within a local context

An assessment of the communities on the site in relation to other sites in the study area and in the locality. The tenure and long term security of other localities shall be examined as part of this discussion.

The relative significance of the subject site for the endangered ecological communities shall be discussed. The assessment of the community should be considered in terms of the following features including, the size of the remnant, the quality of the habitat and the level of disturbance on this site in comparison to other sites in the locality.

6.3.2 Discussion of corridor values

The potential of the proposal to increase fragmentation of the community and increase edge effects.

If corridors that allow connectivity between localities of endangered ecological communities are present within the subject site, the impact of the proposal on these areas shall also be discussed.

6.4 Description of feasible alternatives

A description of any feasible alternatives to the action that are likely to be of lesser effect and the reasons justifying the carrying out of the action in the manner proposed having regard to the biophysical, economic and social considerations and the principles of ecologically sustainable development (Section 110(3)(e))

Where a Statement of Environmental Effects, Environmental Impact Statement or Review of Environmental Factors deals with these matters, the SIS may refer to the relevant section of the SEE, EIS or REF.

This condition must include details of the condition and use of other parts of the subject area and why these can or cannot be considered as feasible alternatives.

7 Ameliorative measures

7.1 Description of ameliorative measures

A full description and justification of the measures proposed to mitigate any adverse effect of the action on the species and populations and ecological community including a compilation (in a single section of the statement) of those measures (Section 110 (2)(i) and Section 110 (3)(f))

7.1.1 Long term management strategies

Consideration shall be given to developing long term management strategies to protect areas within the study area which are of particular importance for the threatened species or endangered populations likely to be affected. This may include proposals to restore or improve habitat on site where possible.

7.1.2 Compensatory strategies

Where significant modification of the proposal to minimise impacts on threatened species or endangered communities is not possible then compensatory strategies should be considered. These may include other offsite or local area proposals that contribute to long term conservation of the threatened species, population or endangered ecological community.

Where such proposals involve other lands, or where involvement of community groups is envisaged in such proposals, such groups are to be consulted and proposals should contain evidence of support from these stakeholders and relevant land managers.

Compensatory benefits likely to result from such measures proposed for alternative sites are to be discussed and evaluated along with a discussion of mechanisms of how they might best occur.

7.1.3 Ongoing monitoring

Any proposed pre-construction monitoring plans or on-going monitoring of the effectiveness of the mitigation measures shall be outlined in detail, including the objectives of the monitoring program, method of monitoring, reporting framework, duration and frequency. Generally, ameliorative strategies which have not been proved effective should be undertaken under experimental design conditions and appropriately monitored.

7.1.4 Translocation

The NPWS does not consider that translocation of threatened species, populations and ecological communities is an appropriate ameliorative strategy for the purposes of considering impacts of a particular development/activity. The NPWS strongly supports the view that development proposals which may impact on a significant local population of threatened species, populations or ecological communities as determined by the SIS should aim to:

i. Minimise the impacts by considering all possible alternatives to the development, such that a significant impact is not likely; and
ii. Manage the remaining habitat (if any) to ensure that the local population continues to exist in the long term.

The translocation of threatened species, populations and ecological communities is only supported by the NPWS in specific conservation programs (eg. recovery planning) but only as a last resort, and only when in-situ conservation options have been exhausted. Such programs should only be reconsidered following extensive investigation of a demonstrated long term financial commitment on behalf of the applicant.

8. Assessment of significance of likely effect of proposed action

An eight part test assessment (s5A EP&A Act) is to be provided for each of the affected species (threatened species, populations or ecological communities) identified in the SIS, incorporating relevant information from sections 5.1 to 7 of the SIS. On the basis of these assessments a conclusion is to be provided concerning whether, based on more detailed assessment through the SIS process and consideration of alternatives and/or ameliorative measures proposed in the SIS, the proposal is still considered likely to have a significant effect on threatened species, populations or ecological communities or their habitats.

9 Additional Information

9.1 Qualifications and experience

A species impact statement must include details of the qualifications and experience in threatened species conservation of the person preparing the statement and of any other person who has conducted research or investigations relied on in preparing the statement (Section 110(4))

9.2 Other approvals required for the development or activity

A list of any approvals that must be obtained under any other Act or law before the action may be lawfully carried out, including details of the conditions of any existing approvals that are relevant to the species or population or ecological community (Sections 110(2)(j) and 110(3)(g)))

In providing a list of other approvals the following shall be included

- Where a consent is required under Part 4 of the *Environmental Planning and Assessment Act 1979*, the name of the consent authority and the timing of the development application should be included; or
- Where an approval(s) is required under Part 5 of the *Environmental Planning and Assessment Act 1979*, the name of the determining authority(ies), the basis for the approval and when these approvals are proposed to be obtained should be included.

Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)

An action will require the approval of the Federal Minister for the Environment (in addition to any State or Local Government approval or determination) if that action will have, or is likely to have, a significant impact on a matter of national environmental significance. Threatened species and communities listed in the *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) are considered to be a matter of national environmental significance.

Many of the species and ecological communities listed in the NSW *Threatened Species Conservation Act* 1995 (NSW) are also listed in the Commonwealth EPBC Act. Further information regarding the operation of the EPBC Act

(including Federally listed threatened species and communities) may be obtained from Environment Australia's website www.ea.gov.au or by contacting Environment Australia on 1800 803 772.

9.3 Licensing matters relating to the survey

Persons conducting flora and fauna surveys must have appropriate licences or approvals under relevant legislation. The relevant legislation and associated licences and approvals that may be required are listed below:

National Parks and Wildlife Act 1974:

- General Licence (Section 120) to harm or obtain protected fauna (this may include threatened fauna).
- Licence to pick protected native plants (Section 131).

Threatened Species Conservation Act 1995:

- Licence to harm threatened animal species, and/or pick threatened plants and/or damage the habitat of a threatened species (Section 91).

Animal Research Act 1985:

- Animal Research Authority to undertake fauna surveys.

9.4 Section 110 (5) reports

Section 110(5) of the *Threatened Species Conservation Act 1995* has the effect of requiring the NPWS to provide that information regarding the State-wide conservation status of the subject species as it has available, in order to satisfy ss.110(2)&(3) of the Act. To this end, a number of publications have been produced:

A. The NPWS Biodiversity Management Unit (Biodiversity Research and Management Division) has produced a set of profiles for a number of threatened species, populations and ecological communities and are available on the NPWS website (www.npws.nsw.gov.au). Some of these are relevant to the suggested list of subject species for this development.

B. The Central Directorate Threatened Species Unit has also produced a number of profiles and environmental assessment guidelines for species, populations and ecological communities (Refer to Attachment 3).

- The profiles and/or guidelines listed in attachment 3, along with an LGA by LGA listing of known threatened species within Central Directorate, are also available as a folder for purchase from the Central Directorate Threatened Species Unit for $110. Registration to this folder entitles the owner to periodic updates, including new profiles and EIA guidelines. A copy of the order form for this resource is also attached.

Proponents and consultants should note that the NPWS has no further published information available to satisfy s.110(5) of the Act and that purchase or receipt and use of the above profiles can be taken to have satisfied the requirements of

ss.110(2)&(3) in relation to the State-wide conservation status of the listed species, populations and ecological communities.
Should you require any further information on these requirements please contact Deb Stevenson on 02 9585 6821 or fax 02 9585 6442.

Yours sincerely

18/2/02

Robert Humphries
Manager Threatened Species Unit
Central Directorate
as delegate to the Director-General

References:

Biosis Research (2001) Kurri *Sand Swamp Recovery Assessment.* Unpublished report prepared for the NSW NPWS and the RTA.

Ecotone Ecological Consultants (2002) *Habitat Management Strategy for the development of the Hunter Employment Zone.* Unpublished report prepared for Cessnock City Council.

Harper Somers (2002) *Species Impact Statement for stage 1 road alignment within the Hunter Employment Zone (HEZ).* Unpublished report prepared for HEZ Pty Ltd.

Harper Somers (2002) *Flora and fauna assessment for proposed rail and road infrastructure within the Hunter Employment Zone (HEZ).* Unpublished report prepared for HEZ Pty Ltd.

NSW National Parks & Wildlife Service (2000) *Vegetation survey classification and mapping – Lower Hunter and Central Coast Region.* A report undertaken for the Lower Hunter and Central Coast Regional Environment Management Strategy.

NSW National Parks and Wildlife Service (1997) *Comprehensive Regional Assessments – vertebrate fauna surveys (1996-1997 summer survey season field survey methods)* Unpublished report, NPWS.

cc: Craig Anderson, Harper Somers

APPENDIX B: SEVEN PART TESTS

SEVEN PART TESTS

The features considered for these Seven Part Tests are those threatened ('Endangered' or 'Vulnerable') species or Endangered Ecological Communities that have been indicated in Table 5-2 as having a Moderate or greater likely level of impact as a result of the proposal.

Threatened Flora Species:

Acacia bynoeana	Bynoe's Wattle
Eucalyptus parramattensis ssp. *decadens*	Drooping Red Gum
Grevillea parviflora ssp. *parviflora*	

Threatened Fauna Species:

Litoria brevipalmata	Green-thighed Frog
Climacteris picumnus	Brown Treecreeper
Pomatostomus temporalis	Grey-crowned Babbler
Chthonicola sagittata	Speckled Warbler
Lathamus discolor	Swift Parrot
Ninox strenua	Powerful Owl
Xanthomyza phrygia	Regent Honeyeater
Melithreptus gularis	Black-chinned Honeyeater
Petaurus norfolcensis	Squirrel Glider
Mormopterus norfolkensis	East-coast Freetail-bat
Scoteanax rueppellii	Greater Broad-nosed Bat

Endangered Ecological Communities:

Kurri Sand Swamp Woodland

Lower Hunter Spotted Gum / Ironbark Forest

Freshwater Wetland Complex

CONSIDERATION UNDER SECTION 5A OF THE *EP&A ACT 1979*

Considerations of the effects of the proposed development under the guidelines of Section 5A of the *Environmental Planning and Assessment Act 1979 (EP&A Act 1979)* for the concerned threatened species and ecological community are given below.

For the purposes of the Seven-Part Tests, threatened species have been grouped into 'guilds' (i.e.. species sharing similar habitat or ecological requirements have been grouped and assessed together). The majority of information used for these assessments has been sourced from NSW NPWS Threatened Species Information and Environmental Impact Assessment Guidelines, NPWS Atlas of NSW Wildlife and other published or widely available literature sources such as scientific journals and reports. Detailed descriptions of the ecology of the threatened species / EEC's addressed herein have been provided in Appendix H.

For the purposes of the Environmental Planning and Assessment Act 1979 and, in particular, in the administration of Sections 78A, 79B, 79C, 111 and 112, the following factors have been taken into account in deciding whether there is likely to be a significant effect on threatened species, populations or ecological communities, or their habitats:

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;

Acacia bynoeana

A. bynoeana was recorded from a total of five (5) specimens along the proposed alignment. A further six (6) specimens were recorded within or immediately adjacent to the 25m impact buffer. A further three (3) plants were recorded approximately 10m to the north of the 'impact buffer' in the vicinity of these plants. Therefore, a total of fourteen (14) specimens could be removed / affected by the proposal. It should be noted that a small number of individual plants could potentially occur within the general vicinity of where the specimens were located, although this is estimated to be less than an additional ten (10) individuals.

Populations of *A. bynoeana* have been identified within the Cessnock area, including within the HEZ and neighbouring lands. Populations within the HEZ study area appear to be quite sizeable, with rough estimates (based on previously reported densities; see Bell & Driscoll 2002) of more than 3000 plants (Bell 2004b). Within the Cessnock LGA, further populations have been recorded near Ellalong (south-west of the HEZ Study Area) and Heddon Greta (immediately north-east of the township of Kurri Kurri). The Ellalong population is thought to be well in advance of one hundred (100) individuals (Harper Somers O'Sullivan 2005) whilst the Heddon Greta population size is also likely to be greater than 100 plants (HSO ecologists pers. obs.). More recent fieldwork has also shown that substantially sized stands of this species exist in other parts of the Cessnock LGA, whilst further afield populations have also been recently recorded from near North Rothbury and Yengo National Park (S. Bell pers. comm.).

The Cessnock LGA populations occur in previously undocumented habitat. A regional analysis of all known populations of this species is currently underway, with the aim of identifying suitable habitat for potential new populations in the wider region (Bell & Driscoll in

prog.). The recent finds in KSSW infers that considerable areas of potential habitat exist in the wider Cessnock area. This species has also been recorded within other vegetation types within the locality, such as Yellow Bloodwood Woodland at Ellalong (Harper Somers O'Sullivan 2005). Although this species has not yet been recorded within Werakata National Park, it could be reasonably stated that the species is likely to exist therein, given the amount of potential habitat that exists within the 'Kearsley Sector'.

Within the context of the local population of this species, this is not considered to be a significant number of individuals. However, given the limited distribution and frequency of the species (i.e. it generally does not occur in high frequencies within large parts of its range), the removal of any number of individuals could be regarded as being potentially significant. Notwithstanding, it is considered unlikely that the proposal will have an adverse effect upon the life cycle of this species such that the local population is likely to be placed at risk of extinction, although it could result in extinction on a finer scale (i.e. the stand of plants along and within the immediate vicinity of the alignment).

It should be recognised that an opportunity exists to further investigate the local ecology of this species due to the removal of the small number of plants along and adjacent to the alignment. It is therefore recommended that consideration be afforded to allowing for the collection and examination of these specimens prior to excavation. In particular, such experiments would gather information on the local reproductive ecology of the species (such as rootstock) and indications of responses to fire, which would be invaluable for effective management of conserved populations.

Locally, it appears that this species is unable to tolerate frequent or severe fire events, as evidenced by the lack of burning in each area it was recorded within the study area. As such, any future management of lands to the east of the alignment (earmarked for conservation) should employ appropriate fire management regimes to ensure the protection of populations in that area. Furthermore, targeted studies into the status of the species within the conserved remnant could be undertaken to enable informed decisions to be made for the effectual management of this species in that area.

Eucalyptus parramattensis* ssp. *decadens

E. p. *decadens* was found to occur commonly throughout the study area, largely in association with KSSW. This species was found to be generally restricted to this community (some scattered individuals occur within transitional zones between KSSW and LHSGIF) and is a recognised keystone species of the KSSW assemblage. Ground surveys were undertaken to determine the number of *E. p. decadens* that are likely to be affected by the proposal. These investigations found that approximately 651 individuals will be either removed or directly affected by the proposal. The bulk of these trees were located within the KSSW in the middle section of the proposed road.

Although no population estimates have been made for *E. p. decadens*, the size of the population within the study area is likely to be significant given that 399ha of KSSW exists therein, the majority of which contains, or is dominated by, *E. p. decadens*. As such, the proportional loss of individuals may not be significant given the occurrence of large numbers of the species throughout the remainder of the study area. However, as alluded to within the KSSW assessment, such a large stand of *E. p. decadens* representing an unbroken gene pool resource must be regarded as significant in conservation terms and any level of impact therein should also be regarded as significant.

However, given that conservation agreements will protect the majority of land to the east of the alignment, a favourable conservation outcome will be achieved for this species (given

that much of that land is potential / occupied habitat). Such an outcome could be viewed as potentially offsetting the impacts of the proposed road and would suggest that an adverse effect upon the life cycle of this species such that a viable local population will be placed at risk of extinction is unlikely to occur as a result of the proposal. As suggested for *A. bynoeana,* detailed investigations into the status of the species within the conserved land should be carried out to enable thoroughly informed management of that area pertaining to these species.

Grevillea parviflora* ssp. *parviflora

G. p. *parviflora* was found to occur in abundance as an understorey plant within large sections of the study area. This species was located within each of the three forested communities throughout the study area. It was found at the greatest density within KSSW and LHSGIF, although most consistently within KSSW where it often occurred as a co-dominant low shrub species.

A detailed investigation of the status of this species within the adjacent HEZ study area revealed that a population estimate of 3,331,631 above-ground stems occurred within that area (Harper Somers O'Sullivan 2002b; 2002c). Based on these detailed population estimate investigations, a broad population estimate of 1,239,217 above-ground stems has been determined to exist within the Pelaw Main By-pass study area. Note that the rhizomatous nature of this species may have some influence on the validity of these figures, although for the purposes of proportional estimates and assessment, it is considered sufficient at the present time. Furthermore, field investigations have revealed that *G. p. parviflora* occurs locally at a greater density on the majority of the subject study area than on the HEZ lands (authors pers. obs.) and therefore this figure may actually be a proportional underestimate.

In relation to the impact of removal of vegetation from the road alignment, the number of plants to be directly affected has been estimated to be 16,930 above-ground stems. This figure was generated via ground sampling and counting of individual plants along the entire proposed road alignment. Although lower than a value calculated using population estimates as outlined above, such a figure has resulted due to the noted low density of *G. p. parviflora* in much of the proposed alignment. This represents an approximation of 1.36% of the total population occurring within the study area. Therefore, given the estimated study area population and the proportion likely to be affected, it would be difficult to conclude that the proposed road would result in an adverse effect upon the life cycle of *G. p. parviflora* such that a viable local population will be placed at risk of extinction. As for the other threatened flora species, proper management of the proposed conservation lands to the east of the alignment will need to occur to ensure the viability of populations therein.

What must also be taken into consideration within the above assessment is the current status of the classification of this species in the Cessnock LGA. It is likely that the *G. parviflora* complex (and allied species) requires taxonomic revision (S. Bell; B. Makinson pers. comms.). Evidence suggests that the identification of *G. p. parviflora* in the locality may be problematic due to the possibility of the occurrence of an analogous *Grevillea,* being the *G. humilis* complex. However, a site inspection with Bob Makinson revealed that there is little evidence that *G. humilis* exists in the area, and that all specimens are indeed, *G. p. parviflora.* It is considered more likely that the morphological differences noted between *G. p. parviflora* individuals within the locality may be due to shortcomings in the description of the *parviflora* sub-species (particularly within juvenile specimens), as opposed to influences from other species.

***Litoria brevipalmata* (Green-thighed Frog)**

Potential habitat for *Litoria brevipalmata* (Green-thighed Frog) occurs within the various creeklines that are found throughout the study area. Along the proposed alignment, potential habitat exists within a vegetated creekline in KSSW. Individuals of this species were located in two separate locations / catchments within the HEZ study area (Harper Somers O'Sullivan 2002b). One of these records is from within one of the creeklines that runs through the study area (approximately 1.85km upstream from the north-west corner).

The habitat that is traversed by the road alignment is broadly similar to that within which *L. brevipalmata* was recorded within the HEZ study area, being creeklines containing overland water flowpaths with 'pock-mark' depressions and intermittent pools. It should be noted that each of the creekline crossings have been degraded by vehicle track construction and the existence of the disused railway embankment in the northern-most crossing. It should also be noted that potential habitat for this species exists within the FWC just off the western edge of the alignment, and it has been recognised that this wetland could be affected by the proposal if appropriate runoff strategies are not employed.

The proposal has the potential to have indirect impacts on this species and potentially direct impacts, although direct impacts are not considered likely. These include alterations to the hydrological regimes of streams including changes to local flooding patterns from the construction of culverts, increased runoff (overland flows), pollution from vehicles, loss of riparian vegetation and potential direct loss of individuals during construction. The latter of these impacts is considered unlikely due to the failure to record the species despite numerous visits to these areas of potential habitat during a range of climatic conditions. Potential impacts to known populations within the HEZ study area are also unlikely as the Pelaw Main By-pass alignment occurs downstream of the HEZ study area.

The creekline crossings should be designed to minimise any potential impacts to the species and the creeklines in general. If this occurs, it can be stated that as far as practically viable, the potential impacts to this species from the proposal would have been minimised, although quantifying the net impacts at this stage is difficult to determine. However, having said that, it could be asserted with reasonable confidence that the proposal is unlikely to have an adverse effect upon the life cycle of this species such that any viable local population will be placed at risk of extinction.

***Ninox strenua* (Powerful Owl)**

No direct observations or secondary indications of this species could be noted within the study area. However, individuals of a local population of *N. strenua* may utilise the study area, including habitat along the road alignment, as part of a larger hunting home range. Potential prey species (such as arboreal mammals) were also recorded in the study area. The relatively small amount of vegetation to be removed under the proposal is considered unlikely to significantly disrupt local hunting patterns of any local population and the vast majority of the study area will remain unaffected as a result of the proposed road alignment. Furthermore, similar potential hunting habitat occurs in abundance both locally and on a regional scale.

Only three (3) trees that contain hollows large enough to meet the nesting requirements of this species occur along or in the vicinity of the proposed road alignment. None of these trees displayed any sign of current usage by nesting pairs during fieldwork undertaken within the known breeding season of this species and given the proximity of the hollows to the ground (less than 8m); they may not be suitable in any case.

As such it has been determined that the proposed road alignment is unlikely to have an adverse effect upon the life cycle of this species such that any viable local population will be placed at risk of extinction.

'Woodland Birds' - *Chthonicola sagittata* (Speckled Warbler), *Climacteris picumnus* (Brown Treecreeper), *Melithreptus gularis* (Black-chinned Honeyeater), *Pomatostomus temporalis* (Grey-crowned Babbler)

C. sagittata was recorded within the study area. An individual of this species was observed foraging in the understorey of the LHSGIF along the edge of the railway embankment in the northern end of the study area during the initial surveys (Harper Somers O'Sullivan 2002a). Numerous subsequent targeted searches in the area have failed to locate any further evidence of the species, although given its sedentary habits, it is considered possible that the species utilises the open forest and woodland habitats throughout the study area and surrounding lands.

The amount of habitat to be removed as a result of the proposal is not considered significant in either the context of the habitat extant within the study area nor within the context of habitat that occurs locally or on a regional scale. The proposal would see the direct loss / impact upon 18.7ha of potential habitat for this species. Moreover, the proposal will have the effect of isolating habitat for this species to the west of the road alignment, in effect increasing the fragmentation of the remnant study area. The area to be isolated is approximately 85ha in size and combined with the area to be affected, this reduces the size of the larger forested remnant study area from approximately 480ha (excluding cleared areas) to 396ha. This remnant size figure is considered sufficient to support viable long-term populations of this species.

Previous surveys have recorded *P. temporalis*, *M. gularis* and *C. picumnus* within similar habitat off the south-west corner of the study area (Harper Somers O'Sullivan 2002b). Although not detected during these or earlier surveys, these species are considered likely to occur within the study area at some time. However, for the same reasons outlined previously for *Chthonicola sagittata*, the resultant remnant patch of habitat would be considered sufficient to support long term populations of these species. Therefore, the removal of vegetation and the subsequent isolation of a small area of potential habitat are not considered likely to have an adverse effect upon the life cycle of these species such that any viable local population will be placed at risk of extinction. The proposal must, however, be viewed as contributing to the continual decline of habitat for 'Woodland Bird' species in the locality.

***Lathamus discolor* (Swift Parrot) and *Xanthomyza phrygia* (Regent Honeyeater)**

Neither of these species were recorded during any of the various surveys, despite the existence of flowering trees in the locality at the time of fieldwork. Potential seasonal foraging habitat exists for these species on the study area. *L. discolor* breeds only in Tasmania and no preferred nesting habitat of *X. phrygia* is considered to occur anywhere within the study area.

Although *L. discolor* was not recorded on the study area (including surveys conducted when the species may be present in the region), it has been widely recorded in a number of locations throughout HEZ, with several records within close proximity to the study area, including a record from immediately south of Pelaw Main (in close proximity to the proposed alignment). The species occurrence appears to be associated with the winter-flowering of Eucalypts in the locality. Previous sightings in the broader locality have been of substantial

numbers (100-200 individuals in 2000 and up to 120 individuals during 2005). Potential habitat for this species is largely restricted to the LHSGIF community.

Likewise, although *X. phrygia* was not recorded within the study area (including surveys conducted when the species may be present in the region), it has been recorded in a number of locations throughout HEZ, with several records within close proximity to the study area (including one record from 2005). The species occurrence appears to be associated with the winter-flowering of Eucalypts in the locality and the availability of flowering trees elsewhere (particularly west of the divide). Previous sightings in the broader locality have been of significant numbers (up to 75 individuals in 2000). Potential habitat for this species is largely restricted to the LHSGIF community, although it has been recorded from the ecotone of this community with KSSW (HSO ecologists pers. obs.).

Whilst there is some anecdotal evidence that these species may move through areas of habitat, and even forage when there are no blossoms present (on lerps etc), it is considered that such birds would be purely transitory and that other areas containing ample blossom resources would be favoured by local populations. What can be safely assumed is that the LHSGIF community on the study area represents potential habitat that may be utilised by both of these 'blossom-nomadic' species during seasons within which winter-flowering Eucalypts are in blossom. In terms of foraging habitat, only a small proportion of preferred foraging habitat trees will be affected by the proposal. Only nine (9) mature winter-flowering trees (*Corymbia maculata* and *Eucalyptus agglomerata*) will be removed as a result of the proposal. A further thirteen (13) of these trees are located within the 'impact 'buffer' (although in terms of habitat, these should not be affected to any great extent). Such a level of removal is not considered to be significant in the context of the local distribution of foraging habitat for these species. Nonetheless, the proposal can be seen as incrementally decreasing habitat available for the species within the local area.

In terms of design, it is recommended that the use of any wire-mesh fencing be avoided as part of the proposal as this is known to be a key threat to *L. discolor* via the potential for collisions (Swift Parrot Recovery Team 2001; 2002).

Therefore, given the small amount of foraging habitat to be affected and given the above recommendation, it is considered unlikely that movements by local populations would be affected by the proposal. Likewise it is considered unlikely that the proposal will have an adverse effect upon the life cycle of these species such that any viable local population will be placed at risk of extinction.

***Petaurus norfolcensis* (Squirrel Glider)**

This species was recorded within the study area. A single animal was observed during nocturnal fieldwork undertaken during recent surveys. This animal was located in the south-eastern corner of the study area within the Grey Gum / Scribbly Gum Open Forest. This part of the study area is not proximate to the proposed road alignment. Notwithstanding, potential habitat does exist for this species along the road alignment. However, this is predominantly in the form of foraging habitat, as a relatively small amount of potential nesting habitat occurs. This is due mainly to the young age class of the trees found therein such that only sixteen (16) trees were found to foster hollows suitable for this species (comprising a total of 25 individual hollows).

The removal of foraging habitat under the proposal is not considered to be significant to any local populations of this species due to the abundance of similar, and more suitable, habitat within the Cessnock locality. Furthermore, the proposal will result in the removal / impact upon only a small proportion of the study area and as a result large areas of potential

foraging habitat should remain unaffected throughout the remnant study area. Likewise, an abundance of more suitable nesting habitat will remain unaffected and also occurs commonly in the locality. The removal of trees containing hollows suitable for this species represents only an incremental loss of such habitat both in the context of the study area and within the locality.

However, to ensure that any potential impacts are minimised to as great an extent as possible, it is recommended that a qualified ecologist / wildlife consultant or carer be present during tree removal to recover any potentially displaced animals from felled trees. Furthermore, the loss of suitable nesting hollows should be offset by relocating removed hollows or by installing artificial nest boxes within retained forested habitat within the study area. Given the above recommendations and the unlikelihood of the proposal to remove or isolate a significant amount of foraging or nesting habitat, it is considered feasible that the proposed road is unlikely to have an adverse effect upon the life cycle of this species such that any viable local population will be placed at risk of extinction.

***Mormopterus norfolkensis* (East-coast Freetail-bat) and *Scoteanax rueppellii* (Greater Broad-nosed Bat)**

M. norfolkensis and *S. rueppellii* have generalist requirements in terms of hunting habitat. Suitable hunting habitat exists throughout the entire study area and in abundance within the Cessnock locality. Therefore, the removal of a proportionally small amount of foraging habitat is not likely to disrupt local hunting patterns for any of these species. These species both roost in tree hollows. Thirteen (13) trees containing hollows suitable for these species were located along the proposed route (comprising a total of 24 individual hollows). An abundance of similar habitat occurs within the study area and the removal of these trees is highly unlikely to compromise roosting habitat available either within the study area or the broader locality. However, it is recommended that a suitable qualified ecologist / wildlife consultant or carer be present during felling operations to recover any potentially displaced animals from these trees. Furthermore, it has been recommended that artificial nest boxes be utilised to offset the loss of potential roosting habitat for these species.

It has therefore been determined that the proposal is unlikely to have an adverse effect upon the life cycle of these species such that any viable local populations will 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;

No Endangered Populations considered for this assessment and relevant to this locality have been identified under Part 2 of Schedule 1 of the *TSC Act 1995*.

c) In the case of a critically endangered or endangered ecological community, whether the action proposed:

Kurri Sand Swamp Woodland

(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

KSSW has a very limited distribution, occurring only in the Kurri Kurri / Cessnock area in the Lower Hunter Valley. The patch of KSSW that occurs on the study area is the largest known unbroken patch of the community anywhere (Biosis 2001).

It is considered that the most significant ecological impact of the proposed road is likely to be that upon the KSSW community, particularly due to the significance of the remnant as the largest unbroken stand. The proposed alignment crosses KSSW in two sections, the main crossing being between the two stands of LHSGIF, the other being proximate to John Renshaw Drive.

Within the study area there is approximately 399ha of KSSW. The proposed road construction is likely to require the removal of 6.7ha of KSSW, representing 1.7% of KSSW extant on the study area.

The total known extent of this community is only 2385 hectares (NPWS 2000a; House 2003). In the context of the total known distribution of KSSW the area to be removed is 0.28% of the total known area. Of the total known area of 2385ha, 435ha is conserved in the Werakata National Park section that is contained within the bounds of the HEZ study area (Bell 2004b). A further 97.5ha is conserved within the remaining two portions of this reserve (NPWS 2000; House 2003). Therefore, a total of 532.5ha exists in Werakata National Park. This represents 22.45% of the total known distribution of this community. A further 231.4ha occurs within 7(b) Habitat Protection Zone within the HEZ study area. This brings the amount of KSSW contained in reserve areas to 763.9ha (approximately 32% of the total known area), the remainder primarily being located on private or crown lands (such as that found on the subject study area).

With the future addition of proposed conservation lands to the east of the road alignment, which is likely to be in the order of 230-300ha (depending on results of negotiations), of which the vast majority is KSSW, over 1000ha of this community may exist within conservation reserves. This would bring the total amount reserved to over 42% of the total known area (with a best-case scenario of around 46%).

In terms of the amount of KSSW that will be removed / affected with regards to both the study area patch size and total known area, such levels of removal / impact may not be regarded as being significant. However, as the stand of KSSW on the study area is the largest remaining patch of the community anywhere, it must be recognised as being of high conservation value. Therefore, even though the levels of removal / impact may not be regarded as being proportionally significant, any such impacts upon an area of high conservation value for an EEC should be regarded as having an adverse impact upon the extent of this Endangered Ecological Community. However, it is not considered that this impact will result in the local occurrence of KSSW to being placed at risk of extinction within the locality.

Conservation agreements are likely to protect the majority of land to the east of the alignment and as such a highly favourable conservation outcome would be achieved for this

community, given that it would constitute the largest unbroken stand of KSSW in a conservation reserve. Such an outcome could be viewed as potentially offsetting the impacts of the proposed road upon the community, given that appropriate management of that area occurs.

(ii) Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction;

Whilst 6.7ha will be removed for the road construction it is likely that a further 6.6ha is considered likely to be modified by the proposed road via edge effects and other indirect impacts. As a result, 13.3ha of KSSW will be affected by the proposal, comprising 3.3% of the total KSSW on the study area. These edge effects may include rubbish dumping and sediment runoff from the road easement. Whilst these edge effects can be detrimental to the immediate area surrounding the road, it is considered that it is unlikely to substantially and or adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction. However, it must be viewed as contributing to the overall decline of the community as a whole.

Lower Hunter Spotted Gum / Ironbark Forest

(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

The alignment dissects the southernmost stand of LHSGIF along a 470m length. A very small section in the north (proximate to the cleared area near John Renshaw Drive) will be traversed, being less than 40m in length.

Approximately 67.2ha occurs within the study area, distributed between two disjunct sections. There is likely to be a direct loss of 2.4ha of LHSGIF, representing 3.6% of this community extant on the study area.

Within the HEZ study area, a total of approximately 1,840ha of this vegetation community has been mapped by Bell (2004b). Of this, approximately 1,105ha (i.e. 60% of occurrence) occurs within zones created and managed for conservation purposes i.e 7(b) 'Habitat Protection' and Werakata National Park. A further 68ha (3.7% of occurrence) is also currently reserved within the DEC Deferred Conservation Areas.

In the context of the total known distribution of LHSGIF (32266ha, using estimates provided by LHCCREMS mapping), the area to be removed is 0.0074% of the total known area whilst the area to be affected represents 0.017% of the total known area. Whilst the LHCCREMS figure is certainly erroneous, the proportions of areas to be removed are likely to be very similar and is indicative of the large size of the extant remaining community.

In conclusion, considering that approximately 96 % of LHSGIF extent within the study area is to be retained and over 60% of this community's extent is conserved within Werakata National Park and habitat corridors within the HEZ study area, it is considered that the proposal is unlikely to have an adverse effect upon the extent of LHSGIF such that its local occurrence is likely to be placed at risk of extinction.

It should be noted that a conservation outcome for this will be achieved within the land to the east of the alignment, although in the context of the distribution of the community, the level of reservation is not regarded as significant.

(ii) Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction;

Approximately 2.4ha of LHSGIF will be removed for the proposal with a further 3.0ha is considered likely to be affected by the proposed road via edge effects and other indirect impacts. As a result, 5.4ha of LHSGIF will be affected by the proposal, comprising 8.0% of the total on the study area. The LHSGIF within the study area is distributed between two disjunct sections. These two stands, and in particular the southern stand, are considered to be quite degraded examples of LHSGIF. In particular, it appears that rubbish dumping and frequent fire events have contributed to the advanced levels of degradation. Both of these factors were particularly evident in the southern stand, which appears to have burnt several times over the past few fire seasons and where continuous illegal dumping appears to occur. Track construction and past clearing have also been factors in their disturbance. It is likely that proximity to settled areas accounts for the high level of these disturbances. In general, it is asserted that this community exists within the study area in a relatively high state of degradation.

It is considered due to the disturbed nature of this vegetation community and the retention of over 96% of LHSGIF within the study area, the proposal is unlikely to substantially modify the composition of LHSGIF such that its local occurrence is likely to be placed as risk of extinction.

Freshwater Wetland Complex

(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

No areas of this community will be removed under the proposal. Therefore, it is considered that the proposal is unlikely to have an adverse effect upon the extent of this EEC such that its local occurrence is likely to be placed at risk of extinction.

(ii) Is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction;

The proposal will not modify the composition of Freshwater Wetland directly but, it is noted that the road passes within close proxmity to the wetland, some edge effects may occur. As such, appropriate management techniques should be employed to minimise the likelihood and severity of such potential impacts. This is particularly important during the construction phase, where soil stability adjacent or upstream of the wetland is likely to be the least secure. If the aforementioned recommendations are undertaken, it is unlikely that the proposal will have an adversely modify the composition of this wetland such that its local occurrence is likely to be placed at risk of extinction.

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

Endangered Ecological Communities

Kurri Sand Swamp Woodland

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

The current proposal will require the removal approximately 6.7ha of KSSW with modification of approximately 6.6ha due to edge effects within the road easement.

(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:

The proposal will also result in the isolation of KSSW that will remain post road construction. Primarily, this would occur between the proposed road alignment and the township of Pelaw Main to the west. Approximately 39ha of KSSW would be isolated from the remainder of KSSW in the study area by the proposed road. This represents 9.3% of the total amount of KSSW found within the study area.

(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

The area of KSSW, which may be isolated from the remainder of KSSW, suffers from edge effects associated with a history of human settlement within Pelaw Main. This area was found to contain several discarded vehicles and illegally dumped rubbish. Many of the vehicles have been burnt out and evidence of an unusually high fire frequency is apparent in this area (such as via the dominance of Blady Grass within the groundcover layer). Several cleared patches and a small wetland area also exists.

The proposal is likely to exacerbate this degradation. However, given the present state of the KSSW in that area, further degradation of this patch is unlikely to be at the significant detriment to the study area patch of KSSW. The habitat to be removed / modified / fragmented can therefore be considered as not important to the long-term survival of the KSSW in the locality.

It is reiterated however, that until the conservation status of the community on the remainder of the study area (being the land to the east of the alignment) can be ascertained, any further degradation of any part of the study area stand of KSSW must be regarded as detracting from the long term and ongoing viability of the community.

Lower Hunter Spotted Gum / Ironbark Forest

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

The proposed road will require removal of 2.4ha of LHSGIF with a further 3.0ha considered likely to be modified by the proposed road via edge effects and other indirect impacts. As a result, 5.4ha of LHSGIF will be affected by the proposal, comprising 8.0% of the total on the study area.

(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:

The proposal will also result in the isolation of LHSGIF that will remain post road construction. Primarily this will result from the dissection of the southern stand of this community along Leggett's Drive. The majority of the remnant community will be situated within land to the west of the proposed road, with approximately 17.1ha being isolated from this to the east of the road. As a result, this land will be subject to the numerous pressures that are currently experienced therein. However, in the context of the overall distribution of the community and the fact that such pressures are unlikely to be exacerbated, such isolation is not considered to be of significance to the status of the community.

(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:

The LHSGIF within the study area is considered to be of relatively poor quality due to rubbish dumping, frequent fire events, track construction and past clearing have all contributed to the current degraded condition of LHSGIF. In general, it is asserted that this community exists within the study area in a relatively high state of degradation. Given the small area to be removed / modified, the poor quality of habitat and large areas (over 1,000 ha) of higher quality habitat within the adjoining HEZ study area of LHSGIF that will be conserved within secure conservation areas it is considered that the habitat to be removed / modified can therefore be considered as not important to the long-term survival of LHSGIF in the locality.

Freshwater Wetland Complex

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

The proposal will not require the removal of any vegetation within this community, but it is considered that there is the possibility that the Freshwater Wetland Complex may be modified as the road crosses creeks which feed this wetland and water quality regimes are recommended. The extent to which these modifications could potentially occur is difficult to predict.

(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:

No isolation of this community will occur as a result of the proposal, although as the proposed road crosses creeks that feed this wetland, strict water quality regimes will need to be emplaced.

(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:

No habitat will be removed, fragmented or isolated as a result of the proposed road construction, although it may be modified by sediment and nutrient runoff from upstream where the road crosses the creeks that feed this wetland complex. Should appropriate water quality procedures be followed, the impact upon the long-term survival of this wetland will be minimised. Therefore, it is considered that the importance of the habitat to be modified is low.

Acacia bynoeana

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

There is likely to be a loss of 6.7ha of habitat for *Acacia bynoeana* (KSSW), representing 1.7% of KSSW extant on the study area. A further 6.6ha is considered likely to be affected by the proposed road via edge effects and other indirect impacts. As a result, 13.3ha of KSSW will be affected by the proposal, comprising 3.3% of the total habitat (KSSW) on the study area.

(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:

A. bynoeana is restricted to the KSSW community within the study area. The proposal will also result in the isolation of KSSW that will remain post road construction. Primarily, this would occur between the proposed road alignment and the township of Pelaw Main to the west. Approximately 39ha of KSSW would be isolated from the remainder of KSSW in the study area by the proposed road. This represents 9.3% of the total amount of KSSW found within the study area. In terms of counts of individual *Acacia bynoeana* a total of five (5) specimens will be removed as a result of the proposed road alignment. A further six (6) specimens were recorded within or immediately adjacent to the 25m impact buffer. A further three (3) plants were recorded approximately 10m to the north of the 'impact buffer' in the vicinity of these plants. Therefore, a total of fourteen (14) specimens could be removed / affected by the proposal. Therefore, three (3) specimens of *A. bynoeana* have been recorded within the area to the west of the alignment that would become isolated following the installation of the road.

(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 terms of potential habitat for *Acacia bynoeana*, this has been defined as KSSW, although it is apparent that much of this habitat does not appear to be occupied. Whilst only very few sections of KSSW within the study area appear to be occupied by this species, any parts that contain populations should be regarded as significant. It should be noted that much of the area likely to be isolated has already been degraded by proximity to residential areas and associated pressures. Whilst it is difficult to ascertain the impact upon the future recruitment of *A. bynoeana* within the isolated remnant, it is likely that the isolation of this area will result in the further degradation of the habitat therein. *Acacia bynoeana* has been observed growing within disturbed habitats such as along the edges of fire trails (authors pers. obs.). Therefore, it cannot be clearly determined how important the removal / modification /

isolation of habitat (and three known individuals) will be to the long-term survival of the species within this population.

However, within the broader locality of the HEZ study area the importance of the habitat to be removed / modified / isolated on the *A. bynoeana* populations is considered to be low, as there are large areas of habitat (over 1,000ha) and *A. bynoeana* numbers (over 3000).

Eucalyptus parramattensis* ssp*. decadens

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

There is likely to be a loss of 6.7ha of habitat for *E. p. decadens* (KSSW), representing 1.7% of KSSW extant on the study area. A further 6.6ha is considered likely to be affected by the proposed road via edge effects and other indirect impacts. As a result, 13.3ha of KSSW will be affected by the proposal, comprising 3.3% of the total habitat (KSSW) on the study area.

(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:

E. p. decadens is restricted to the KSSW community within the study area. The proposal will also result in the isolation of stands of *E. p. decadens* habitat (KSSW) that will remain post road construction. Primarily, this would occur between the proposed road alignment and the township of Pelaw Main to the west. Approximately 39ha of KSSW would be isolated from the remainder of KSSW in the study area by the proposed road. This represents 9.3% of the total amount of *E. p. decadens* habitat (KSSW) found within the study area.

(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:

Given the species restricted distribution, any loss of habitat for this species could be regarded as important. Within the study area, this species was found almost exclusively in association with KSSW where it occurred as either a co-dominant or sporadic canopy species. Along the proposed road alignment and 'footprint' area the distribution of this species is defined by the boundaries of the KSSW. As for KSSW above, the amount of habitat for this species has been determined to be the area from which it currently exists.

As outlined in *a)* previously, approximately 651 individuals of *E. p. decadens* will be either removed or directly affected by the proposal. The habitat from which these individuals are to be removed is KSSW. Accordingly, a similar assessment could be made pertaining to the significance of habitat removal as was made for KSSW above (given that it was recorded commonly therein, as opposed to *A. bynoeana*). It should be noted though that within the regional distribution of the species, habitat is not entirely restricted to KSSW.

It should also be noted that much of the area likely to be isolated has already been degraded by proximity to residential areas and associated pressures. Whilst it is difficult to ascertain the impact upon the future recruitment of *E. p. decadens* within the isolated remnant, it is likely that the isolation of this area will result in the further degradation of the habitat therein. Having, said this, it is apparent that *E. p. decadens* responds well to some degree of habitat modification / isolation. This is evidenced by stands of *E. p. decadens* that occur as scattered trees within roadside 'parkland areas' that contain no semblance of an understorey whatsoever (such as at Neath and Abermain).

In conclusion, due to the small area of habitat required for removal / modification / isolation (3.3%) within the study area, large areas (over 1,000 ha) of *E. p. decadens* to be retained within conservation reserves within the HEZ study area, and that this species can apparently adapt to small levels of disturbance, it is considered that the importance of the habitat to be removed is low.

Grevillea parviflora* ssp. *parviflora

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

The habitat for *Grevillea parviflora* subsp. *parviflora* is considered to be within both the KSSW and the LHSGIF within the study area. Therefore, 6.7ha of KSSW and 2.4ha of LHSGIF is to be removed for the proposed road alignment. In addition, 6.6ha of KSSW and 3.0ha of LHSGIF will be modified via edge effects and other indirect effects. In conclusion a total of 18.7ha of habitat for *G. p. parviflora* will be removed / modifed by the proposal.

(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:

The proposal will also result in the isolation of KSSW that will remain post road construction. Primarily, this would occur between the proposed road alignment and the township of Pelaw Main to the west. Approximately 39ha of KSSW would be isolated from the remainder of KSSW in the study area by the proposed road. This represents 9.3% of the total amount of KSSW found within the study area.

The proposal will also result in the isolation of LHSGIF that will remain post road construction. Primarily this will result from the dissection of the southern stand of this community along Leggett's Drive. The majority of the remnant community will be situated within land to the west of the proposed road, with approximately 17.1ha being isolated from this to the east of the road.

(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 terms of habitat modification, recent targeted studies into local populations of *G. p. parviflora* have found that a significant proportion of populations of within the Cessnock LGA are found in open, slightly disturbed sites, particularly close to roads and tracks (Harper Somers O'Sullivan 2002c). This species is known from significant populations in the Cessnock / Kurri Kurri area. Population estimates for this species within the HEZ lands exceed 3 million above-ground stems whilst estimates for the Pelaw Main By-pass study area are approximately 1.3 million above-ground stems. Based on these estimates and given other known occurrences within the Cessnock LGA (such as Werakata National Park, Ellalong, Kurri Kurri), it is likely that far more than 5 million above-ground stems exist in this part of the region (comprising an unconfirmed number of plants, although considered to be proportionally substantial).

Furthermore, this species is not limited in terms of vegetation community habitat. This species has been recorded within at least four vegetation communities in the Cessnock LGA (KSSW, LHSGIF, GGSGF and Yellow Bloodwood Woodland [Harper Somers O'Sullivan 2005]). As such, large areas of habitat exist for *G. p. parviflora* within this part of the region.

In conclusion due to the small area of habitat required for removal / modification / isolation (3.8%) within the study area, large areas (over 1,000 ha) of *G. p. parviflora* to be retained within conservation reserves within the HEZ study area, and that this species can apparently adapt to small levels of disturbance, it is considered that the importance of the habitat to be removed to be low.

Therefore, in the context of the distribution of this species habitat within the Cessnock locality, it has been considered that the importance of the habitat to be removed / modified / isolated is considered to be low as a result of the proposal.

Threatened Fauna

***Litoria brevipalmata* (Green-thighed Frog)**

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

Potential habitat for *Litoria brevipalmata* (Green-thighed Frog) occurs within the various creeklines that are found throughout the study area. Along the proposed alignment, potential habitat exists within a vegetated creekline in KSSW and within the Freshwater Wetland Complex. Whilst the proposal could have some impact upon areas of potential habitat, riparian areas will be afforded the greatest possible protection and it is considered unlikely that the small amount of habitat to be affected at creek crossings would be significant.

(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:

The proposed road poses potentially the greatest threat to the isolation of habitat for *L. brevipalmata* at the location along its length where it crosses the drainage line. At this location, a number of ameliorative measures are proposed, including the installation of underpasses (culverts) designed to maintain both the hydrological regimes of the creeklines and the habitat connectivity for this species.

(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:

The proposal has the potential to have indirect impacts, which may potentially modify the habitat for this species through direct impacts, although direct impacts are not considered likely. These include alterations to the hydrological regimes of streams including changes to local flooding patterns from the construction of culverts, increased runoff (overland flows), pollution from vehicles, loss of riparian vegetation and potential direct loss of individuals during construction. The latter of these impacts is considered unlikely due to the failure to record the species despite numerous visits to these areas of potential habitat during a range of climatic conditions. Potential impacts to known populations within the HEZ study area are also unlikely as the Pelaw Main By-pass alignment occurs downstream of the HEZ study area. Furthermore, measures have been implemented into the design of the road that will ensure that habitat attributes for this species will be maintained. The habitat for *Litoria brevipalmata* (Green-thighed Frog) to be removed / modified can therefore be considered as not being important to the long-term survival of the species in the locality.

***Ninox strenua* (Powerful Owl)**

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

A total of 18.7ha of habitat for *Ninox strenua* (Powerful Owl) will be removed / modifed by the proposal.

(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:*

The proposed road alignment will traverse habitat for the Powerful Owl from the south west to the north east of the study area. The width of the alignment is expected to be approximately 25m including an edge buffer. The proposal will fragment the eastern two thirds of the study area with one third on the western portion of the study area. While the proposal will fragment habitat for the Powerful Owl, the high mobility of the species results in it being unlikely to become isolated from other areas of habitat.

(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:

Due to the small area of habitat (18.7ha) to be removed / modified, with no trees suitable for breeding to be removed and the large areas of habitat to be conserved within the HEZ study area, it is considered that the habitat to be removed / modified is not important to the long-term survival of the species in the locality.

'Woodland Birds' - *Chthonicola sagittata* (Speckled Warbler), *Climacteris picumnus* (Brown Treecreeper), *Melithreptus gularis* (Black-chinned Honeyeater), *Pomatostomus temporalis* (Grey-crowned Babbler)

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

The proposal will remove / modify approximately 18.7ha of potential habitat for these species.

(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:

The proposal will have the effect of isolating habitat for *C. sagitatta* (Speckled Warbler) to the west of the road alignment, in effect increasing the fragmentation of the remnant study area. The area to be isolated is approximately 85ha in size and combined with the area to be affected; this reduces the size of the larger forested remnant study area from approximately 480ha to 396ha. This remnant size figure is considered sufficient to support viable long-term populations of this species.

However, to reduce the likelihood of breeding pairs and potentially dependant young becoming isolated, it is recommended that pre-clearing surveys be carried out for nesting pairs to determine the local status of the species prior to potential isolation. This would be considered most appropriate should clearing / road construction be carried out during the known breeding months of this species, being August to January (Pizzey and Knight 2003). Such surveys should be carried out along the proposed road alignment and within the area of habitat that will become isolated post-development (i.e. the forested land to the west of the

alignment). Such surveys would also identify and potentially benefit other native fauna that could become isolated.

(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:

The 'Woodland Bird' species are likely to be less tolerant to the removal and modification of habitat within the study area, as these species are generally not able to persist in fragmented landscapes and in remnants smaller than 100-200 hectares. Other potential adverse impacts from fragmentation and the proposal could include; severing of species movement / migration corridors, altering species local movement patterns, increasing road mortality to moving / migrating individuals from vehicles; and increasing vulnerability to predation (by traversing open spaces). However, the proposal should not significantly fragment areas of habitat for these species given that the road alignment would result in a larger forested fragment that would be reduced in size from 480ha to 396ha. Therefore the habitat to be removed / modified is not likely to be of high importance to the long-term survival of the species in the locality.

***Lathamus discolor* (Swift Parrot) and *Xanthomyza phrygia* (Regent Honeyeater)**

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

The proposal will remove / modify approximately 18.7ha of potential habitat for these two species.

(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:

The proposal will have the effect of isolating habitat for these two species to the west of the road alignment, in effect increasing the fragmentation of the remnant study area. The area to be isolated is approximately 85ha in size and combined with the area to be affected; this reduces the size of the larger forested remnant study area from approximately 480ha to 396ha. This remnant size figure is considered sufficient to support viable long-term populations of these species within the locality. While the proposal will fragment habitat for these two species due to the mobility of these two species, they are unlikely to become isolated from other areas of habitat.

(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:

The proposal should not significantly fragment / modify areas of habitat for these species given that the road alignment would result in a larger forested fragment that would be reduced in size from 480ha to 396ha. In addition, due to the small area to be removed (3.3%) and the large areas of habitat to be conserved within the HEZ study area, it is considered that the habitat to be removed / modified can be considered as not being of high importance to the long-term survival of these species in the locality.

However, some other potential adverse impacts from fragmentation / modification of habitat from the proposal could include; severing of species movement / migration corridors, altering species local movement patterns, increasing road mortality to moving / migrating individuals from vehicles; and increasing vulnerability to predation (by traversing open spaces).

***Petaurus norfolcensis* (Squirrel Glider)**

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

The proposal will remove / modify approximately 18.7ha of potential habitat for the Squirrel Glider.

(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:

The proposal will have the effect of isolating habitat for these two species to the west of the road alignment, in effect increasing the fragmentation of the remnant study area. The area to be isolated is approximately 85ha in size and combined with the area to be affected; this reduces the size of the larger forested remnant study area from approximately 480ha to 396ha. This remnant size figure is considered sufficient to support viable long-term populations of this species within the locality.

(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:

The proposal should not significantly fragment / modify areas of habitat for the squirrel glider given that the road alignment would result in a larger forested fragment that would be reduced in size from 480ha to 396ha. In addition, the small area to be removed (3.3%) to be removed and the large areas of habitat to be conserved within the HEZ study area, it is considered that the habitat to be removed / modified can be considered as not important to the long-term survival of the species in the locality.

However, some other potential adverse impacts from fragmentation / modification of habitat from the proposal could include; severing of species movement / migration corridors, altering species local movement patterns, increasing road mortality to moving / migrating individuals from vehicles; and increasing vulnerability to predation (by traversing open spaces).

***Mormopterus norfolkensis* (East-coast Freetail-bat) and *Scoteanax rueppellii* (Greater Broad-nosed Bat)**

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

The proposal will remove / modify approximately 18.7ha of potential habitat for these two species.

(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:

The proposal will have the effect of isolating habitat for these two species to the west of the road alignment, in effect increasing the fragmentation of the remnant study area. The area to be isolated is approximately 85ha in size and combined with the area to be affected; this reduces the size of the larger forested remnant study area from approximately 480ha to 396ha. This remnant size figure is considered sufficient to support viable long-term populations of these species within the locality.

(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:

The proposal should not significantly fragment / modify areas of habitat for the squirrel glider given that the road alignment would result in a larger forested fragment that would be reduced in size from 480ha to 396ha. In addition, the small area to be removed (3.3%) to be removed and the large areas of habitat to be conserved within the HEZ study area, it is considered that the habitat to be removed / modified can be considered as not important to the long-term survival of the species in the locality.

However, some other potential adverse impacts from fragmentation / modification of habitat from the proposal could include; severing of species movement / migration corridors, altering species local movement patterns, increasing road mortality to moving / migrating individuals from vehicles.

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

None of the study area has been designated 'critical habitat' under Part 3 of the *TSC Act 1995*.

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

Recovery Plan Kurri Sand Swamp Woodland (KSSW)

The DEC has prepared a Draft Recovery Plan for Kurri Sand Swamp Woodland. This Recovery Plan was not at the time of writing this report on public display, although HSO has been provided with a copy by Cessnock City Council for our reference.

1. To gain greater insight into the distribution, floristics, and variance within KSSW and to investigate the relative significance of KSSW remnants.

The mapping of KSSW undertaken as part of this project has resulted in the addition of distributional knowledge for this endangered community within the locality. Other information provided within this assessment will also add to the knowledge bank in relation to this community. It has also confirmed the importance of the remnant as an example of KSSW.

2. To provide public authorities with information that assists in conserving and managing KSSW.

Although not directly the role of an SIS, this document nevertheless will assist DEC in understanding the occurrence of KSSW within the study area. Correspondingly, DEC will be able to relate such information to other information resources on the community.

3. To raise awareness of KSSW and facilitate community involvement in the recovery program.

It is not the role of this assessment report or the project to raise awareness of KSSW.

4. To identify and minimise the threats operating at sites where KSSW occurs and to ensure appropriate ecological restoration where necessary.

It is beyond the scope of this SIS to identify and minimise threats to KSSW. This has been done within the Draft Recovery Plan for the EEC. With regards to ensuring appropriate ecological restoration, this SIS has outlined recommendations pertaining to effective environmental management both during and post construction. Such strategies are likely to be expanded upon within relevant management plans for land to the east and west of the road.

5. To initiate potential conservation of KSSW on private property.

While no direct conservation of KSSW will result from the development, the environments to the east are likely to be conserved in the future as a result of the majority being under crown land ownership.

6. To promote research and monitoring projects that will assist future management decisions.

Research projects on the KSSW have been recommended as part of this SIS. Such projects (which are expected to include monitoring) are likely to assist in the future management of KSSW.

7. Broaden legislative protection afforded KSSW.

It is not the role of this assessment report or the project to broaden the legislative protection of KSSW.

Threatened Species

There are currently no recovery plans for the following species; *Acacia bynoeana, Grevillea parviflora* subsp. *parviflora, Litoria brevipalmata* (Green-thighed Frog), *Climacteris picumus* (Brown Treecreeper), *Chthonicola sagittata* (Speckled Warbler), *Lathamus discolor* (Swift Parrot), *Xanthomyza phrygia* (Regent Honeyeater), *Melithreptus gularis* (Black-chinned Honeyeater), *Petaurus norfolcensis* (Squirrel Glider), *Mormopterus norfolkensis* (East-coast Freetail-bat) and *Scoteanax rueppellii* (Greater Broad-nosed Bat).

There is a recovery plan for Large Forest Owls which includes the Powerful Owl.

Recovery Plan Powerful Owl

The following are the objectives of the Recovery Plan:-

1. To minimise further loss and fragmentation of habitat outside conservation reserves and State Forests by protection and management of significant owl habitat (including protection of individual nest sites).

The proposal will involve the removal of approximately 18.7ha of foraging habitat for the Powerful Owl. The proposal could therefore not be considered to be fully consistent with this objective. No potential nest sites will be removed.

2. To minimise the impacts of development activities on large forest owls and their habitats outside conservation reserves and State Forests.

The eastern portion (over 396ha) is currently subject to negotiations between the current landholders and DEC to come to a possible agreement to conserve this portion of the study area. In addition, within the adjoining HEZ study area the Cessnock LEP (Amendment 60) rezoned approximately 855ha of land at the HEZ as 7(b) Habitat Protection. A further 1273 ha was concurrently rezoned from State Forest to 8(a) National Park. These conservation zones within the HEZ LEP and some 89ha of additional conservation areas set aside by the DEC Assumed Concurrence are likely to have produced adequate conservation outcomes for each of these species. The setting aside of these areas are considered to have minimised the impacts of the proposed road alignment on the Powerful Owl and its habitats.

3. To assess the distribution and amount of high quality habitat for each owl species across public and private lands to get an estimate of the number and proportion of occupied territories of each species that are, and are not protected.

The Ecological Constraints Master Plan (ECMP) (HSO 2004) project aimed to obtain detailed ecological data for superior strategic planning, development sequencing and conservation decisions for HEZ. The mapping aimed to provide the accurate identification of flora and fauna (and their habitats) on the HEZ site. This work has culminated in a significant ecological database which forms the basis of on-going environmental management strategies.

Whilst the ECMP data is generally limited to the 4(h) zoned lands of the HEZ, within this area it can be used to assess the distribution and quality of habitat for these owl species. In regard to the Powerful Owl, habitat characteristics, particularly hollow trees for nest sites and hollows and tree species potentially used by prey species, give a strong indication of habitat quality. Any sightings or evidence of Owls, or their prey is also included in this data set, which is regularly updated.

4. To monitor trends in population parameters (number, distribution, territory fidelity and breeding success) across the range of the species and across different land tenures and disturbance history.

No detailed monitoring studies identifying trends in population parameters have been conducted as part of the proposal or as part of the wider HEZ.

5. To assess the implementation and effectiveness for forest management prescriptions designed to mitigate the impact of timber-harvesting operations on the owl species and, (if necessary), to use this information to refine the prescriptions so that forestry activities in State Forests are not resulting in adverse changes in species abundance and breeding success.

This objective is not relevant to the current proposal.

6. To improve the recovery and management of the large forest owls based on an improved understanding of key areas of their biology and ecology.

Whilst the eastern portion (depending upon outcomes of negionations) may be reserved within the study area and a large portion of potential habitat for the Powerful Owl has been reserved within the adjoining HEZ study area, the current proposal cannot be regarded as improving the recovery and management of the Powerful Owl.

7. To raise awareness of the conservation requirements of the three large forest owls amongst the broader community, to involve the community in owl conservation efforts and in so doing increase the information base owl habitats and biology.

No schemes, in relation to this proposal, have been put in place that are considered to raise awareness of the conservation requirements of these owl species or involve the community in owl conservation efforts.

8. To coordinate the implementation of the recovery plan and continually seek to integrate actions in this plan with actions in other recovery plans or conservation initiatives.

The DEC co-ordinates the implementation of the actions in this recovery plan and carries out a review of the plan in its final year.

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 number of Threatening Processes listed within Schedule 3 of the *Threatened Species Conservation Act 1995* (*TSC Act 1995*) may be at least in part applicable to the proposed development. These processes are listed below in italics, and relevant comments follow.

- *Alteration to the Natural Flow Regimes of Rivers and Streams and Their Floodplains and Wetlands*

The main creekline that runs through the north of the study area may potentially be affected by the proposal. This creek runs south into Wallis Creek and eventually into the Hunter River and will be crossed by the Pelaw Main By-pass at the south-western end of the proposed road alignment.

The creekline crossing has been designed to minimise any potential impacts to the natural flow regimes that may influence the water quality within the creekline itself as well as areas downstream such as the small wetland and ultimately Wallis Creek. The proposed design of the creekline crossing utilises a box culvert system, employing ancillary culverts that maintain moisture distribution across the breadth of the creekline.

In essence, it is not foreseen that the proposed road construction would significantly contribute to the fundamental criteria that led to the listing of this KTP.

- *Clearing of Native Vegetation*

This process is considered the most relevant Schedule 3 matter resulting from the proposed development. This process can now be seen to be applicable to any proposal involving some clearing of native vegetation. As such, this KTP encompasses a wide variety of proposed land use activities.

Key matters as described within the Final Determination of this process that may be at least in part applicable to the proposed development include direct loss of habitat, fragmentation, riparian zone degradation, increased greenhouse gas emissions, increased habitat for invasive species, loss of leaf litter layer, loss or disruption of ecological function and changes to soil biota.

The proposed development will result in direct loss of 9.1ha of forested areas and in the impact upon a further 9.5ha of forested land. These areas provide habitat resources for a diverse assemblage of flora and fauna species, including threatened flora and fauna species and an EEC. The linear alignment of the road will create a cleared corridor through the north-western part of the study area. This part of the study area has already been fragmented by

small and large bush tracks, including the disused Richmond Main Railway. Whilst this may potentially increase the suitability of the habitat present for invasive species, these species are scarce to absent from the study area at present, despite the already fragmented landscape.

All of the above contributes to the cumulative impact on the state of ecological function of the study area as a natural ecosystem and it is apparent that the proposed development can be seen to be contributing to the detrimental process of Clearing of Native Vegetation. However, given the small proportion of forested land to be removed / affected (1.9% / 3.9% of the study area respectively) this contribution can only be viewed as being incremental on a broader scale. Furthermore, the conservation outcomes achieved in the associated HEZ rezoning process have been based on conserving representative areas of each habitat unit occurring within that area. The maintenance of biodiversity was a fundamental aim of this representative area conservation approach.

- *Competition and Grazing by the Feral European Rabbit (Oryctolagus cuniculus)*

Evidence of Rabbits was recorded within the study area, although the population does not appear to be of a significant size. Whilst clearing for the road alignment may inadvertently create a small amount of foraging habitat in the form of grassed road verges, the development as proposed is not considered likely to contribute to the broad-scale expansion of this KTP.

- *High Frequency Fire Resulting in the Disruption of Life Cycle Processes in Plants and Animals and Loss of Vegetation Structure and Composition*

At present, the flora and fauna assemblages occurring within the study area have each been affected to varying extents by an 'unnaturally' frequent fire regime. This regime is largely the result of recent human activity in the area, particularly in proximity to existing human settlements where evidence of dumped and torched vehicles were observed.

Whilst the newly created road may allow some access into the study area for illegal arsonists, it will also allow better access into the study area for Rural Fire Brigades. More importantly, however, it will also open up the area to transient motorists, thus decreasing the likelihood of arsonists exploiting the site due to increased exposure.

- *Predation by Gambusia holbrooki (Plague Minnow or Mosquito Fish)*

No *Gambusia* is considered to be present on the study area and there are no areas where this species is likely to be found.

- *Predation by the European Red Fox (Vulpes vulpes)*

Evidence of Foxes has been recorded within the study area. The construction of the road may serve to open up the study area more for predators such as Foxes, but this is not considered a significant incursion given the network of existing tracks already existing and the proximity of the road alignment to the community of Pelaw Main.

- *Predation by the Feral Cat (Felis catus)*

Evidence of Cats has been recorded within the study area. The construction of the road may serve to open up the site more for predators such as the Cat, but this is not considered a significant incursion given the network of existing tracks that already exist and the proximity of the road alignment to the community of Pelaw Main.

- *Infection of native plants by Phytophthora cinnamomi*

Phytophthora cinnamomi is listed as a Key Threatening Process (KTP) under the *Threatened Species Conservation Act 1995* (*TSC Act*). *P. cinnamomi* is a water mould (like a fungus) that attacks the roots of susceptible plants, in many cases killing the plants. In some native plant communities, epidemic disease can develop causing the death of large numbers of plants.

P. cinnamomi may spread with the movement of infected soil or plant material by people or animals and may be transported by water percolating through the soil, in creeks or storm runoff. People can also transport the fungus to new areas on dirt adhering to vehicles, items they are carrying or footwear.

Humans have the capacity to spread the fungus long distances and across barriers which sets us apart from the natural mechanisms for spread. There is practically nothing that can be done to control the natural spread of the fungus or to destroy it, in the native plant communities. Such actions are largely limited to the horticultural industry where soil fumigation and control of vectors for spread is possible. In some areas, this fungus has been found in 60% of nursery stocks – so it is a very real problem and a threat to native vegetation.

The extent and impact of *P. cinnamomi* is difficult to ascertain, particularly due to a lack of literature for the local area. Currently there are no records of *P. cinnamomi* within the local area but this KTP must be regarded as potentially applicable to this development, particularly given the nature of activities that could potentially introduce this *P. cinnamomi* onto the site and aid its spread throughout the study area.

It is recommended that any fill brought into the site for the construction of the road be source from local areas to reduce the possibility of infection from *P. cinnamomi.*

- *Invasion of native plant communities by exotic perennial grasses*

Dense monocultures of perennial grasses that develop after invasion threaten local vegetation. This may result in local and regional declines of many native species and communities including threatened species such as the Speckled Warbler and the Grey-crowned Babbler that have been recorded within the study area. Many of the perennial exotic grasses establish following disturbances such as construction works.

Whilst clearing for the construction of the proposed nursery may inadvertently create a disturbed area for many perennial exotic grasses to establish, implementation of control and management measures will help to create an environment within which these exotic perennial grasses do not thrive. Furthermore, it is recommended that a weed management and monitoring program be put in place to mitigate any invasion from exotic grasses.

APPENDIX C: FLORA SPECIES LIST

FLORA SPECIES RECORDED WITHIN THE STUDY AREA

The following is a list of all flora species that have been recorded within the study area. Note that this list should not be seen to be fully comprehensive, but an indication of the flora present. A period of some years is often needed to identify all the species present in an area, especially as some species are only apparent at certain times of the year, such as Orchids.

A number of species cannot always be accurately identified during a brief survey, generally due to a lack of suitable flowering and/or fruiting material. Any such species are identified as accurately as possible, and are indicated in the list thus:

- Specimens which could only be identified to genus level are indicated by the generic name followed by the abbreviation "sp.", indicating an unidentified species of that genus;
- Specimens for which identification of the genus was uncertain are indicated by a question mark ("?") placed in front of the generic, which is followed by the abbreviation "sp." and;
- Specimens that could be accurately identified to genus level, but could be identified to species level with only a degree of certainty are indicated by a ("?") placed in front of the epithet.

Authorities for the scientific names are not provided in the list. These follow the references outlined below.

Harden, G. (ed) (2000) *Flora of New South Wales, Volume 1*. Revised edition. New South Wales University Press, NSW.

Harden, G. (ed) (2002) *Flora of New South Wales, Volume 2*. Revised edition. New South Wales University Press, NSW.

Harden, G. (ed) (1992) *Flora of New South Wales, Volume 3.* New South Wales University Press, NSW.

Harden, G. (ed) (1993) *Flora of New South Wales, Volume 4*. New South Wales University Press, NSW.

Introduced species are indicated by an asterisk "*".

Threatened species listed under the *TSC Act 1995* or the *EPBC Act 1999* and / or ROTAP-listed species are indicated in **bold font** and marked as thus

(V) = Vulnerable species listed under *TSC Act 1995.*
(E) = Endangered species listed under *TSC Act 1995.*
(EE) = Endangered species listed under *EPBC Act 1999.*
(EV) = Vulnerable species listed under the *EPBC Act 1999*.
(R + [coding]) = Rare or Threatened Australian Plant (ROTAP) as per *Briggs and Leigh (1996).*
(S) = Species considered to be regionally significant.

The following standard abbreviations are used to indicate subspecific taxa:

ssp. - subspecies
var.- variety
× - hybrid between the two indicated species

CLASS FAMILY *Scientific Name*	Common Name
CLASS FILICOPSIDA (Ferns)	
ADIANTACEAE *Adiantum aethiopicum*	Common Maidenhair Fern
BLECHNACEAE *Blechnum indicum*	Bungwahl fern
DENNSTAEDTIACEAE *Pteridium esculentum*	Bracken
SINOPTERIDACEAE *Cheilanthes sieberi* ssp. *sieberi*	Mulga Fern
CLASS CYCADOPSIDA (Cycads)	
ZAMIACEAE *Macrozamia flexuosa* **(R - 2K)**	
CLASS MAGNOLIOPSIDA (Flowering Plants) **Subclass Magnoliidae (Dicotyledons)**	
ACANTHACEAE *Pseuderanthemum variabile*	Pastel Flower
APIACEAE *Centella asiatica* *Hydrocotyle peduncularis* *H. tripartita* *Platysace ericoides* *P. lanceolata*	 Forest Pennywort Heathy Platysace
ARALIACEAE *Polyscias sambuccifolia*	Elderberry Panax
ASTERACEAE *Bidens pilosa* *Brachycome angustifolia* *Cassinia uncata* *Chrysocephalum apiculatum* **Conyza* spp. **Coreopsis lanceolata* *Gnaphalium sphaericum* *Helichrysum collinum* **Hypochaeris radicata* *Lagenifera gracilis* *Olearia microphylla*	 Pitchforks Bent Cassinia Yellow Buttons Fleabanes Coreopsis Cudweed Catsear Slender Lagenifera Bridal Daisy Bush

Ozothamnus diosmifolium	Everlasting
**Senecio madagascariensis*	Variable Grounsel
Vernonia cinerea var. *cinerea*	
BIGNONIACEAE	
Pandorea pandorana	Wonga-Wonga Vine
CAMPANULACEAE	
Wahlenbergia gracilis	Native Bluebell
CASUARINACEAE	
Allocasuarina littoralis	Black She-oak
A. torulosa	Forest Oak
CELASTRACEAE	
Maytenus silvestris	Narrow-leaved Orangebark
CHENOPODIACEAE	
Einadia hastata	
CONVOLVULACEAE	
Dichondra repens	Kidney Weed
DILLENIACEAE	
Hibbertia aspera	Rough Guinea Flower
H. dentata	Twining Guinea Flower
H. linearis	Showy Guinea Flower
H. pedunculata	
DROSERACEAE	
Drosera peltata	Sundew
D. spathulata	Common Sundew
EPACRIDACEAE	
Epacris pulchella	NSW Coral Heath
Leucopogon juniperinus	Beared Heath
L. virgatus	
Lissanthe strigosa ssp. *strigosa*	Native Cranberry
Melichrus procumbens	Jam Tarts
M. urceolatus	Urn Heath
Monotoca scoparia	
Styphelia triflora	
EUPHORBIACEAE	
Breynia oblongifolia	Breynia
Phyllanthus hirtellus	Thyme Spurge
FABACEAE	
Bossiaea heterophylla	Variable Bossiaea
B. obcordata	Spiny Bossiaea
B. rhombifolia	
Chorizema parviflorum	
Daviesia ulicifolia	

Desmodium brachypodum	
D. rhytidophyllum	
Dillwynia retorta	
Glycine clandestina	Love Creeper
G. microphylla	
G. tabacina	Twining Glycine
Gompholobium pinnatum	Wedge Pea
Hardenbergia violacea	False Sarsaparilla
Hovea linearis	
Indigofera australis	
Jacksonia scoparia	Dogwood
Mirbelia rubifolia	
Podolobium ilicifolium	Native Holly
Pultenaea retusa	
P. spinosa	
P. villosa	
GERANIACEAE	
Geranium homeanum	Northern Cranesbill
GOODENIACEAE	
Dampiera stricta	
Goodenia hederacea var. *hederacea*	Violet-leaved Goodenia
G. heterophylla	
G. paniculata	Swamp Goodenia
HALORAGACEAE	
Gonocarpus tetragynus	Poverty Raspwort
LAURACEAE	
Cassytha glabella	Slender Devil's Twine
**Cinnamomum camphora*	Camphor Laurel
LOBELIACEAE	
Pratia purpurascens	White Root
LORANTHACEAE	
Amyema gaudichaudi	
MIMOSACEAE	
Acacia brownii	
***A. bynoeana* (E/EV)**	**Bynoe's Wattle**
A. elongata	
A. falcata	Falcate Wattle
A. irrorata ssp. *irrorata*	
A. longifolia	Sydney Golden Wattle
A. myrtifloia	Myrtle Wattle
A. terminalis	
A. ulicifolia	Pricly Moses
A. suaveolens	Sweet-scented Wattle

MYRTACEAE	
Angophora bakeri	Narrow-leaved Apple
Callistemon linearis	Narrow-leaved Bottlebrush
C. rigidus	Stiff Bottlebrush
Corymbia eximia **(S)**	Yellow Bloodwood
C. gummifera	Red Bloodwood
C. maculata	Spotted Gum
Eucalyptus agglomerata	Blue-leaved Stringybark
E. canaliculata	Large-fruited Grey Gum
E. crebra	Narrow-leaved Ironbark
E. fibrosa ssp. *fibrosa*	Broad-leaved Ironbark
***E. glaucina* (V/EV)**	**Slaty Red Gum**
***E. parramattensis* ssp. *decadens* (V/EV)**	**Drooping Red Gum**
E. punctata	Grey Gum
E. punctata x *canaliculata*	
E. signata	Scribbly Gum
E. sparsifolia	Narrow-leaved Stringybark
E. tereticornis	Forest Red Gum
E. umbra	Bastard Mahogany
Leptospermum parvifolium	Small-leaved Tea-tree
L. polygalifolium ssp. *cismontanum*	Lemon-scented Tea-tree
L. trinervium	Paperbark Tea-tree
Melaleuca armillaris	Bracelet Honeymyrtle
M. decora	
M. lineariifolia	Snow-in-summer
M. nodosa	Ball Honeymyrtle
M. sieberi	Sieber's Paperbark
M. styphelioides	Prickly-leaved Paperbark
M. thymifolia	
OLEACEAE	
Notelaea longifolia	Mock Olive
OXALIDACEAE	
Oxalis perennans	Native Oxalis
PITTOSPORACEAE	
Billardiera scandens var. *scandens*	Apple Dumplings
Bursaria spinosa	Native Blackthorn
PLANTAGINACEAE	
**Plantago lanceolata*	Lambs Tongues
POLYGONACEAE	
Persicaria sp.	
PROTEACEAE	
Banksia oblongifolia	
B. spinulosa var. *collina*	Hill Banksia
Grevillea montana **(R – 2KC-)**	
***G. parviflora* ssp. *parviflora* (V/EV)**	
Hakea dactyloides	Broad-leaved Hakea
H. salicifolia	Willow-leaved Hakea

H. sericea	Bushy Needlebush
Isopogon anemonifolius	Drumsticks
Lambertia formosa	Mountain Devils
Persoonia linearis	Narrow-leaved Geebung
RUBIACEAE	
Opercularia aspera	
Pomax umbellata	Pomax
**Richardia humistrata*	
RUTACEAE	
Boronia polygalifolia	
SANTALACEAE	
Exocarpus cupressiformis	Cherry Ballart
E. strictus	Dwarf Currant
SAPINDACEAE	
Dodonaea triquetra	Common Hop Bush
SCROPHULARIACEAE	
Veronica plebeia	Speedwell
SOLANACEAE	
**Solanum nigrum*	Blackberry Nightshade
S. prinophyllum	Forest Nightshade
STERCULIACEAE	
Lasiopetalum sp.	Rusty Petals
STYLIDIACEAE	
Stylidium graminifolium	Trigger Plant
THYMELAEACEAE	
Pimelea linifolia ssp. *linifolia*	Slender Rice Flower
VERBENACEAE	
**Lantana camara*	Lantana
**Verbena bonariensis*	Purple Top
VIOLACEAE	
Viola hederacea	Ivy-leaved Violet

CLASS MAGNOLIOPSIDA (Flowering Plants)
Subclass Liliidae (Monocotyledons)

ANTHERICACEAE	
Arthropodium minus	Small Vanilla Lily
Caesia parviflora	Pale Grass-lily
Laxmannia gracilis	Slender Wire-lily

CYPERACEAE	
Baumea juncea	
Carex appressa	Tall Sedge
Cyperus difformis	Dirty Dora
Cyperus sp.	
Eleochaeris sphacelata	Tall Spike-rush
Gahnia aspera	
Lepidosperma laterale	Variable Sword-sedge
Ptilothrix deusta	
Schoenus brevifolius	
HAEMODORACEAE	
Haemodorum planifolium	Blood Root
HYDROCHARITACEAE	
Ottelia ovalifolia	Swamp Lily
IRIDACEAE	
Patersonia sericea	Silky Purple Flag
JUNCACEAE	
Juncus continuous	
J, cognatus	
J. planifolius	Broad-leaved Rush
J. subsecundus	Finger Rush
J. usitatus	Common Rush
HYPOXIDACEAE	
Hypoxis hygrometrica	Golden Stars
LOMANDRACEAE	
Lomandra filiformis ssp. *filiformis*	
L. glauca	Pale Mat-rush
L. longifolia	Mat-rush
L. multiflora ssp. *multiflora*	Mat-rush
LUZURIAGACEAE	
Eustrephus latifolius	Wombat Berry
ORCHIDACEAE	
Caladenia caerulea	Blue Caladenia
C. carnea	Pink Fingers
C. catenata	White Fingers
Diuris aurea	Golden Donkey Orchid
Diuris sp. aff. *dendrobioides* (Hunter Valley) **(S)**	
Glossodia major	Wax Lip Orchid
G. minor	Swamp Wax Lip Orchid
PHILYDRACEAE	
Philydrum lanuginosum	Wooly Frogmouth

PHORMIACEAE	
Dianella caerulea var. *caerulea*	Blue Flax Lily
D. longifolia	
D. prunina	
D. revoluta var. *revoluta*	
POACEAE	
**Andropogon virginicus*	Whisky Grass
Anisopogon avenaceus	Oat Speargrass
Aristida vagans	Three-awn Speargrass
Austrodanthonia tenuior	Wallaby Grass
**Axonopus affinus*	Narrowleaf Carpet Grass
Cynodon dactylon	Couch
Dichelachne micrantha	Shorthair Plume Grass
Echinopogon caespitosus var. *caespitosus*	Tufted Hedgehog Grass
E. ovatus	Forest Hedgehog Grass
Entolasia marginata	
E. stricta	Wiry Panic
Eragrostis brownii.	Brown's Love Grass
Imperata cylindrica var. *major*	Blady Grass
Oplismenus aemulus	Basket Grass
O. imbecillus	
Panicum simile	Two Colour Panic
**Paspalum dilatatum*	Paspalum
P. distichum	
**Pennisetium clandestina*	Kikuyu
Phragmites australis	Common Reed
**Setaria gracilis*	Slender Pigeon Grass
Sporobolus sp.	
Themeda australis	Kangaroo Grass
XANTHORRHOEACEAE	
Xanthorrhoea glauca	
X. latifolia ssp. *latifolia*	

APPENDIX D: FLORA PLOT AND TRANSECT DATA

Flora Transect No: T1

Location: North-western corner of Study Area (within original ECS study area)
Date: 05/09/02

Details

Length of Transect:	***Vegetation Community(s):***	***Co-ordinates (MGA)***
200m	Lower Hunter Spotted Gum / Ironbark Forest	Start Easting: 358320 Finish Easting: 358220 Start Northing: 6365740 Finish Northing: 6365650

Physical Attributes

Topographic Position:	***Elevation:***	***Slope:***
Lower slope from creekline	34m AHD	5-10 degrees
Aspect:	***Soil Type:***	***Other attributes of influence:***
Easterly	Loam/Clay	

Species Recorded	
Cheilanthes sieberi ssp*. sieberi*	*Melaleuca thymifolia*
Macrozamia flexuosa	*Notalaea* sp*.*
Leucopogon virgatus	*Bursaria spinosa*
Phyllanthus hirtellus	*Grevillea parviflora* ssp*. parviflora*
Daviesia ulicifolia	*Hakea sericea*
Dillwynia retorta	*Persoonia linearis*
Glycine microphylla	*Pomax umbellata*
Pultenaea spinosa	*Exocarpus strictus*
Gonocarpus tetragynus	*Lasiopetalum sp.*
Acacia brownii	*Lepidosperma laterale*
Acacia terminalis	*Patersonia sericea*
Callistemon linearis	*Caladenia caerulea*
Corymbia maculata	*Caladenia carnea*
Eucalyptus canaliculata	*Caladenia catenata*
Eucalyptus agglomerata	*Glossodia major*
Eucalyptus fibrosa ssp*. fibrosa*	*Anisopogon avenaceus*
Leptospermum trinervium	*Aristida vagans*
Melaleuca nodosa	*Dichelachne micrantha*
Entolasia stricta	*Eragrostis brownii*
Imperata cylindrica var*. major*	*Panicum simile*
Themeda australis	

Flora Transect No: T2

Location: Mid-northern section of study area (within original ECS study area)
Date: 05/09/02

Details

Length of Transect:	***Vegetation Community(s):***	***Co-ordinates (MGA)***
200m	Kurri Sand Swamp Woodland	Start Easting: 359060 Finish Easting: 359260 Start Northing: 6366390 Finish Northing: 6366390

Physical Attributes

Topographic Position:	***Elevation:***	***Slope:***
Upper slope	30m AHD	0-5 degrees
Aspect:	***Soil Type:***	***Other attributes of influence:***
South-easterly	Sand	

Species Recorded	
Macrozamia flexuosa	*Daviesia ulicifolia*
Leucopogon virgatus	*Dillwynia retorta*
Gompholobium pinnatum	*Hardenbergia violacea*
Pultanea retusa	*Pultanea villosa*
Cassytha glabella	*Acacia brownii*
Acacia elongata	*Acacia longifolia*
Angophora bakeri	*Eucalyptus fibrosa* ssp. *fibrosa*
Eucalyptus parramattensis ssp. *decadens*	*Leptospermum polygalifolium*
Leptospermum trinervium	*Melaleuca nodosa*
Melaleuca sieberi	*Melaleuca thymifolia*
Bursaria spinosa	*Grevillea parviflora* ssp. *parvifloa*
Hakea sericea	*Isopogon anemonifolius*
Lambertia formosa	*Persoonia linearis*
Pomax umbellata	*Exocarpus strictus*
Lasiopetalum sp.	*Pimelea linifolia* ssp. *linifolia*
Lepidosperma laterale	*Ptilothrix deusta*
Haemodorum planifolium	*Lomandra longifolia*
Glossodia major	*Glossodia minor*
Anisopogon avenaceus	*Aristida vagans*
Danthonia tenuior	*Entolasia stricta*
Imperata cylindrica var *major*	*Themeda australis*
Xanthorrhoea glauca ssp. *glauca*	

Flora Transect No: T3

Location: North-western corner of study area (within original ECS study area)
Date: 05/09/02

Details

Length of Transect:	***Vegetation Community(s):***	***Co-ordinates (MGA)***
200m	Kurri Sand Swamp Woodland	Start Easting: 358940 Finish Easting: 359030 Start Northing: 6366050 Finish Northing: 6366220

Physical Attributes

Topographic Position:	***Elevation:***	***Slope:***
Within creekline	25m AHD	Flat with slight riparian gradient
Aspect:	***Soil Type:***	***Other attributes of influence:***
None	Sand / loam	

Species Recorded	
Hydrocotyle tripartita	*Dichondra repens*
Goodenia paniculata	*Acacia longifolia*
Melaleuca decora	*M. lineariifolia*
Eleocharis sphacelata	*Carex appressa*
Ottelia ovalifolia	*Juncus continuus*
Philydrum lanuginosum	

Flora Transect No: T4

Location: North-eastern Corner of Study Area
Date: 13/6/2003

Details

Length of Transect:	***Vegetation Community(s):***	***Co-ordinates (MGA)***
200m	Kurri Sand Swamp Woodland	Start Easting: 360040 Finish Easting: 359840 Start Northing: 6366210 Finish Northing: 6366160

Physical Attributes

Topographic Position:	***Elevation:***	***Slope:***
Crest	46m	Negligible
Aspect:	***Soil Type:***	***Other attributes of influence:***
Various	Sand	Crossed creekline @ 75m

Comments
Very large numbers of *Grevillea parviflora* ssp. *parviflora* throughout transect.
Eucalyptus parramattensis ssp. *decadens* began to dominate at a small drainage line crossing.

Species Recorded	
Echinopogon caespitosus	*Melaleuca thymifolia*
Banskia spinulosa	*G. p. parviflora*
Angophora bakeri	*Dampiera stricta*
Leptospermum polygalifolium	*Acacia elongata*
Entolasia stricta	*Imperata cylindrica* var. *major*
Gonocarpus teragynus	*Cheilanthes sieberi*
Dillwynia sp.	*Hibbertia* sp.
Ptilothrix duestum	*Persoonia linearis*
Eucalyptus parramattensis ssp. *decadens*	*Billardiera scandens*
Pimelea linifolia	*Melaleuca sieberi*
Acacia brownii	*Glycine clandestina*
Pomax umbellata	*Isopogon anemonifolius*
Macrozamia flexuosa	*Lissanthe strigosa*
Melaleuca nodosa	*Oplismenus aemulus*
Haemodorum corymbosum	*Exocarpus cuppressiformis*
Xanthorrhoea glauca	*Lomandra multiflora*
Oplismenus imbecillis	*Lambertia formosa*

Species Recorded	
Gompholobium pinnatum	*Bossiaea obcordata*
Drosera spathulata	*Pteridium esculentum*
Pultanaea sp.	
+ In Small Drainage Line Crossing	
Persicaria sp.	*Cyperus* sp.
Juncus usitatus	*Paspalum dilatatum*
Melaleuca lineariifolia	*Hypochaeris radicata*
Blechnum indicum	*Axonopus affinus*
Philydrum laguninosum	

Flora Transect No: T5

Location: Northern part of Study Area, midway between disused railway and JR Drive
Date: 13/6/2003

Details

Length of Transect:	***Vegetation Community(s):***	***Co-ordinates (MGA)***
200m	Kurri Sand Swamp Woodland	Start Easting: 359440 Finish Easting: 359640 Start Northing: 6366170 Finish Northing: 6366040

Physical Attributes

Topographic Position:	***Elevation:***	***Slope:***
Above Creekline	29m	0-5 degrees
Aspect:	***Soil Type:***	***Other attributes of influence:***
Various	Sand	

Comments
Large numbers of *Grevillea parviflora* ssp. *parviflora* throughout transect.

Species Recorded	
Eucalyptus parramattensis ssp*. decadens*	*E. agglomerata*
Macrozamia flexuosa	*Angophora bakeri*
G. p. parviflora	*Gompholobium pinnatum*
Billardiera scandens	*Callistemon rigidus*
Entolasia stricta	*Exocarpus cuppressiformis*
Gonocarpus teragynus	*Monotoca scoparia*
Ptilothrix duesta	*Persoonia linearis*
Echinopogon caespitosus	*Leptospermum polygalifolium*
Banskia spinulosa	*Melichrus procumbens*
Eustrephus latifolius	*Epacris pulchella*
Drosera spathulata	*Isopogon anemonifolius*
Xanthorrhoea glauca	*Lissanthe strigosa*
Melaleuca nodosa	*Banksia marginata*
Dampiera stricta	*Mirbelia rubifloia*
Lomandra multiflora	

Flora Transect No:T6

Location: South-western Corner of Study Area
Date: 13/6/2003

Details

Length of Transect:	***Vegetation Community(s):***	***Co-ordinates (MGA)***
200m	Kurri Sand Swamp Woodland	Start Easting: 359080 Finish Easting: 358890 Start Northing: 6364960 Finish Northing: 6365020

Physical Attributes

Topographic Position:	***Elevation:***	***Slope:***
Flat	30m	Negligible
Aspect:	***Soil Type:***	***Other attributes of influence:***
N/A	Sand	

Species Recorded	
Eucalyptus parramattensis ssp. *decadens*	*E. signata*
Banskia spinulosa	*Banksia marginata*
Angophora bakeri	*Hakea dactyloides*
Leptospermum polygalifolium	*Acacia elongata*
Xanthorrhoea glauca	*Hakea sericea*
Melaleuca thymifolia	*Leptomeria acida*
Ptilothrix duesta	*Persoonia linearis*
Echinopogon caespitosus	*Billardiera scandens*
Pimelea linifolia	*Melaleuca sieberi*
Acacia brownii	*Glycine clandestina*
Themeda australis	*Lomandra multiflora*
Eustrephus latifolius	*Lambertia formosa*
Gompholobium pinnatum	

Flora Transect No: T7

Location: South-eastern corner of study area
Date: 13/6/2003

Details

Length of Transect:	***Vegetation Community(s):***	***Co-ordinates (MGA)***
200m	Kurri Sand Swamp Woodland	Start Easting: 360200 Finish Easting: 360030 Start Northing: 6364800 Finish Northing: 6364730

Physical Attributes

Topographic Position:	***Elevation:***	***Slope:***
Upper Slope, towards creekline	40m	0-5 degrees
Aspect:	***Soil Type:***	***Other attributes of influence:***
South-easterly	Sand	

Species Recorded	
Eucalyptus punctata	*E. signata*
Banskia spinulosa	*Melaleuca lineariifolia*
Angophora bakeri	*Daviesia ulicifolia*
Bursaria spinosa	*Acacia elongata*
Grevillea montana	*Acacia ulicifolia*
Entolasia stricta	*Imperata cylindrica* var. *major*
Hardenbergia violacea	*Cheilanthes sieberi*
Verbena bonariensis	*Vernonia cinerea*
Styphelia triflora	*Hibbertia* sp.
Hakea sericea	*Persoonia linearis*
Echinopogon caespitosus	*Billardiera scandens*
Acacia falcata	*Callistemon rigidus*
Dianella prunina	*Acacia suaveolens*
Pimelea linifolia	*Melaleuca sieberi*
Acacia brownii	*Phyllanthus hirtellus*
Banksia spinulosa	*Pratia purpurascens*
Pomax umbellata	*Melichrus procumbens*
Macrozamia flexuosa	*G. p. parviflora*
Melaleuca nodosa	*Oplismenus aemulus*
Hypochaeris radicata	*Exocarpus cuppressiformis*
Conyza sp.	*Lomandra longifolia*
Oplismenus imbecillis	*Lambertia formosa*
Axonopus affinus	

Flora Transect No: T8

Location: South-eastern corner of study area
Date: 05/09/02

Details

Length of Transect:	***Vegetation Community(s):***	***Co-ordinates (MGA)***
200m	Grey Gum / Scribbly Gum Open Forest	Start Easting: 359970 Finish Easting: 360170 Start Northing: 6364720 Finish Northing: 6364820

Physical Attributes

Topographic Position:	***Elevation:***	***Slope:***
Lower slope in association with drainage line.	52m AHD	5 degrees
Aspect:	***Soil Type:***	***Other attributes of influence:***
Southerly	Sand	Isolated Community

Comments
Small numbers of *Grevillea parviflora* ssp. *parviflora* along transect.
Community does not easily equate

Species Recorded	
Lomandra longifolia	*Eucalyptus signata*
Leucopogon sp.	*Xanthorrohea glauca*
Macrozamia flexuosa	*Pimelea linifolia* ssp. *linifolia*
E. punctata	*Melaleuca sieberi*
Melaleuca thymifolia	*Damperia stricta*
Platysace ericoides	*Gompholobium pinnatum*
Dillwynia retorta	*Grevillea parviflora* ssp. *parviflora*
Exocarpus cupressiformis	*Dianella prunina*
Pratia purpurascens	*Drosera peltata*
Haemodorum sp.	*E. agglomerata*
Banksia spinulosa var. *collina*	*Bursaria spinosa*
Acacia suaveolens	*A. falcata*
E. fibrosa	*Themeda australis*
Axonopus affinus	*Hypochaeris radicata*

Flora Quadrat No: P1

Location: North-western corner of study area (original ECS study area)
Date: 05/09/02

Details

Size of Quadrat:	***Vegetation Community:***	***Co-ordinates (MGA)***
20m x 20m	Lower Hunter Spotted Gum Ironbark Forest	Easting: 358340 Northing: 6365460

Physical Attributes

Topographic Position:	***Elevation:***	***Slope:***
Lower Slope	41m AHD	5-10 degrees
Aspect:	***Soil Type:***	***Other attributes of influence:***
Easterly	Loam/Clay	

Structural Components

Structural Layers	Height	Relative Cover Abundance	Dominant Species
Tree / Canopy Layer	15m	30%	*Corymbia maculata, Eucalyptus fibrosa* ssp*. fibrosa, Eucalyptus canaliculata*
Sub-canopy Layer	N/A		
Tall Shrub / Small Tree Layer	5m	5%	*Melaleuca nodosa*
Shrub Layer	2m	5%	*Persoonia linearis, Acacia ulicifolia*
Groundcover	<0.5	80%	*Themeda australis, Aristida vagans, Entolasia stricta*

Flora Quadrat No: P2

Location: North western corner of study area (original ECS study area)
Date: 05/09/02

Details

Size of Quadrat:	***Vegetation Community:***	***Co-ordinates (MGA)***
20m x 20m	Kurri Sand Swamp Woodland	Easting: 359030 Northing: 6366300

Physical Attributes

Topographic Position:	***Elevation:***	***Slope:***
Flat	22m AHD	Slight riparian gradient
Aspect:	***Soil Type:***	***Other attributes of influence:***
None	Sand/ Loam	

Structural Components

Structural Layers	Height	Relative Cover abundance	Dominant Species
Tree / Canopy Layer		25%	*Melaleuca lineariifolia*
Sub-canopy Layer	5m	15%	Juvenile dominants
Tall Shrub / Small Tree Layer	N/A		
Shrub Layer	2m	80%	*Eleocharis sphacelata*
Groundcover	<0.5m	20%	*Goodenia paniculata, Dichondra repens*

Flora Quadrat No: P3

Location: North-western corner of study area (original ECS study area)
Date: 05/09/02

Details

Size of Quadrat:	***Vegetation Community:***	***Co-ordinates (MGA)***
20m x 20m	Kurri Sand Swamp Woodland	Easting: 358890 Northing: 6366300

Physical Attributes

Topographic Position:	***Elevation:***	***Slope:***
Lower slope	20m AHD	0-5 degrees
Aspect:	***Soil Type:***	***Other attributes of influence:***
South easterly	Sand	

Structural Components

Structural Layers	Height	Relative Cover abundance	Dominant Species
Tree / Canopy Layer	15m	30%	*Angophora bakeri, Eucalyptus fibrosa* ssp*. fibrosa*
Sub-canopy Layer	N/A		
Tall Shrub / Small Tree Layer	N/A		
Shrub Layer	2m	80%	*Acacia elongata, Dillwynia retorta, Leucopogon virgatus*
Groundcover	<0.5m	20%	*Echinopogon caespitosus, Dichondra repens*

Flora Quadrat No: P4

Location: North western corner of study area (original ECS study area)
Date: 05/09/02

Details

Size of Quadrat:	***Vegetation Community:***	***Co-ordinates (MGA)***
20m x 20m	Lower Hunter Spotted Gum Ironbark Forest	Easting: 358570 Northing: 6366540

Physical Attributes

Topographic Position:	***Elevation:***	***Slope:***
Lower slope	21m	0-5 degrees
Aspect:	***Soil Type:***	***Other attributes of influence:***
Southerly	Clay	

Structural Components

Structural Layers	Height	Relative Cover abundance	Dominant Species
Tree / Canopy Layer	15m	50%	*Corymbia maculata, Eucalyptus agglomerata, E. punctata, Angophora bakeri*
Sub-canopy Layer	N/A		
Tall Shrub / Small Tree Layer	5m	5%	*Allocasuarina littoralis*
Shrub Layer	2m	10%	*Exocarpus strictus, Hakea sericea*
Groundcover	0.4m	10%	*Pratia purpurascens, Entolasia stricta*

Flora Quadrat No: P5

Location: North-western corner of study area (original ECS study area)
Date: 05/09/02

Details

Size of Quadrat:	***Vegetation Community:***	***Co-ordinates (MGA)***
20m x 20m	Kurri Sand Swamp Woodland	Easting: 358570 Northing: 6366540

Physical Attributes

Topographic Position:	***Elevation:***	***Slope:***
Upper Slope	28m AHD	5-10 degrees
Aspect:	***Soil Type:***	***Other attributes of influence:***
Northerly	Clay/Sand	

Structural Components

Structural Layers	Height	Relative Cover abundance	Dominant Species
Tree / Canopy Layer	15m	20%	*Eucalyptus agglomerata, E. parramattensis* ssp*. decadens*,
Sub-canopy Layer	10m	15%	*Angophora bakeri, Leptospermum trinervium*
Tall Shrub / Small Tree Layer	N/A		
Shrub Layer	2m	40%	*Banksia spinulosa* var*. collina, Lambertia formosa, Xanthorrhoea glauca* ssp*. glauca*
Groundcover	<0.5m	40%	*Themeda australis, Dillwynia retorta*

.

Flora Quadrat No: P6

Location: North-eastern corner of study area
Date: 13/6/2003

Details

Size of Quadrat:	***Vegetation Community:***	***Co-ordinates (MGA)***
20m x 20m	Kurri Sand Swamp Woodland	Easting: 360260 Northing: 6366250

Physical Attributes

Topographic Position:	***Elevation:***	***Slope:***
Crest	41m AHD	0-5 degrees
Aspect:	***Soil Type:***	***Other attributes of influence:***
Westerly	Sand	See Comments below

Comments
Some evidence of minor disturbance (proximate to John Renshaw Drive).
Much localised variation in *G. p. parviflora* leaves.

Structural Components

Structural Layers	Height	Relative Cover abundance	Dominant Species
Tree / Canopy Layer	8m	50%	*Angophora bakeri*, *Eucalyptus signata* (1 only), *E. parramattensis* ssp. *decadens* (1 only)
Sub-canopy Layer	N/A		
Tall Shrub / Small Tree Layer	4m		Juvenile dominants
Shrub Layer	2m	80%	*Acacia elongata, Persoonia linearis, Grevillea parviflora* ssp. *parviflora, Banksia spinulosa, Pteridium esculentum, Gompholobium pinnatum*
Groundcover	0.5m	70%	*Themeda australis, Pomax umbellata, Cheilanthes sieberi, Gonocarpus tetragynus*

Flora Quadrat No: P7

Location: Northern boundary of study area, south of John Renshaw Drive
Date: 13/6/2003

Details

Size of Quadrat:	***Vegetation Community:***	***Co-ordinates (MGA)***
20m x 20m	Kurri Sand Swamp Woodland	Easting: 359530 Northing: 6366330

Physical Attributes

Topographic Position:	***Elevation:***	***Slope:***
Creekline and catchment	20-25m AHD	0-5 degrees
Aspect:	***Soil Type:***	***Other attributes of influence:***
Westerly	Sand	See Comments below

Comments
Some evidence of minor disturbance (proximate to John Renshaw Drive).

Structural Components

Structural Layers	Height	Relative Cover abundance	Dominant Species
Tree / Canopy Layer	10m	25%	*Angophora bakeri*, *Eucalyptus punctata, E. parramattensis* ssp. *decadens*
Sub-canopy Layer	4m		*Melaleuca linearifolia,* Juvenile dominants
Tall Shrub / Small Tree Layer	3m		Juvenile dominants
Shrub Layer	2m	70%	*Melaleuca thymifolia, Dillwynia retorta, Grevillea montana, Banksia spinulosa, Melichrus procrumbens*
Groundcover	0.3m	40%	*Themeda australis, Lomandra glauca, L. multiflora, Eragrostis brownii*
Other (In Creekline Only)			*Phragmites australis, Hydrocotyle peduncularis, Carex appressa, Acacia longifolia*

Flora Quadrat No: P8

Location: South-western corner of study area
Date: 13/6/2003

Details

Size of Quadrat:	***Vegetation Community:***	***Co-ordinates (MGA)***
20m x 20m	Kurri Sand Swamp Woodland	Easting: 358760 Northing: 6364800

Physical Attributes

Topographic Position:	***Elevation:***	***Slope:***
Flat	30m AHD	Negligible
Aspect:	***Soil Type:***	***Other attributes of influence:***
N/A	Sand	

Structural Components

Structural Layers	Height	Relative Cover abundance	Dominant Species
Tree / Canopy Layer	6m	20%	*Angophora bakeri, Melaleuca lineariifolia E. parramattensis* ssp. *decadens*
Sub-canopy Layer	N/A		
Tall Shrub / Small Tree Layer	2.5m	10%	*Leptospermum polygalifolium,* Juvenile *A. bakeri*
Shrub Layer	1-1.5m	90%	*Acacia elongata, Xanthorrhoea glauca, Hakea dactyloides, H. sericea*
Groundcover	0.3m	50%	*Dillwynia* sp., *Lomandra* spp., *Echinopogon caespitosus*

Flora Quadrat No: P9

Location: Creekline in KSSW, off disused railway in middle-eastern part of study area
Date: 13/6/2003

Details

Size of Quadrat:	***Vegetation Community:***	***Co-ordinates (MGA)***
20m x 20m	Kurri Sand Swamp Woodland	Easting: 359720 Northing: 6365570

Physical Attributes

Topographic Position:	***Elevation:***	***Slope:***
Creekline beneath steep banks	34m AHD	N/A
Aspect:	***Soil Type:***	***Other attributes of influence:***
N/A	Sand / Clay	Pond area associated with disused railway

Comments
No *E. p. decadens* in or near the quadrat.
Evidence of recent burning in bushland nearby.

Structural Components

Structural Layers	Height	Relative Cover abundance	Dominant Species
Tree / Canopy Layer	8m	35%	*Angophora bakeri, Eucalyptus signata, E. agglomerata*
Sub-canopy Layer	5m		*Melaleuca lineariifolia, M. armillaris*
Tall Shrub / Small Tree Layer	3m		*Leptospermum polygalyfolium*
Shrub Layer	2m	70%	*Baumea* sp., *Juncus subsecundus, Acacia longifolia, Rumex* sp., *Pteridium esculentum, Solanum nigrum*
Groundcover	0.4m	10%	*Lomandra longifolia, Hydrocotyle tripartita, Adiantum aethiopicum*

Flora Quadrat No: P10

Location: South-eastern corner of study area
Date: 13/6/2003

Details

Size of Quadrat:	***Vegetation Community:***	***Co-ordinates (MGA)***
20m x 20m	Grey Gum / Scribbly Gum Open Forest	Easting: 360070 Northing: 6364900

Physical Attributes

Topographic Position:	***Elevation:***	***Slope:***
Upper Slope	40m AHD	0-5 degrees^{o}
Aspect:	***Soil Type:***	***Other attributes of influence:***
South-easterly	Sand	See Comments below

Comments
Isolated community containing species consistent with Kurri Sand Swamp Woodland, although much taller canopy and with species such as *E. punctata* and *Bursaria spinosa.*

Structural Components

Structural Layers	Height	Relative Cover abundance	Dominant Species
Tree / Canopy Layer	20m	70%	*Eucalyptus signata, E. punctata*
Sub-canopy Layer	6m	20%	*Melaleuca sieberi, Angophora bakeri*
Tall Shrub / Small Tree Layer	4m	25%	As above + juvenile dominants
Shrub Layer	2m	30%	*Exocarpus cupressiformis, Styphelia triflora, Bursaria spinosa*
Groundcover	0.5m	70%	*Laxmannia gracilis, Themeda australis, Imperata cylindrica* var. *major, Pomax umbellata, Panicum simile, Echinopogon caespitosus*

Flora Quadrat No: P11

Location: Middle-eastern section of the study area.
Date: 13/06/03

Details

Size of Quadrat:	***Vegetation Community:***	***Co-ordinates (MGA)***
20m x 20m	Kurri Sand Swamp Woodland	Easting: 359580 Northing: 6365760

Physical Attributes

Topographic Position:	***Elevation:***	***Slope:***
Mid-slope	40m AHD	Flat
Aspect:	***Soil Type:***	***Other attributes of influence:***
N/A	Sand	

Structural Components

Structural Layers	Height	Relative Cover abundance	Dominant Species
Tree / Canopy Layer	10m	30%	*Eucalyptus fibrosa* ssp. *fibrosa, Angophora bakeri, E. parramattensis* ssp. *decadens*
Sub-canopy Layer			Nil
Tall Shrub / Small Tree Layer	3m		*Persoonia linearis*
Shrub Layer	2m	70%	*Grevillea parviflora* ssp. *parviflora, Acacia elongata, Banksia spinulosa, Lambertia formosa, Acacia ulicifolia*
Ground Cover	0.3m	90%	*Themeda australis, Ptilothrix deusta, Pomax umbellata*

APPENDIX E: KNOWN AND EXPECTED FAUNA SPECIES LIST

EXPECTED FAUNA SPECIES LIST

Below are tabulated lists of fauna species (separated into class guilds) that could be ***reasonably*** expected to be found within the study area at some time. Such an approach has been taken given the unlikelihood to record all potentially occurring species within an area during formal fauna surveys (due to seasonality of certain species, climatic limitations, crypticism etc). Those species recorded within the study area (and the adjacent HEZ lands) have been indicated by a "✓" symbol in the appropriate columns.

Family sequencing and taxonomy follow for each fauna class:

Birds – Christidis and Boles (1994).

Herpetofauna - Cogger (1996).

Mammals - Strahan (ed) (1995) and Churchill (1998).

Known and Expected Bird List

Appendix Key:
= introduced species
? = species not confirmed (or possible escapee)
(C) = listed as CAMBA species
(J) = listed as JAMBA species
(EV) = Species listed under the Commonwealth EPBC Act as Vulnerable
(E) = listed as Endangered in NSW.
(V) = listed as Vulnerable in NSW.
(EE) = Species listed under the Commonwealth EPBC Act as Endangered
(EM) = Species listed under the Commonwealth EPBC Act as Migratory

Data Source:
1 = Species recorded within the study area during recent surveys (between 2003-2005).
2 = Species previously recorded within the study area (Harper Somers O'Sullivan 2002a).
3 = Species previously recorded within Hunter Economic Zone (various sources as indicated within Harper Somers O'Sullivan 2004a and Harper Somers O'Sullivan 2002b and ongoing / recent fieldwork undertaken therein).
4 = Additional species indicated in the locality (as per Atlas of NSW Wildlife Database, January 2006).

Family	*Scientific Name*	Common Name	1	2	3	4
Casuariidae (Emus)	*Dromaius novaehollandiae*	Emu			✓?	
Megapodiidae (Mound Builders)	*Alectura lathami*	Australian Brush-turkey				
Phasianidae (Quails, Pheasants and Fowls)	*Coturnix pectoralis*	Stubble Quail			✓	
	Coturnix ypsilophora	Brown Quail	✓	✓	✓	
Anatidae (Swans, Geese and Ducks)	*Anas castanea*	Chestnut Teal				
	Anas gracilis	Grey Teal			✓	
	Anas platyrhynchos	*Mallard				
	Anas superciliosa	Pacific Black Duck			✓	
	Aytha australis	Hardhead			✓	
	Chenonetta jubata	Australian Wood Duck				
	Cygnus atratus	Black Swan				
Podicipedidae (Grebes)	*Tachybaptus novaehollandiae*	Australasian Grebe			✓	
Anhingidae (Darters)	*Anhinga melanogaster*	Darter				
Phalacrocoracidae (Cormorants)	*Phalacrocorax carbo*	Great Cormorant			✓	
	Phalacrocorax melanoleucos	Little Pied Cormorant		✓		
	Phalacrocorax sulcirostris	Little Black Cormorant			✓	
	Phalacrocorax varius	Pied Cormorant				
Pelecanide (Pelicans)	*Pelecanus conspicillatus*	Australian Pelican			✓	
Ardeidae (Herons, Bitterns and Egrets)	*Ardea alba*	Great Egret (C,J, EM)			✓	
	Ardea ibis	Cattle Egret (C,J, EM))			✓	
	Ardea intermedia	Intermediate Egret			✓	
	Ardea pacifica	White-necked Heron		✓		
	Egretta garzetta	Little Egret				
	Egretta novaehollandiae	White-faced Heron		✓	✓	
	Nycticorax caledonicus	Nankeen Night Heron				

Family	*Scientific Name*	Common Name	1	2	3	4
Threskiornithidae (Ibises and Spoonbills)	*Platalea flavipes*	Yellow-billed Spoonbill		✓	✓	
	Platalea regia	Royal Spoonbill			✓	
	Threskiornis molucca	Australian White Ibis		✓	✓	
	Threskiornis spinicollis	Straw-necked Ibis				
Ciconiidae (Storks)	*Ephippiorhynchus asiaticus*	Black-necked Stork (E)				✓
Accipitridae (Hawks, Kites and Eagles)	*Accipiter fasciatus*	Brown Goshawk		✓	✓	
	Accipiter cirrhocephalus	Collared Sparrowhawk				
	Accipiter novaehollandiae	Grey Goshawk			✓	
	Aquila audax	Wedge-tailed Eagle	✓		✓	
	Aviceda subcristata	Pacific Baza			✓	
	Circus approximans	Swamp Harrier				
	Circus assimilis	Spotted Harrier				
	Elanus axillaris	Black-shouldered Kite			✓	
	Haliaeetus leucogaster	White-bellied Sea-Eagle				
	Haliastur sphenurus	Whistling Kite	✓	✓	✓	
	Hamirostra melanosternon	Black-breasted Buzzard (V)			✓	
	Hieraaetus morphnoides	Little Eagle	✓		✓	
	Lophoictinia isura	Square-tailed Kite (V)				
Falconidae (Falcons)	*Falco berigora*	Brown Falcon			✓	
	Falco cenchroides	Nankeen Kestrel	✓		✓	
	Falco longipennis	Australian Hobby	✓			
	Falco peregrinus	Peregrine Falcon			✓	
	Falco subniger	Black Falcon			✓	
Rallidae (Crakes, Rails and Gallinules)	*Fulica atra*	Eurasian Coot			✓	
	Gallinula philippensis	Buff-banded Rail				
	Gallinula tenebrosa	Dusky Moorhen			✓	
	Porphyrio porphyrio	Purple Swamphen	✓	✓		
	Porzana fluminea	Australian Spotted Crake				
	Porzana pusilla	Baillon's Crake				
	Porzana tabuensis	Spotless Crake				
	Rallus pectoralis	Lewin's Rail				
Turnicidae (Button-Quail)	*Turnix pyrrhothorax*	Red-chested Button-quail				
	Turnix varia	Painted Button-quail			✓	
Jacanidae (Jacanas)	*Irediparra gallinacea*	Comb-crested Jacana (V)				✓
Charadriidae (Lapwings, Plovers and Dottrels)	*Erythrogonys cinctus*	Red-kneed Dotterel				
	Elseyornis melanops	Black-fronted Dotterel				
	Vanellus miles	Masked Lapwing	✓	✓	✓	
Laridae (Gulls and Terns)	*Chlidonias hybrida*	Whiskered Tern				
	Larus novaehollandiae	Silver Gull				
Columbidae (Pigeons and Doves)	*Columba livia*	Rock Dove #			✓	
	Columba leucomela	White-headed Pigeon				
	Streptopelia chinensis	Spotted Turtle-Dove #			✓	
	Chalcophaps indica	Emerald Dove				

Family	*Scientific Name*	Common Name	1	2	3	4
	Phaps chalcoptera	Common Bronzewing			✓	
	Phaps elegans	Brush Bronzewing				✓
	Ocyphaps lophotes	Crested Pigeon	✓	✓	✓	
	Geopelia striata	Peaceful Dove	✓		✓	
	Geopelia humeralis	Bar-shouldered Dove	✓	✓	✓	
	Leucosarcia melanoleuca	Wonga Pigeon			✓	
Cacatuidae (Cockatoos)	*Calyptrohynchus funereus*	Yellow-tailed Black-Cockatoo	✓	✓	✓	
	Calyptorhynchus lathami	Glossy Black-Cockatoo (V)			✓	
	Cacatua roseicapilla	Galah	✓		✓	
	Cacatua tenuirostris	Long-billed Corella	✓			
	Cacatua sanguinea	Little Corella			✓	
	Cacatua galerita	Sulphur-crested Cockatoo	✓	✓	✓	
	Callocephalon fimbriatum	Gang-gang Cockatoo			✓	
Psittacidae (Parrots)	*Trichoglossus haematodus*	Rainbow Lorikeet	✓			
	Trichoglossus chlorolepidotus	Scaly-breasted Lorikeet			✓	
	Trichoglossus concina	Musk Lorikeet	✓		✓	
	Glassopsitta pusilla	Little Lorikeet	✓	✓	✓	
	Alisterus scapularis	Australian King Parrot	✓		✓	
	Lathamus discolor	Swift Parrot (E, EE)			✓	
	Platycercus elegans	Crimson Rosella			✓	
	Platycercus eximius	Eastern Rosella	✓	✓	✓	
	Neophema pulchella	Turquoise Parrot (V)			✓	
	Psephotus haematonotus	Red-rumped Parrot			✓	
Cuculidae (Old World Cuckoos)	*Cuculus saturatus*	Oriental Cuckoo (C,J, EM)				
	Cuculus pallidus	Pallid Cuckoo			✓	
	Cacomantis variolosus	Brush Cuckoo			✓	
	Cacomantis flabelliformis	Fan-tailed Cuckoo	✓	✓	✓	
	Chrysococcyx basalis	Horsfield's Bronze-Cuckoo			✓	
	Chrysococcyx lucidus	Shining Bronze-Cuckoo	✓	✓	✓	
	Eudynamys scolopacea	Common Koel	✓		✓	
	Scythrops novaehollandiae	Channel-billed Cuckoo	✓		✓	
Centropodidae (Coucals)	*Centropus phasianinus*	Pheasant Coucal			✓	
Strigidae (Hawk Owls)	*Ninox strenua*	Powerful Owl (V)			✓	
	Ninox connivens	Barking Owl (V)				
	Ninox boobook	Southern Boobook	✓		✓	
Tytonidae (Barn Owls)	*Tyto alba*	Barn Owl				
	Tyto novaehollandiae	Masked Owl (V)			✓	
	Tyto tenebricosa	Sooty Owl (V)			✓	
Podargidae (Frogmouths)	*Podargus strigoides*	Tawny Frogmouth			✓	
Caprimulgidae (Nightjars)	*Eurostopodus mystacalis*	White-throated Nightjar				
Aegothelidae (Owlet-nightjars)	*Aegotheles cristatus*	Australian Owlet-nightjar	✓	✓	✓	
Apodidae (Typical Swifts)	*Hirundapus caudacutus*	White-throated Needletail (C,J, EM)	✓		✓	
	Apus pacificus	Fork-tailed Swift (C,J, EM)				

Family	*Scientific Name*	Common Name	1	2	3	4
Alcedinidae (True Kingfishers)	*Alcedo azurea*	Azure Kingfisher			✓	
Halcyonidae (Kingfishers and Kookaburras)	*Dacelo novaeguineae*	Laughing Kookaburra	✓	✓	✓	
	Todiramphus sanctus	Sacred Kingfisher	✓	✓	✓	
Meropidae (Bee-eaters)	*Merops ornatus*	Rainbow Bee-eater (J,EM)	✓	✓	✓	
Coraciidae (Typical Rollers)	*Eurystomus orientalis*	Dollarbird	✓		✓	
Menuridae (Lyrebirds)	*Menura novaehollandiae*	Superb Lyrebird				
Climacteridae (Australo-Papuan Treecreepers)	*Cormobates leucophaeus*	White-throated Treecreeper	✓	✓	✓	
	Climacteris erythrops	Red-browed Treecreeper				
	Climacteris picumnus	Brown Treecreeper (V)			✓	
Maluridae (Fairy-Wrens and Emu-Wrens)	*Malurus cyaneus*	Superb Fairy-wren	✓	✓	✓	
	Malurus lamberti	Variegated Fairy-wren	✓		✓	
	Stipiturus malachurus	Southern Emu-wren				
Pardalotidae (Pardalotes, Scrubwrens, Thornbills)	*Pardalotus punctatus*	Spotted Pardalote	✓	✓	✓	
	Paradalotus striatus	Striated Pardalote	✓	✓	✓	
	Sericornis frontalis	White-browed Scrubwren	✓		✓	
	Chthonicola sagittata	Speckled Warbler (V)		✓	✓	
	Smicrornis brevirostris	Weebill	✓		✓	
	Gerygone mouki	Brown Gerygone			✓	
	Gerygone olivacea	White-throated Gerygone	✓	✓	✓	
	Acanthiza pusilla	Brown Thornbill	✓	✓	✓	
	Acanthiza reguloides	Buff-rumped Thornbill	✓		✓	
	Acanthiza chrysorrhoa	Yellow-rumped Thornbill	✓	✓	✓	
	Acanthiza nana	Yellow Thornbill	✓		✓	
	Acanthiza lineata	Striated Thornbill	✓	✓	✓	
	Hylacola pyrrhopygia	Chestnut-rumped Heathwren				
Meliphagidae (Honeyeaters)	*Anthochaera carunculata*	Red Wattlebird	✓	✓	✓	
	Plectrhyncha lanceolata	Striped Honeyeater	✓		✓	
	Anthochaera chrysoptera	Brush Wattlebird				
	Philemon corniculatus	Noisy Friarbird	✓	✓	✓	
	Philemon citerogularis	Little Friarbird				
	Xanthomyza phrygia	Regent Honeyeater (E, EE)			✓	
	Manorina melanophrys	Bell Miner			✓	
	Manorina melanocephala	Noisy Miner	✓	✓	✓	
	Meliphaga lewinii	Lewin's Honeyeater		✓	✓	
	Lichenostomus chrysops	Yellow-faced Honeyeater	✓	✓	✓	
	Lichenostomus melanops	Yellow-tufted Honeyeater	✓	✓	✓	
	Lichenostomus fuscus	Fuscous Honeyeater		✓	✓	
	Lichenostomus penicillatus	White-plumed Honeyeater			✓	
	Melithreptus brevirostris	Brown-headed Honeyeater	✓		✓	
	Melithreptus lunatus	White-naped Honeyeater	✓		✓	
	Melithreptus gularis	Black-chinned Honeyeater (V)			✓	
	Entomyzon cyanotis	Blue-faced Honeyeater			✓	

Family	*Scientific Name*	Common Name	1	2	3	4
	Lichmera indistincta	Brown Honeyeater			✓	
	Phylidonyris novaehollandiae	New Holland Honeyeater				
	Phylidonyris nigra	White-cheeked Honeyeater	✓		✓	
	Acanthorhynchus tenuirostris	Eastern Spinebill	✓	✓	✓	
	Grantiella picta	Painted Honeyeater (V)				
	Myzomela sanguinolenta	Scarlet Honeyeater	✓		✓	
	Epthianura albifrons	White-fronted Chat				
Eopsaltriidae (Robins)	*Microeca fascinans*	Jacky Winter			✓	
	Petroica multicolor	Scarlet Robin			✓	
	Petroica phoenicea	Flame Robin				
	Petroica rosea	Rose Robin	✓		✓	
	Eopsaltria australis	Eastern Yellow Robin	✓	✓	✓	
Pomatostomidae (Australo-Papuan Babblers)	*Pomatostomus temporalis*	Grey-crowned Babbler (V)			✓	
Cinclosomidae (Quail-thrushes and allies)	*Psophodes olivaceus*	Eastern Whipbird		✓	✓	
	Cinclosoma punctatum	Spotted Quail-thrush			✓	
Neosittidae (Sittellas)	*Daphoenositta chrysoptera*	Varied Sittella	✓		✓	
Pachycephalidae (Whistlers, Shrike-tit and Shrike-thrushes)	*Falcunculus frontatus*	Crested Shrike-tit	✓		✓	
	Pachycephala pectoralis	Golden Whistler	✓	✓	✓	
	Pachycephala rufiventris	Rufous Whistler	✓		✓	
	Colluricincla harmonica	Grey Shrike-thrush	✓	✓	✓	
Dicruridae (Monarchs, Fantails and Drongo)	*Monarcha melanopsis*	Black-faced Monarch				
	Myiagra rubecula	Leaden Flycatcher			✓	
	Myiagra inquieta	Restless Flycatcher			✓	
	Grallina cyanoleuca	Magpie-lark	✓	✓	✓	
	Rhipidura rufifrons	Rufous Fantail			✓	
	Rhipidura fuliginosa	Grey Fantail	✓	✓	✓	
	Rhipidura leucophyrs	Willie Wagtail	✓		✓	
	Dicrurus bracteatus	Spangled Drongo				
Campephagidae (Cuckoo-shrikes and Trillers)	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike	✓	✓	✓	
	Coracina papuensis	White-bellied Cuckoo-shrike		✓	✓	
	Coracina tenuirostris	Cicadabird			✓	
	Lalage sueurii	White-winged Triller				
Oriolidae (Orioles and Figbird)	*Oriolus sagittatus*	Olive-backed Oriole	✓		✓	
	Sphecotheres viridis	Figbird				
Artamidae (Woodswallows, Butcherbirds and Currawongs)	*Artamus leucorynchus*	White-breasted Woodswallow				
	Artamus cyanopterus	Dusky Woodswallow	✓		✓	
	Cracticus torquatus	Grey Butcherbird	✓	✓	✓	
	Cracticus nigrogularis	Pied Butcherbird	✓	✓	✓	
	Gymnorhina tibicen	Australian Magpie	✓	✓	✓	
	Strepera graculina	Pied Currawong	✓	✓	✓	
Corvidae (Crows and allies)	*Corvus coronoides*	Australian Raven	✓	✓	✓	

Family	*Scientific Name*	Common Name	1	2	3	4
Cororacidae (Choughs)	*Corcorax melanorhamphos*	White-winged Chough	✓	✓	✓	
Ptilinorhynchidae (Bowerbirds)	*Ptilonorhynchus violaceus*	Satin Bowerbird			✓	
Motacillidae (Old World Wagtails and Pipits)	*Anthus novaeseelandiae*	Richard's Pipit				
Passeridae (Sparrows, Weaverbirds, Waxbills and allies)	*Passer domesticus*	House Sparrow #				
	Taeniopygia guttata	Zebra Finch				
	Taeniopygia bichenovii	Double-barred Finch	✓		✓	
	Stagonopleura guttata	Diamond Firetail (V)				
	Neochmia modesta	Plum-headed Finch				
	Neochmia temporalis	Red-browed Finch	✓	✓	✓	
	Lonchura castaneothorax	Chestnut-breasted Mannikin				
Dicaeidae (Flowerpeckers)	*Dicaeum hirundinaceum*	Mistletoebird	✓		✓	
Hirundinidae (Swallows and Martins)	*Hirundo neoxena*	Welcome Swallow	✓	✓	✓	
	Hirundo nigricans	Tree Martin	✓		✓	
	Hirundo ariel	Fairy Martin			✓	
	Cheramoeca leucosternus	White-backed Swallow				
Sylviidae (Old World Warblers)	*Cincloramphus mathewsi*	Rufous Songlark				
	Acrocephalus stentoreus	Clamorous Reed Warbler			✓	
	Cisticola exilis	Golden-headed Cisticola				
Zosteropidae (White-eyes)	*Zosterops lateralis*	Silvereye	✓	✓	✓	
Sturnidae (Starlings and allies)	*Sturnus vulgaris*	Common Starling #			✓	
	Acridotheres tristis	Common Myna #	✓		✓	

Known and Expected Mammal List

Appendix Key:
= introduced species
(E) = listed as Endangered in NSW.
(V) = listed as Vulnerable in NSW.
(EV) = Species listed under the Commonwealth EPBC Act as Vulnerable
(EE) = Species listed under the Commonwealth EPBC Act as Endangered

Data Source:
1 = Species recorded within the study area during recent surveys (between 2003-2005).
2 = Species previously recorded within the study area (Harper Somers O'Sullivan 2002a).
3 = Species previously recorded within Hunter Economic Zone (various sources as indicated within Harper Somers O'Sullivan 2004a and Harper Somers O'Sullivan 2002b and ongoing / recent fieldwork undertaken therein).

Sub-Class	Family Name	*Scientific Name*	Common Name	1	2	3
Protehria (Monotremes)	Tachyglossidae (Echidnas)	*Tachyglossus aculeatus*	Short-beaked Echidna			✓
Marsupalia (Marsupials)	Dasyuridae (Dasyurids)	*Antechinus flavipes*	Yellow-footed Antechinus		✓	✓
		Antechinus stuartii	Brown Antechinus		✓	
		Antechinus swainsonii	Dusky Antechinus			
		Dasyurus maculatus	Tiger Quoll (V, EE)			
		Phascogale tapoatafa	Brush-tailed Phascogale (V)			
		Planigale maculata	Common Planigale (V)			
		Sminthopsis murina	Common Dunnart		✓	✓
	Peramelidae (Bandicoots and Bilbies)	*Isoodon macrourus*	Northern Brown Bandicoot			
		Peremeles nasuta	Long-nosed Bandicoot			✓
	Phascolarctidae (Koala)	*Phascolarctos cinereus*	Koala (V)			✓
	Vombatidae	*Vombatus ursinus*	Common Wombat			✓
	Petauridae (Wrist-winged Gliders)	*Petaurus breviceps*	Sugar Glider		✓	✓
		Petaurus norfolcensis	Squirrel Glider (V)	✓		
		Petaurus australis	Yellow-bellied Glider (V)			✓
	Pseudocheiridae (Ringtail Possums)	*Pseudocheirus peregrinus*	Common Ringtail Possum			
	Acrobatidae (Feathertail Glider)	*Acrobates pygmaeus*	Feathertail Glider			
	Phalangeridae (Brushtail Possums and Cuscuses)	*Trichosurus vulpecula*	Common Brushtail Possum	✓		✓
	Macropodidae (Wallabies and Kangaroos)	*Macropus giganteus*	Eastern Grey Kangaroo	✓	✓	✓
		Macropus robustus	Common Wallaroo			✓
		Macropus rufogriseus	Red-necked Wallaby	✓	✓	✓
		Wallabia bicolor	Swamp Wallaby		✓	✓
	Pteropodidae (Flying-foxes and Blossum-bats)	*Pteropus poliocephalus*	Grey-headed Flying-fox (V, EV)			
		Pteropus scapulatus	Little Red Flying-fox			
	Rhinolophidae (Horseshoe-bats)	*Rhinolophus megaphyllus*	Eastern Horseshoe-bat			
	Emballonuridae (Sheathtail-bats)	*Saccolaimus flaviventris*	Yellow-bellied Sheathtail-bat (V)			
	Molossidae (Freetail-bats)	*Mormopterus norfolkensis*	East-coast Freetail-bat (V)			✓

		Mormopterus sp.1	Little Freetail-bat		✓	
		Mormopterus sp.2	Freetail-bat	✓		✓
		Mormopterus planiceps (long penis form)	Southern Freetail Bat	✓		
		Nyctinomus australis	White-striped Freetail-bat		✓	✓
	Vespertilionidae (Vespertilionid Bats)	*Miniopterus australis*	Little Bentwing-bat (V)			✓
		Miniopterus schreibersii	Common Bentwing-bat (V)			✓
		Nyctophilus geoffroyi	Lesser Long-eared Bat			✓
		Nyctophilus gouldii	Gould's Long-eared Bat	✓		✓
		Chalinolobus dwyeri	Large-eared Pied Bat (V, EV)			
		Chalinolobus gouldii	Gould's Wattled Bat		✓	✓
		Chalinolobus morio	Chocolate Wattled Bat		✓	✓
		Falsistrellus tasmaniensis	Eastern Falsistrelle (V)			✓
		Myotis adversus	Large-footed Myotis (V)			✓
		Scoteanax orion	Eastern Broad-nosed Bat			✓
		Scoteanax rueppellii	Greater Broad-nosed Bat (V)			✓
		Scotorepens greyii	Little Broad-nosed Bat			
		Vespadelus darlingtoni	Large Forest Bat			
		Vespadelus regulus	Southern Forest Bat			
		Vespadelus pumilus	Eastern Forest Bat			✓
		Vespadelus vulturnus	Little Forest Bat		✓	✓
Eutheria (Non-Flying Placental Mammals)	Muridae (Murids)	*Hydromys chrysogaster*	Water Rat			
		Melomys burtoni	Grassland Melomys			
		Mus musculus	House Mouse #			✓
		Pseudomys novaehollandiae	New Holland Mouse		✓	✓
		Rattus fuscipes	Bush Rat			
		Rattus lutreolus	Swamp Rat			✓
		Rattus norvegicus	Brown Rat #		✓	✓
		Rattus rattus	Black Rat #			✓
	Canidae (Dingo and Fox)	*Canis familiaris*	Dog #		✓	✓
		Canis familiaris dingo	Dingo			
		Vulpes vulpes	Red Fox #		✓	✓
	Felidae (Cat)	*Felis catus*	Feral Cat #		✓	✓
	Leporidae (Rabbit and Hare)	*Oryctolagus cuniculus*	European Rabbit #	✓	✓	✓
		Lepus capensis	Brown Hare #			✓
	Equidae (Horse and Donkey)					✓
		Equus caballus	Horse #	✓	✓	✓
	Suidae (Pig)	*Sus scrofa*	Pig #			✓
	Bovidae (Horned Ruminants)	*Bos taurus*	Cow #			
		Capra hircus	Goat #			✓**?**
	Cervidae (Deer)	*Cervus timorensis*	Rusa Deer #			✓

Known and Expected Reptile List

Appendix Key: (E) = listed as Endangered in NSW.
(V) = listed as Vulnerable in NSW.

Data Source: **1** = Species recorded within the study area during recent surveys (between 2003-2005).
2 = Species previously recorded within the study area (Harper Somers O'Sullivan 2002a).
3 = Species previously recorded within Hunter Economic Zone (various sources as indicated within Harper Somers O'Sullivan 2004a, Harper Somers O'Sullivan 2002b and ongoing / recent fieldwork undertaken therein).

Order	Family Name	*Scientific Name*	Common Name	1	2	3
Testudines	Chelidae (Tortoises)	*Chelodina longicollis*	Long-necked Tortoise		✓	✓
Squamata (Sauria)	Agamidae (Dragons)	*Amphibolurus muricatus*	Jacky Lizard	✓	✓	✓
		Physignathus lesuerii	Eastern Water Dragon		✓	✓
		Pogona barbata	Eastern Bearded Dragon			✓
	Pygopodidae (Legless Lizards)	*Lialis burtonis*	Burton's Snake Lizard			
		Pygopus lepidopus	Common Scaly-foot			
		Delma plebeia	Leaden Delma			
	Varanidae (Monitors)	*Varanus gouldii*	Gould's Monitor			
		Varanus varius	Lace Monitor			✓
	Scincidae (Skinks)	*Carlia tetradactyla*				✓
		Cryptoblepharus virgatus				✓
		Ctenotus taeniolatus	Copper-tailed Skink			✓
		Ctenotus robustus	Striped Skink			✓
		Cyclodomorphus casuarinae	She-oak Skink			✓
		Egernia cunninghamii	Cunningham's Skink			
		Egernia major	Land Mullet			
		Egernia modesta				
		Egernia striolata	Tree-crevice Skink			
		Egernia saxatilis	Black Rock Skink			
		Egernia whitii	White's Skink			✓
		Eulamprus quoyii	Eastern Water Skink			✓
		Eulamprus tenuis	Barred-sided Skink			✓
		Lampropholis delicata	Grass Skink	✓	✓	✓
		Lampropholis guichenoti	Garden Skink	✓		✓
		Lygisaurus foliorum	Tree-base Litter-skink			
		Morethia boulengeri	South-eastern Morethia			
		Pseudomoia platynota	Red-throated Skink			
		Saiphos equalis				
		Saproscincus mustelinus	Weasel Skink			
		Tiliqua scincoides	Eastern Blue-tongued Lizard			✓
Squamata (Serpentes)	Typhlopidae (Blind Snakes)	*Ramphotyphlops bituberculatus*	Prong-snouted Blind Snake			
		Ramphotyphlops weidii	Brown-snouted Blind Snake			
		Ramphotyphlops nigrescens	Black Blind Snake			
	Boidae (Pythons)	*Morelia spilota*	Diamond Python			
	Colubridae (Tree Snakes)	*Boiga irregularis*	Brown Tree Snake			

Order	Family Name	*Scientific Name*	Common Name	1	2	3
		Dendralaphis punctulata	Green Tree Snake		✓	✓
	Elapidae (Venomous Snakes)	*Furina diadema*	Red-naped Snake			
		Acanthopis antarcticus	Death Adder			
		Cacophis krefftii	Dwarf Crowned Snake			
		Cacophis squamulosus	Golden Crowned Snake			
		Demansia psammophis	Yellow-faced Whip Snake		✓	✓
		Furina diadema	Red-naped Snake			
		Hoplocephalus bitorquatus	Pale-headed Snake (V)			
		Hoplocephalus stephensii	Stephen's Banded Snake (V)			
		Notechis scutatus	Eastern Tiger Snake			
		Pseudonaja textilis	Eastern Brown Snake		✓	
		Rhinoplocephalus nigrescens	Eastern Small-eyed Snake			
		Vermicella annulata	Bandy Bandy			
		Hemiaspis signata	Black-bellied Swamp Snake			
		Pseudechis porphyriacus	Red-bellied Black Snake		✓	✓
		Rhinoplocephalus nigrescens	Eastern Small-eyed Snake			✓

Known and Expected Frog List

Appendix Key:
(EV) = Species listed under the Commonwealth EPBC Act as Vulnerable
(E) = listed as Endangered in NSW.
(V) = listed as Vulnerable in NSW.

Data Source:
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Family Name	***Scientific Name***	**Common Name**	**1**	**2**	**3**
Hylidae (Tree Frogs)	*Litoria aurea*	Green and Golden Bell Frog (E, EV)			
	Litoria brevipalmata	Green-thighed Frog (V)			✓
	Litoria dentata	Bleating Tree Frog			✓
	Litoria fallax	Eastern Dwarf Tree Frog	✓	✓	✓
	Litoria latopalmata	Broad-palmed Frog	✓	✓	✓
	Litoria lesueuri	Lesueur's Frog			✓
	Litoris nasuta	Rocket Frog			
	Litoria peronii	Peron's Tree Frog		✓	✓
	Litoria phyllochroa	Green Leaf Tree Frog			
	Litoria tyleri	Tyler's Tree Frog			✓
	Litoria verreauxii	Verreaux's Frog			✓
Myobatrachidae (Ground Frogs)	*Crinia signifera*	Common Eastern Froglet	✓	✓	✓
	Crinia tinnula	Wallum Froglet (V)			
	Limnodynastes dumerilli	Eastern Banjo Frog			✓
	Limnodynastes ornatus	Ornate Burrowing Frog	✓		✓
	Limnodynastes peronii	Striped Marsh Frog			✓
	Limnodynastes tasmaniensis	Spotted Grass Frog	✓		✓
	Pseudophryne coriacea	Red-backed Toadlet			
	Pseudophryne bibronii	Brown Toadlet	✓		✓
	Uperoleia fusca		✓?		✓
	Uperoleia laevigata	Smooth Toadlet	✓?	✓	✓

APPENDIX F: FLORA IDENTIFICATIONS FROM THE ROYAL BOTANIC GARDENS

ROYAL BOTANIC GARDENS SYDNEY

Lucas Grenadier
Harper Somers P/L
PO Box 428
Hamilton NSW 2303
Australia

Inquiry No: 6 (May 2002)

Telephone No: (02) 9231 8155*
Fax No: (02) 9251 1952

Date: 21 May 2002

Dear Mr Grenadier ,

In reply to your inquiry of 17 May 2002, the following information is supplied:

Bob Makinson has identified your specimen as *Grevillea parviflora* subsp. *parviflora* (Family Proteaceae). We will retain this specimen for our herbarium collection and thus there will be no charge for this inquiry.

Thank you for your inquiry.

Yours sincerely

Helen Jolley

Helen Jolley, Information Officer
Botanical Information Service

* Note: The Botanical Information phone service operates between 9:30 am and 1 pm Monday to Friday.

APPENDIX G: SURVEY PROFORMA SHEETS

~~Attachment 1:~~

DIURNAL HERPETOFAUNA NOCTURNAL STREAMSIDE CENSUS SURVEY PROFORMA

Survey Details

Date of survey	27/2/03		
Name of surveyor	Mick Roderick	Contact number	49616500
Name of person analysing calls		Contact number	
Total effort expressed in person hours	0.5 hrs		

Location Details

Location (including basic habitat) description: HEZ Link Rd site, off Stanford Road, South of Pelaw Main. Track in Spotted Gum/Ironbark forest where there are many dumped vehicles/metal/rubbish.

Map number	9182-2N	Map name	Cessnock
Type of survey, eg. transect or quadrat		~~AMG~~ GDA Zone	56
Active or passive search	Active	Size of survey area (ha)	
Survey area Eastings (6 digits)	358450	Northings (7 digits)	6365370
Eastings (6 digits)		Northings (7 digit)	
Start time (24hr)	1145	End time (24 hr)	1215

Weather Details

At start of survey, record:		Cloud cover*	2/8
Wind direction and speed*	NE, 2	Rain*	0
Temperature (°C)	27°	Moon*	0
Comments			

Attachment 1:

Species name (Scientific/Common)	Ob. type*	MH type*	Grid reference (full AMAs ie Eastings and Northings)	Accuracy
Lampropholis delicata				
Grass Skink	O	IG, IL	As earlier	10m
Amphibolurus muricatus				
Jacky Lizard	O	OL	"	"

* See Appendix 1: Standard reporting codes

~~Attachment 1:~~

DIURNAL HERPETOFAUNA NOCTURNAL STREAMSIDE CENSUS SURVEY PROFORMA

Survey Details

Date of survey	25/2/03		
Name of surveyor	Mick Roderick / Lucas Grenadier	Contact number	49616500
Name of person analysing calls	As Above	Contact number	
Total effort expressed in person hours	1 per/hr		

Location Details

Location (including basic habitat) description: Creekline at HEZ Link Rd site, roadside puddles in sandy soils.

Map number	9132-2N	Map name	Cessnock
Type of survey, eg. transect or quadrat		GDA ~~AMG~~ Zone	56
Active or passive search	Active	Size of survey area (ha)	
Survey area Eastings (6 digits)	358930	Northings (7 digits)	6366060
Eastings (6 digits)		Northings (7 digit)	
Start time (24hr)	2015	End time (24 hr)	2045

Weather Details

At start of survey, record:		Cloud cover*	5/8
Wind direction and speed*	0	Rain*	0
Temperature (°C)	20°	Moon*	0
Comments			

Attachment 1:

Species name (Scientific/Common)	Ob. type*	MH type*	Grid reference (full AMAs ie Eastings and Northings)	Accuracy
Litoria latopalmata Broad-palmed frog	O/W	EW	As earlier	10m
L. fallax Orarf Tree Frog	W	IG	" "	"
Limnodynastes ornatus Ornate Burrowing Frog	O/W	EW	" "	"
Uperoleia sp.	W	IG	" "	"

* See Appendix 1: Standard reporting codes

Attachment 1:

DIURNAL HERPETOFAUNA NOCTURNAL STREAMSIDE CENSUS SURVEY PROFORMA

Survey Details

Date of survey	3/6/13		
Name of surveyor	Nick Roderick	Contact number	49616500
Name of person analysing calls	-	Contact number	
Total effort expressed in person hours	0.5		

Location Details

Location (including basic habitat) description: HEZ Link Rd, or old Train Tracks

Map number	9132-2N	Map name	Cessnock
Type of survey, eg. transect or quadrat		AMG Zone	56
Active or passive search	Active	Size of survey area (ha)	
Survey area Eastings (6 digits)	359590	Northings (7 digits)	6364740
Eastings (6 digits)		Northings (7 digit)	
Start time (24hr)	1430	End time (24 hr)	1500

Weather Details

At start of survey, record:	Sunny	Cloud cover*	2/8
Wind direction and speed*	W, 2	Rain*	-
Temperature (°C)		Moon*	-

Comments:

Attachment 1:

Species name (Scientific/Common)	Ob. type*	MH type*	Grid reference (full AMAs ie Eastings and Northings)	Accuracy
Lampropholis delicata	O	IL	As earlier	
Grass Skink				

* See Appendix 1: Standard reporting codes

~~Attachment 1:~~

DIURNAL HERPETOFAUNA NOCTURNAL STREAMSIDE CENSUS SURVEY PROFORMA

Survey Details

Date of survey	18/6/03		
Name of surveyor	Mick Roderick	Contact number	49616580
Name of person analysing calls	As above	Contact number	
Total effort expressed in person hours	1 person hr		

Location Details

Location (including basic habitat) description: HEZ Link Rd study area, south of Kurri Kurri NSW Habitat = Kurri Sand Swamp Woodland & Creeklines

Map number	9132-N	Map name	Cessnock
Type of survey, eg. transect or quadrat	Transect	~~AMG~~ GDA Zone	56
Active or passive search	Active	Size of survey area (ha)	
Survey area Eastings (6 digits)	358100	Northings (7 digits)	6365760
Eastings (6 digits)		Northings (7 digit)	
Start time (24hr)	0900	End time (24 hr)	0920

Weather Details

At start of survey, record:		Cloud cover*	2/8
Wind direction and speed*	0	Rain*	0
Temperature (°C)	22°	Moon*	-
Comments			

Attachment 1:

Species name (Scientific/Common)	Ob. type*	MH type*	Grid reference (full AMAs ie Eastings and Northings)	Accuracy
Litoria fallax (Common	W	14	388900	6366000
Eastern Froglet)			↙	10m

* See Appendix 1: Standard reporting codes

~~Attachment 1~~:

DIURNAL HERPETOFAUNA NOCTURNAL STREAMSIDE CENSUS SURVEY PROFORMA

Survey Details

Date of survey	20/11/03		
Name of surveyor	Mark Roderick	Contact number	49616500
Name of person analysing calls	N/A	Contact number	
Total effort expressed in person hours	0.75 hrs		

Location Details

Location (including basic habitat) description: HEZ Link Rd Study Area - Road Alignment - near Stanford Rd, Pelan Main. Habitat = Woodland & Creeklines / melaleuca scrub.

Map number	9132-N	Map name	Gosnells
Type of survey, eg. transect or quadrat	Transect	~~AMG~~ GDA Zone	56
Active or passive search	Active	Size of survey area (ha)	
Survey area Eastings (6 digits)	358280	Northings (7 digits)	
Eastings (6 digits)	6365820	Northings (7 digit)	
Start time (24hr)	1430	End time (24 hr)	1450

Weather Details

At start of survey, record:		Cloud cover*	2/8
Wind direction and speed*	0	Rain*	0
Temperature (°C)	35	Moon*	0
Comments			

Attachment 1:

Species name (Scientific/Common)	Ob. type*	MH type*	Grid reference (full AMAs ie Eastings and Northings)	Accuracy
Lamprophalis delicata	O	IL		
Grass Skink				
Amphibolurus muricatus	O	AC		
Jacky Lizard				
Litoria Fallax	W	IG		
Common Eastern Froglet				

* See Appendix 1: Standard reporting codes

~~Attachment 1~~:

DIURNAL HERPETOFAUNA NOCTURNAL STREAMSIDE CENSUS SURVEY PROFORMA

Survey Details

Date of survey	26/11/03		
Name of surveyor	Lucas Cavaliere / Mark Evans	Contact number	49616500
Name of person analysing calls	NA	Contact number	
Total effort expressed in person hours	40 mins		

Location Details

Location (including basic habitat) description: Creekline along alignment of Link Road to the HEZ

Map number	9132-N	Map name	Cessnock
Type of survey, eg. transect or quadrat	Transect	~~AMG~~ GDA Zone	56
Active or passive search	Active	Size of survey area (ha)	1ha
Survey area Eastings (6 digits)	358190	Northings (7 digits)	6365740
Eastings (6 digits)	358290	Northings (7 digit)	6365780
Start time (24hr)	1215	End time (24 hr)	1235

Weather Details

At start of survey, record:		Cloud cover*	5/8
Wind direction and speed*	SE	Rain*	1
Temperature (°C)	22°	Moon*	-
Comments			

Attachment 1:

Species name (Scientific/Common)	Ob. type*	MH type*	Grid reference (full AMAs ie Eastings and Northings)	Accuracy
Crinia signifera	N	16	358200	
Common Eastern Froglet			6365740	
Litoria fallax	N	16	358250	
Dwarf Tree Frog			6365750	

* See Appendix 1: Standard reporting codes

ELLIOTT / PITFALL / CAGE TRAPPING SURVEY PROFORMAS

Survey Details

Name of surveyor: Lucas Grenadier

Contact number: 4961 6580

Date traps set: 2/6/07

Date traps collected: 6[redacted]/6/07

Type of trap (e.g. Elliot type B cage): Elliot Type A/B

Dimensions of trap (length x breadth x width): Standard

Number of traps (i.e. trap nights): 19EA, 9EB + 3EB Arboreally

Intervals between traps: 10m

Length of transect or grid dimensions: 200m

Bait used (e.g. meat type, peanut butter/oats): Peanut butter + oats
Aniseed ring in arboreal trap

Location Details

Location description: Bushland immediately south-west of Stanford Merthyr, NSW. HEZ Link Rd Study Area

GDA ~~AMG~~ Zone: 56

Transect start or grid corner Easting (6 digits): 358 580

Transect end or grid corner Eastings (6 digits): [redacted]

[redacted] Centre →

Northing (7 digits): 6366470

Northing (7 digits):

Comments: Traps tampered with / stolen - Trapline 1 (See body of report)

Date trap checked	Trap No*	Trap position**	Species name	Sex	Comments
4/6	Not noted	Ground	Brown Antechinus		
"	"	"	Brown Rat		

* Trap number should correspond to map outlining location of traps

**For example ground or tree mounted

ELLIOTT / PITFALL / CAGE TRAPPING SURVEY PROFORMAS

Survey Details

Name of surveyor: Lucas Grenadier
Contact number: 49616500

Date traps set: 3/6/02
Date traps collected: 6 /6/02

Type of trap (e.g. Elliot type B cage): Elliot Type A/B
Dimensions of trap (length x breadth x width): Standard

Number of traps (in trap nights): 18A 8B +4EB Arboreally
Intervals between traps: 10m

Length of transect or grid dimensions: 200m
Bait used (e.g. meat type, peanut butter/oats): Peanut butter/oats Aniseed rings in arboreals

Location Details

Location description: Bushland immediately south-west of Stanford Merthyr. HEZ Link Rd Study Area.

GDA ~~AMG~~ Zone: 56

Centre Transect start or grid corner Easting (6 digits): 358890
Transect end or grid corner Eastings (6 digits):

Northing (7 digits): 6366130
Northing (7 digits):

Comments: Traps tampered with / stolen. (Trapline 2 - See body of report)

Date trap checked	Trap No*	Trap position**	Species name	Sex	Comments
3/6/02	Not noted	Ground	Brown Rat		
"	"	"	Brown Antechinus		
4/6/02	"	"	Brown Rat		
"	"	"	Yellow-Footed Antechinus		
4/6/02	"	"	"		

* Trap number should correspond to map outlining location of traps
**For example ground or tree mounted

ELLIOTT / PITFALL / CAGE TRAPPING SURVEY PROFORMAS

Survey Details

Name of surveyor: Lucas Grenadier

Contact number: 4961650

Date traps set: 2/6/02

Date traps collected: 6/6/02

Type of trap (e.g. Elliot type B cage): Elliot Type A/B

Dimensions of trap (length x breadth x width): Standard

Number of traps (in trap nights): 40EA, 20EB, + 16EB (terrestrial) (aboreal)

Intervals between traps: 10m

Length of transect or grid dimensions: 200m

Bait used (e.g. meat type, peanut butter/oats): Peanut butter + oat
Aniseed ring in arboreals

Location Details

Location description: Bushland off Stanford Rd near Pelan Main NSW. HEZ Link Rd Study Area

GDA
AMG Zone: 56

Transect start or grid corner Easting (6 digits): 358400

Transect end or grid corner Eastings (6 digits):

centre
Northing (7 digits): 6365580

Northing (7 digits):

Comments: Trapline 3 (see body of report)

Date trap checked	Trap No*	Trap position**	Species name	Sex	Comments
5/6	Not noted	Ground	New Holland	-	-
			Mouse		
"	"	"	Yellow-footed	-	-
			Antechinus		
6/6	"	Tree	Sugar Glider	-	
"		Ground	Yellow-footed		
			Antechinus		

* Trap number should correspond to map outlining location of traps
**For example ground or tree mounted

ELLIOTT / PITFALL / CAGE TRAPPING SURVEY PROFORMAS

Survey Details

Name of surveyor: Lucas Crenadier

Contact number: 4961650

Date traps set: 2/6/07

Date traps collected: 6/6/07

Type of trap (e.g. Elliot type B cage): Elliot Type A/B

Dimensions of trap (length x breadth x width): Standard

Number of traps (in two lines): 32 EA, 6 EB = 16 EB arboreally

Intervals between traps: 10m

Length of transect or grid dimensions: 200m

Bait used (e.g. meat type, peanut butter/oats): Peanut butter + oat Aniseed ring, in arboreals

Location Details

Location description: Bushland off Stanford Rd near Pelaw Main, NSW. HEZ Link Rd Study Area.

~~AMG~~ GDA Zone: 56

Transect start or grid corner Easting (6 digits) (Centre): 355700

Transect end or grid corner Eastings (6 digits):

Northing (7 digits): 6365 350

Northing (7 digits):

Comments: Traps tampered with / stolen. Topline 4 (see back of report)

Date trap checked	Trap No*	Trap position**	Species name	Sex	Comments
3/6	Not noted	Ground	Yellow-footed Antechinus		
4/6	"	"	"		
"	"	"	Common Dunnart		
6/6	"	"	Yellow-footed Antechinus		

* Trap number should correspond to map outlining location of traps

**For example ground or tree mounted

ELLIOTT / PITFALL / CAGE TRAPPING SURVEY PROFORMAS

↳ HAIR TUBES

Survey Details

Name of surveyor: Nick Roderick

Contact number: 4961 6500

Date traps set: 3/6/03

Date traps collected: 28/6/03

Type of trap (e.g. Elliot type B cage): Hair Tube

Dimensions of trap (length x breadth x width): As supplied by Faunatech

Number of traps: 10 - 5 terrestrial - 5 arboreal

Intervals between traps: 20m

Length of transect or grid dimensions: 200m

Bait used (e.g. meat type, peanut butter/oats): Peanut butter : oat

Location Details

Location description: HEZ Link Rd study area - in bushland south of Kurri Kurri, NSW.

LOA
AMG Zone: 56

Transect start or grid corner Easting (6 digits): 359400

Transect end or grid corner Eastings (6 digits): 359590

Northing (7 digits): 6365590

Northing (7 digits): 6365740

Comments: Wafers sent to Barbara Triggs for analysis.

Hair Tube transect ~~LOA~~ as per report.

Date trap checked	Trap No*	Trap position**	Species name	Sex	Comments
		Ground	Rat species		Unable to be confirmed

* Trap number should correspond to map outlining location of traps

**For example ground or tree mounted

ELLIOTT / PITFALL / CAGE TRAPPING SURVEY PROFORMAS

↳ HAIR TUBES

Survey Details

Name of surveyor: Mick Roderick
Contact number: 49616500
Date traps set: 3/6/03
Date traps collected: 28/6/03
Type of trap (e.g. Elliot type B cage): Hair Tube
Dimensions of trap (length x breadth x width): As supplied by Fauna c
Number of traps: 10 - 5 Arboreal - 5 terrestrial
Intervals between traps: 20m
Length of transect or grid dimensions: 200m
Bait used (e.g. meat type, peanut butter/oats): Peanut Butter/oats

Location Details

Location description: HEZ Link Rd Study Area, in bushland to the south of Kurri Kurri, NSW
~~GDA~~ AMG Zone: 56
Transect start or grid corner Easting (6 digits): 359670
Transect end or grid corner Eastings (6 digits):
Northing (7 digits): 6365380
Northing (7 digits):
Comments: Waters sent to Barbara Triggs for Analysis.
Hair tube transect B as per report.

Date trap checked	Trap No*	Trap position**	Species name	Sex	Comments
		Ground	Swamp Rat	-	-

* Trap number should correspond to map outlining location of traps
**For example ground or tree mounted

ELLIOTT / PITFALL / CAGE TRAPPING SURVEY PROFORMAS

15 HAIR TUBES

Survey Details

Name of surveyor: Nick Roderick

Contact number: 4961650c

Date traps set: 3/6/03

Date traps collected: 28/6/03

Type of trap (e.g. Elliot type B cage): Hair Tube

Dimensions of trap (length x breadth x width): As supplied by Forestech

Number of traps: 10 - 5 arboreal

Intervals between traps: 20m

- 5 terrestrial

Length of transect or grid dimensions: 200m

Bait used (e.g. meat type, peanut butter/oats): Peanut butter + oats

Location Details

Location description: HEZ Link Rd Study Area - in bushland South of Kurri Kurri, NSW.

~~AMG~~ GDA Zone: 56

Transect start or grid corner Easting (6 digits): 359830

Transect end or grid corner Eastings (6 digits): 359990

Northing (7 digits): 6365050

Northing (7 digits): 6365190

Comments: Hair tube transect C as per report. Waiting sent to Barbara Triggs for analysis.

Date trap checked	Trap No*	Trap position**	Species name	Sex	Comments
		Ground	Swamp Rat		
		"	Swamp Wallaby		

* Trap number should correspond to map outlining location of traps

**For example ground or tree mounted

ELLIOTT / PITFALL / CAGE TRAPPING SURVEY PROFORMAS

Survey Details

↳ HAIR TUBES

Name of surveyor	Lucas Grenadier	Contact number	49616500
Date traps set	5/9/02	Date traps collected	13/9/02
Type of trap (e.g. Elliot type B cage)	Hair Tube	Dimensions of trap (length x breadth x width)	As supplied by Faunatech
Number of traps	10 - 5 ~~terrestrial~~ - 5 arboreal	Intervals between traps	20m
Length of transect or grid dimensions	200m	Bait used (e.g. meat type, peanut butter/oats)	Peanut butter + oats

Location Details

Location description: HEZ Link Rd study area - bushland to the south of Kurri Kurri, NSW.

~~AMG~~ GDA Zone: 56

Transect start or grid corner Eastings (6 digits)	358350	Transect end or grid corner Eastings (6 digits)	358160
Northing (7 digits)	6365380	Northing (7 digits)	6365630

Comments: Hair Tube transect D, as per report. Waters sent to Barbara Triggs for analysis

Date trap checked	Trap No*	Trap position**	Species name	Sex	Comments
—	—	Nothing recorded	—	—	

* Trap number should correspond to map outlining location of traps

**For example ground or tree mounted

ELLIOTT / PITFALL / CAGE TRAPPING SURVEY PROFORMAS

Survey Details

↳ Hair Tubes

Name of surveyor	Lucas Grenadier	Contact number	4961 6580
Date traps set	5/9/02	Date traps collected	13/9/02
Type of trap (e.g. Elliot type B cage)	Hair Tube	Dimensions of trap (length x breadth x width)	As supplied by Faunatech
Number of traps	10 - 5 terrestrial - 5 arboreal	Intervals between traps	20m
Length of transect or grid dimensions	200m	Bait used (e.g. meat type, peanut butter/oats)	Peanut butter + oats

Location Details

Location description: HEZ Link Rd Study Area - bushland to the south of Kurri Kurri, NSW

~~GDA~~ AMG Zone: 56

Transect start or grid corner Easting (6 digits)	358830	Transect end or grid corner Eastings (6 digits)	359240
Northing (7 digits)	6366230	Northing (7 digits)	6366480

Comments: Hair tube transect E, as per report. Waters sent to Barbara Triggs for analysis.

Date trap checked	Trap No*	Trap position**	Species name	Sex	Comments
		Ground	European Fox		

* Trap number should correspond to map outlining location of traps

**For example ground or tree mounted

SPOTLIGHTING SURVEY PROFORMA

Survey Details

Name of surveyor	Lucas Grenadier	Contact number	4461550
Date of survey	2	On foot or in vehicle	On foot & In Vehicle
Number of surveyors	1	Total effort expressed in person hours	2
Length of transect or grid dimensions	6.8km	Number of lights	1
Wattage of spotlight	75 watt		

Location Details

Location (including basic habitat) description: HEZ Links Rd Study Area, bushland south of Kurri Kurri Habitat includes Spotted Gum / Ironbark Forest + Kurri Sand Swamp Woodland.

Map name	Cessnock	Map number	9132-N
~~GDA~~ AMG Zone	56		
Start details Easting (6 digits)	358540	Finish details Eastings (6 digits)	359520
Northing (7 digits)	6366730	Northing (7 digits)	6364960
Start time (24 hr)	1900	End time (24 hr)	2100

Weather Details

At start of survey, record Cloud cover*	0	Moon*	Full
Wind direction and speed*	1N-W	Rain*	0
Temperature (°C)	22°		

Comments

Date, time (24h)	Species Name	Ob type	No Indi	Grid reference (full AMGs)	Accuracy	Comments
	Litoria	O,W		358860	10m	
	latopalmata			6365860		
	Uperoleia					
	laevigata	W		As above		
	Litoria peronii	W		As above		
	Crinia signifera	W,O		As above		
	Nyctinomus	W		Several locations		
	australis					
	European Rabbit	O		Several locations		
	Common Ringtail	O		358640	10m	
	Possum			6366070		

* See Appendix A Standard reporting codes

SPOTLIGHTING SURVEY PROFORMA

Survey Details

Name of surveyor	Mick Roderick / Lucas Grenadier	Contact number	49616500
Date of survey	25/2/03	On foot or in vehicle	Both
Number of surveyors	2	Total effort expressed in person hours	2hrs
Length of transect or grid dimensions	500m	Number of lights	2
Wattage of spotlight			

Location Details

Location (including basic habitat) description: Open Forest / Woodland in HEZ Link Rd Study area SE of Pelaw Main.

Map name	9132-2N	Map number	Cessnock
~~CQA~~ AMG Zone	56		
Start details Easting (6 digits)	359810	Finish details Eastings (6 digits)	360120
Northing (7 digits)	6365040	Northing (7 digits)	6364660
Start time (24 hr)	2100	End time (24 hr)	2200

Weather Details

At start of survey, record Cloud cover*	2/8	Moon*	0
Wind direction and speed*	0	Rain*	0
Temperature (°C)	19°		

Comments:

Date, time (24h)	Species Name	Ob type	No Indi	Grid reference (full AMGs)	Accuracy	Comments
	Common Brushtail Possum	O	5	Several, within		
				transect co-ords		
	Squirrel Glider	O	1	360030	10m	
				6364820	"	
	Aust. Owlet	W	1	359970	"	
	Nightjar			6364860		

* See Appendix A Standard reporting codes

ULTRASONIC CALL ('ANABAT') SURVEY PROFORMA

Survey Details

Name of principle surveyor	Lucas Grenadier	Contact number	49616500
Name of person analysing calls	Glenn Hoye	Contact number	49477794
Date of survey	2/9/03	GMA handheld or set and left	Set & left overnite

Location Details

Location description: HEZ Link Rd Study Area - bushland South of Kuri Kuri, NSW.

Time delay used - yes/no

Start details or point location		Finish details	
Map name	Cessnock	Map number	9132-2N
Full AMG reference(s) for survey site or transects		GDA ~~AMG~~ Zone	56
Easting (6 digits)	358670	Northing (7 digits)	6365810
Start time (24 hr)	~~6365810~~ 1700	Finish time (24hr)	0700 (following day)

Weather Details

At start of survey, record

Temperature (°C)	Mild		
Cloud cover*	2/8	Moon*	Not Recorded
Wind direction and speed*	Light, Westerly	Rain*	Nil

Comments

DATE	TIME	AMGs	DEFINITE	PROBABLE	POSSIBLE
	(24 hr)	if used	Species name	Species name	Species name
2/9/02		(As earlier	Chalinolobus morio		
"			C. gouldii		
"			Vespadelus vulturnus		

* See Appendix A Standard reporting codes

ULTRASONIC CALL ('ANABAT') SURVEY PROFORMA

Survey Details

Name of principle surveyor	Mick Roderick	Contact number	49616500
Name of person analysing calls	Glenn Hoye	Contact number	49477794
Date of survey	25/2/03	GMA handheld or set and left	Handheld

Location Details

Location description: HEZ Link Rd Study Area. Open Forest / Woodland habitat.

Time delay used - ~~yes~~/no

Start details or point location		Finish details	
Map name	Cessnock	Map number	9132-2N
Full AMG reference(s) for survey site or transects		~~AMG~~ GDA Zone	56
Easting (6 digits)	360000	Northing (7 digits)	6364730
Start time (24 hr)	2045	Finish time (24hr)	2145

Weather Details

At start of survey, record

Temperature (°C)	20°		
Cloud cover*	7/8	Moon*	0
Wind direction and speed*	ENE - [illegible]	Rain*	0

Comments

DATE	TIME	AMGs	DEFINITE	PROBABLE	POSSIBLE
	(24 hr)	if used	Species name	Species name	Species name
25/2/05		As earlier	Mormopterus		
			planiceps	(long penis form)	
		"	Mormopterus		
			sp. 2		
		"	Chalinolobus		
			gouldii		

* See Appendix A Standard reporting codes

NOCTURNAL CALL PLAYBACK SURVEY PROFORMA

Survey Details

Name of surveyor: Lucas Crenadier
Contact number: 49616500

Date of survey: 24/9/02
Type of amplification (loudhaler, tape deck only): Loud hailer

Duration of call playback (minutes): 30
Duration of listening (minutes): 40

Location Details

Location description: HEZ Link Rd Study Area, south of Kurri Kurri NSW.

Map name: Cessnock
Map number: 9132-N

Full AMG reference(s) for survey site or transect
~~AMG~~ GDA Zone: 56

Easting (6 digits): 358480
Northing (7 digits): 6365320

Start time (24 hr): 1930
End time (24 hr): 1950 (playback) 2030 (listening)

Weather Details

Temperature (°C)

At start of survey, record

Cloud cover*: 0
Moon*: Full

Wind direction and speed*: 1 N-W
Rain*: 0

Comments: 20°

Playback details		Species response			
Time (24hr)	Call Species Name	Time (24hr)	Species name	No Ind	Comments
1930	Powerful Owl	–	–		
1940	Barking Owl	–	–		
1950	Masked Owl	–	–		

* See Appendix A Standard reporting codes

NOCTURNAL CALL PLAYBACK SURVEY PROFORMA

Survey Details

Name of surveyor	Mick Roderick	Contact number	49616580
Date of survey	25/2/03	Type of amplification (loudhaler, tape deck only)	Tape deck
Duration of call playback (minutes)	15	Duration of listening (minutes)	15

Location Details

Location description: Creekline @ Proposed Link Road to the HEZ.

Map name	9132-N	Map number	Cessnock
Full AMG reference(s) for survey site or transect		~~AMG~~ GDA Zone	56
Easting (6 digits)	358930	Northing (7 digits)	6366060
Start time (24 hr)	2045	End time (24 hr)	2115

Weather Details

		Temperature (°C)	20°
At start of survey, record			
Cloud cover*	5/8	Moon*	0
Wind direction and speed*	0	Rain*	0

Comments:

Playback details		Species response			
Time (24hr)	**Call Species Name**	**Time (24hr)**	**Species name**	**No Ind**	**Comments**
2045	Litoria	–	———		L. latopalmata
	brevipalmata				calling

* See Appendix A Standard reporting codes

NOCTURNAL CALL PLAYBACK SURVEY PROFORMA

Survey Details

Name of surveyor	Mick Roderick	Contact number	49616500
Date of survey	25/2/03	Type of amplification (loudhaler, tape deck only)	Loudhaler
Duration of call playback (minutes)	30 mins	Duration of listening (minutes)	30 mins

Location Details

Location description: HEZ Link Rd Study area, 2.3km SE of Pelow Main.

Map name	Cessnock	Map number	9132-2N
Full AMG reference(s) for survey site or transect		~~AMG~~ GDA Zone	56
Easting (6 digits)	360070	Northing (7 digits)	6364730
Start time (24 hr)	2115	End time (24 hr)	2215

Weather Details

		Temperature (°C)	18°
At start of survey, record			
Cloud cover*	2/8	Moon*	0
Wind direction and speed*	ENE - 1	Rain*	0

Comments:

Playback details		Species response			
Time (24hr)	Call Species Name	Time (24hr)	Species name	No Ind	Comments
2115	Powerful Owl	-	-	-	
2135	Barking Owl	-	-	-	
2155	Masked Owl	-	-	-	

* See Appendix A Standard reporting codes

Playback details		Species response			
Time (24hr)	**Call Species Name**	**Time (24hr)**	**Species name**	**No Ind**	**Comments**

* See Appendix A Standard reporting codes

DIURNAL BIRD CENSUS SURVEY PROFORMA

Survey Details

Name of surveyor	Lucas Grenadier	Contact number	49616500
Number of surveyors	1	Date of survey	25/02/03
Total effort expressed in person hours	20 mins.	Number of hectares covered or transect or point dimensions	1 hectare

Location Details

Location description	South-east of Pelaw Main		
Map number	Cessnock	Map name	
Full AMG reference(s) for survey site or transect		~~GDA~~ AMG Zone	
Start details	6:50am	Finish details	7:10am
Easting (6 digits)	358 210	Easting (6 digits)	
Northing (7 digits)	6 365 890	Northing (7 digits)	
Start time (24hr)	6:50	End time (24 hr)	7:10am.

Weather Details

At start of survey, record:		Cloud cover*	3/8
Wind direction and speed*	0	Rain*	0
Temperature (°C)	17°C	Moon*	0
Comments			

Species name	Ob. type*	MH type*	Grid reference (full AMGs)	Accuracy
Australian Magpie	O	16	358200, 6365,900	100m
Peewee	O	AC	"	
Noisy Friarbird	W	UC	"	
Grey Shrike-thrush	W	LC	"	
Yellow-faced Honeyeater	O	UC	"	
Yellow-tufted Honeyeater	O	MC	"	
Yellow Thornbill	O	MC	"	
Striated Pardalote	O	MC	"	
Eastern Yellow Robin	O	LC	"	

* See Appendix 1: Standard reporting codes

Attachment 1:

Species name	Ob. type*	MH type*	Grid reference (full AMGs)	Accuracy
Superb Blue Wren	W	LS		
Yellow-tailed Black-Cockatoo	W	AC		
Eastern Spinebill	O	MC		
Golden Whistler	O	MC		
Galah.	W	AC		

* See Appendix 1: Standard reporting codes

DIURNAL BIRD CENSUS SURVEY PROFORMA

Survey Details

Name of surveyor	Mick Roderick / Lucas Grenadier	Contact number	4961650[illegible]
Number of surveyors	2	Date of survey	25/2/03
Total effort expressed in person hours	40 mins	Number of hectares covered or transect or point dimensions	1 ha

Location Details

Location description	HEZ Link Rd Study Area, 2.3km SE of Pelaw M[illegible]		
Map number	9137-2N	Map name	Cessnock
Full AMG reference(s) for survey site or transect		~~AMG~~ GDA Zone	56
Start details	1640	Finish details	1700
Easting (6 digits)	360050	Easting (6 digits)	
Northing (7 digits)	6364800	Northing (7 digits)	
Start time (24hr)		End time (24 hr)	

Weather Details

At start of survey, record:		Cloud cover*	2/8
Wind direction and speed*	NE 1.	Rain*	0
Temperature (°C)	22°	Moon*	0
Comments			

Species name	Ob. type*	MH type*	Grid reference (full AMGs)	Accuracy
Rufous Whistler	O/W	IT	As Above for All	10m
White-browed Scrubwren	O/W	LS		
Spotted Pardalote	W	MC		
Striated "	W	MC		
Brown-headed HE	W	IT		
Yellow-tufted "	O/W	MC		
Superb Blue Wren	O/W	GR		
White-throated Needletail	O	AC		
Pied Butcherbird	O/W	IT		

* See Appendix 1: Standard reporting codes

Attachment 1:

Species name	Ob. type*	MH type*	Grid reference (full AMGs)	Accuracy
White-thr. Treecreeper	W	IT		
Little Lorikeet	O/W	IT/AC		
Musk "	O/W	IT/AC		
Rainbow Bee Eater	O/W	IT		
Grey Fantail	W	HS		
Noisy Friarbird	W	IT		
Mistletoebird	W	AC		
Magpie	O/W	AC		
Aust. Raven	O/W	AC		
Dusky Woodswallow	O/W	IT		
Crested Shrike-tit	O	IT		
Pied Currawong	O/W	IT		

* See Appendix 1: Standard reporting codes

DIURNAL BIRD CENSUS SURVEY PROFORMA

Survey Details

Name of surveyor	Mick Roderick	Contact number	4961 6500
Number of surveyors	1	Date of survey	27/2/03
Total effort expressed in person hours	20 mins	Number of hectares covered or transect or point dimensions	1 ha

Location Details

Location description	HEZ Link Rd Alignment, 200m SE of Pelaw Main		
Map number	9132-2N	Map name	Cessnock
Full AMG reference(s) for survey site or transect		~~AMG~~ GDA Zone	56
Start details		Finish details	
Easting (6 digits)	358480	Easting (6 digits)	
Northing (7 digits)	6365 920	Northing (7 digits)	
Start time (24hr)	0940	End time (24 hr)	1000

Weather Details

At start of survey, record:		Cloud cover*	3/8
Wind direction and speed*	NE 1	Rain*	0
Temperature (°C)	20°	Moon*	0
Comments			

Species name	Ob. type*	MH type*	Grid reference (full AMGs)	Accuracy
Yellow-tufted HE	O/W	IT		
White-cheeked HE	O/W	IT		
Aust. Magpie	O	AC		
Aust. Raven	O/W	AC		
White-browed Scrubwren	W	GR		
Superb. Fairy Wren	O/W	GR		
Noisy Friarbird	W	IT		
Spotted Pardalote	W	IT		
Pied Butcherbird	W	IT		

* See Appendix 1: Standard reporting codes

Attachment 1:

Species name	Ob. type*	MH type*	Grid reference (full AMGs)	Accuracy
Pied Currawong	O	AC		
Grey Butcherbird	W	IT		

* See Appendix 1: Standard reporting codes

DIURNAL BIRD CENSUS SURVEY PROFORMA

Survey Details

Name of surveyor	Nick Roderick	Contact number	49616500
Number of surveyors	1	Date of survey	3/6/13
Total effort expressed in person hours	20 mins	Number of hectares covered or transect or point dimensions	1ha

Location Details

Location description	NE Corner of HEZ Link Rd Study Area		
Map number	9132-2N	Map name	Cessnock
Full AMG reference(s) for survey site or transect		~~AMG~~ GDA Zone	56
Start details		Finish details	
Easting (6 digits)	360360	Easting (6 digits)	
Northing (7 digits)	6366450	Northing (7 digits)	
Start time (24hr)	0900	End time (24 hr)	0920

Weather Details

At start of survey, record:		Cloud cover*	2/8
Wind direction and speed*	W. 2	Rain*	0
Temperature (°C)	19°	Moon*	0
Comments			

Species name	Ob. type*	MH type*	Grid reference (full AMGs)	Accuracy
Yellow-faced HE	O,W	IT,AC		
Yellow-tufted HE	O,W	IT		
Spotted Pardalote	O,W	IT		
Aust. Raven	W	AC		
Brown-headed HE	W	IT		
Superb Fairy-Wren	O,W	GR		
Rufous Whistler	O,W	IT		
Striated Thornbill	O,W	IT		
Yellow Thornbill	W	IT		

* See Appendix 1: Standard reporting codes

Attachment 1:

Species name	Ob. type*	MH type*	Grid reference (full AMGs)	Accuracy
Little Eagle	O	AC		
Aust. Magpie	O.W	AC		
Pied Currawong	O.W	AC		

* See Appendix 1: Standard reporting codes

DIURNAL BIRD CENSUS SURVEY PROFORMA

Survey Details

Name of surveyor	Mick Roderick	Contact number	4961 6550
Number of surveyors	1	Date of survey	4/6/03
Total effort expressed in person hours	20 mins	Number of hectares covered or transect or point dimensions	1ha

Location Details

Location description	HEZ Link Rd Study Area, Kurri Kurri		
Map number	9132-N	Map name	Cessnock
Full AMG reference(s) for survey site or transect		~~GDA~~ AMG Zone	56
Start details	N/A	Finish details	N/A
Easting (6 digits)	358500	Easting (6 digits)	
Northing (7 digits)	6366040	Northing (7 digits)	
Start time (24hr)	1100	End time (24 hr)	1120

Weather Details

At start of survey, record:		Cloud cover*	4-6/8
Wind direction and speed*	2 W	Rain*	0
Temperature (°C)	23	Moon*	-
Comments			

Species name	Ob. type*	MH type*	Grid reference (full AMGs)	Accuracy
Spotted Pardalote	O,W	IT		
Australian Raven	O,W	IT		
Pied Currawong	O	AC		
Yellow Thornbill	W	IT		
Superb Fairy-Wren	O,W	GR		
Noisy Friarbird	O,W	IT		
Grey Butcherbird	W	IT		
Grey Fantail	O	IT		
Australian Magpie	O,W	AC		

* See Appendix 1: Standard reporting codes

Attachment 1:

Species name	Ob. type*	MH type*	Grid reference (full AMGs)	Accuracy
Welcome Swallow	O	AC		
Yellow-faced Honeyeater	W	AC		
White-throated Treecreeper	W	IT		

* See Appendix 1: Standard reporting codes

DIURNAL BIRD CENSUS SURVEY PROFORMA

Survey Details

Name of surveyor	Mark Roderick	Contact number	4901600
Number of surveyors	1	Date of survey	4/6/03
Total effort expressed in person hours	20 mins	Number of hectares covered or transect or point dimensions	1 ha

Location Details

Location description	HEZ Link Rd study area south of Kurri Kurri		
Map number	9132-N	Map name	Cessnock
Full AMG reference(s) for survey site or transect		~~AMG~~ GDA Zone	56
Start details		Finish details	
Easting (6 digits)	358270	Easting (6 digits)	
Northing (7 digits)	6365820	Northing (7 digits)	
Start time (24hr)	1530	End time (24 hr)	1550

Weather Details

At start of survey, record:		Cloud cover*	3/8
Wind direction and speed*	2W	Rain*	0
Temperature (°C)	21°	Moon*	0
Comments			

Species name	Ob. type*	MH type*	Grid reference (full AMGs)	Accuracy
Spotted Pardalote	W	IT		
Laughing Kookaburra	W	IT		
Australian Hobby	O	AC		
Yellow-faced Honeyeater	O,W	IT		
Pied Butcherbird	O,W	IT		
Eastern Spinebill	O	IT		
Superb Fairy-Wren	O,W	GR		
Australian Raven	O	AC		
Black-faced Cuckoo-shrike	O,W	AC		

* See Appendix 1: Standard reporting codes

Attachment 1:

Species name	Ob. type*	MH type*	Grid reference (full AMGs)	Accuracy
White-cheeked Honeyeater	O.W	IT		
Pied Currawong	O.W	IT		
Australian Magpie	O.W	IT		
Red-browed Finch	O	GR		
Welcome Swallow	O	AC		

* See Appendix 1: Standard reporting codes

DIURNAL BIRD CENSUS SURVEY PROFORMA

Survey Details

Name of surveyor	Nick Roderick	Contact number	49616582
Number of surveyors	1	Date of survey	18/6/03
Total effort expressed in person hours	20 mins	Number of hectares covered or transect or point dimensions	1ha

Location Details

Location description	HEZ Link Rd study Area, Kurri Kurri NSW		
Map number	9132-N	Map name	Cessnock
Full AMG reference(s) for survey site or transect		~~AMG~~ GDA Zone	56
Start details		Finish details	
Easting (6 digits)	358690	Easting (6 digits)	
Northing (7 digits)	6366650	Northing (7 digits)	
Start time (24hr)	0900	End time (24 hr)	0920

Weather Details

At start of survey, record:		Cloud cover*	0
Wind direction and speed*	0	Rain*	0
Temperature (°C)	24°	Moon*	0
Comments			

Species name	Ob. type*	MH type*	Grid reference (full AMGs)	Accuracy
Australian Magpie	O,W	AC		
Whistling Kite	O	AC		
Brown-headed Honeyeater	O	IT		
Noisy Friarbird	O,W	IT		
Red Wattlebird	O	IT		
Yellow-faced Honeyeater	O	IT		
Australian Raven	W	AC		
Mistlebobird	O,W	AC		
Rainbow Lorikeet	W	AC		

* See Appendix 1: Standard reporting codes

Attachment 1:

Species name	Ob. type*	MH type*	Grid reference (full AMGs)	Accuracy
Brown Thornbill	E,W	IT		
Yellow Thornbill	N	IT		
Superb Fairy Wren	U	GR		
Willie Wagtail	O	GR		
Black-faced Cuckoo-shrike	O	IT		

* See Appendix 1: Standard reporting codes

DIURNAL BIRD CENSUS SURVEY PROFORMA

Survey Details

Name of surveyor	Mick Roderick	Contact number	4961 6500
Number of surveyors	2	Date of survey	28/6/03
Total effort expressed in person hours	40 mins	Number of hectares covered or transect or point dimensions	1 ha

Location Details

Location description	Link Rd Study area - South of Korri Korr		
Map number	9132-N	Map name	Cessnock
Full AMG reference(s) for survey site or transect		GDA AMG Zone	56
Start details		Finish details	
Easting (6 digits)	359280	Easting (6 digits)	
Northing (7 digits)	6365 740	Northing (7 digits)	
Start time (24hr)	1000	End time (24 hr)	1020

Weather Details

At start of survey, record:		Cloud cover*	1/8
Wind direction and speed*	2W	Rain*	0
Temperature (°C)	20°	Moon*	0
Comments			

Species name	Ob. type*	MH type*	Grid reference (full AMGs)	Accuracy
Yellow-tufted Honeyeater	O,W	IT		
Yellow-rumped Thornbill	O,W	IT		
Brown-headed Honeyeater	O,W	IT		
Peaceful Dove	W	GR		
Little Lorikeet	W	AC		
Laughing Kookaburra	O,W	IT		
Grey-shrike Thrush	O,W	IT		
Willie Wagtail	O,W	GR		
Black-faced Cuckoo-shrike	O,W	AC		

* See Appendix 1: Standard reporting codes

DIURNAL BIRD CENSUS SURVEY PROFORMA

Survey Details

Name of surveyor	Nick Roderick	Contact number	49616560
Number of surveyors	2	Date of survey	29/6/03
Total effort expressed in person hours	40 mins	Number of hectares covered or transect or point dimensions	1ha

Location Details

Location description	HEZ Link Rd Study Area, south of Kurri Kurri		
Map number	9132-N	Map name	Cessnock
Full AMG reference(s) for survey site or transect		GDA AMG Zone	56
Start details		Finish details	
Easting (6 digits)	359860	Easting (6 digits)	
Northing (7 digits)	6364960	Northing (7 digits)	
Start time (24hr)	1300	End time (24 hr)	1320

Weather Details

At start of survey, record:		Cloud cover*	2/8
Wind direction and speed*	2W	Rain*	0
Temperature (°C)	21°	Moon*	0
Comments			

Species name	Ob. type*	MH type*	Grid reference (full AMGs)	Accuracy
Yellow-faced Honeyeater	O,W	IT		
Welcome Swallow	O,W	AC		
Yellow-tufted Honeyeater	O	IT		
Australian Magpie	O	IT		
Superb Fairy-Wren	O	GR		
White-browed Scrubwren	O,W	GR		
Little Eagle	O	AC		
Willie Wagtail	O,W	GR		

* See Appendix 1: Standard reporting codes

APPENDIX H: ADDRESSED THREATENED SPECIES AND EEC PROFILES

Acacia bynoeana Bynoe's Wattle

Acacia bynoeana is a low bushy shrub found in heath and woodland vegetation associated with sandy soils. This species can be recognised by the rough coarse hairs covering the branchlets and the phyllodes, and the thick and resinous phyllodes with parallel veins. Flowering occurs during the summer months and is characterised by a bright yellow, globular single flower located within the leaf axil. It is considered to be uncommon, with scattered populations having been noted throughout the Sydney region.

The Final Determination to list this species provides a description of its range as being from the Morisset to Mittagong. However, during 2003 new populations of *A. bynoeana* were discovered in the Cessnock area, including within the HEZ and neighbouring lands. Populations within the HEZ appear to be quite sizeable, with rough estimates (based on previously reported densities; see Bell & Driscoll 2002) of more than 3000 plants (Bell 2004b). Within the Cessnock LGA, further populations have been recorded near Ellalong (south-west of the HEZ Study Area) and Heddon Greta (immediately north-east of the township of Kurri Kurri). The Ellalong population is thought to be well in advance of one hundred (100) individuals (Harper Somers O'Sullivan 2005) whilst the Heddon Greta population size is also likely to be greater than 100 plants (HSO ecologists pers. obs.). More recent fieldwork has also shown that substantially sized stands of this species exist in other parts of the Cessnock LGA, whilst further afield populations have also been recently recorded from near North Rothbury and Yengo National Park (S. Bell pers. comm.).

The Cessnock LGA populations occur in previously undocumented habitat. A regional analysis of all known populations of this species is currently underway, with the aim of identifying suitable habitat for potential new populations in the wider region (Bell & Driscoll in prog.). The recent finds in KSSW infers that considerable areas of potential habitat exist in the wider Cessnock area. This species has also been recorded within other vegetation types within the locality, such as Yellow Bloodwood Woodland at Ellalong (Harper Somers O'Sullivan 2005).

This species has been ROTAP-coded 3VC- and was upgraded from 'Vulnerable' to 'Endangered' in March 2000. In terms of direct reservation, this species is known from Lake Macquarie State Conservation Area, Blue Mountains, Royal and Marramarra National Parks, and Castlereagh, Dharawal and Agnes Banks Nature Reserves (Bell and Driscoll 2002). Additional specimens and known habitat areas are reserved within the conservation zone of the Hunter Economic Zone. Although this species has not yet been recorded within Werakata National Park, it could be reasonably stated that the species is likely to exist therein, given the amount of potential habitat that exists within the 'Kearsley Sector'.

Eucalyptus parramattensis ssp. *decadens* Drooping Red Gum

Eucalyptus parramattensis ssp. *decadens* has a scattered distributed within the lower Hunter Valley from Tomago to Kurri Kurri. It occurs in woodland on sandy soils in wet sites. Any occurrences are likely to be restricted to areas along riparian vegetation strips or within close proximity to the water table. In the Port Stephens area, it occurs in open wet sclerophyll woodland on heavy, often waterlogged, interbarrier depression soils. It is commonly associated with *Melaleuca quinquenervia* (Broad-leaved Paperbark) and *Eucalyptus robusta* (Swamp Mahogany). Within the Cessnock LGA it occurs almost exclusively within Kurri Sand Swamp Woodland (KSSW) and ecotones with neighbouring communities. Within this community it occurs as a co-dominant canopy species. An isolated individual has also been

recorded within Central Hunter Ironbark / Spotted Gum / Grey Box Forest in the North Rothbury area (HSO Ecologists pers. obs.).

It is distinguished from *E. p. parramattensis* by the larger fruit, which are greater than 7mm in diameter.

According to Briggs and Leigh (1995) criterion, *E. p*. *decadens* is ROTAP-coded 2V, indicating that it is not known to occur within the reserve system. Within conservation reserves, this species is only known from Werakata National Park. Additional areas are conserved within the conservation zone of the HEZ. In terms of potential habitat, a total of 532.5ha of KSSW exists in Werakata National Park, although detailed surveys have revealed that only a 37ha area of KSSW within this reserve is dominated by *E. p. decadens* (Harper Somers O'Sullivan 2004a). Additional specimens and known habitat areas are reserved within the conservation zones of the HEZ, where 122ha of habitat dominated by this species exists.

Grevillea parviflora ssp. *parviflora*

Grevillea parviflora ssp. *parviflora* is distributed from Prospect to Camden and Appin, with disjunct northern populations occurring near Putty, Cessnock and Cooranbong. It occurs in light clayey soils in woodlands. This species is a low open to erect shrub, 0.3-1m tall. Flowering time is from July to October.

It is likely that the *G. parviflora* complex (and allied species) requires taxonomic revision (S. Bell; B. Makinson pers. comms.). Recent evidence suggests that the identification of *G. p. parviflora* in the Cessnock LGA may be problematic due to the possibility of the occurrence of an analogous *Grevillea,* being the *G. humilis* complex. However, ground inspections with Bob Makinson (a recognised expert in the *Grevillea* genus) revealed that there is little evidence that *G. humilis* exists in the area, and that all specimens are indeed, *G. p. parviflora.* It is considered more likely that the morphological differences noted between *G. p. parviflora* individuals within the locality may be due to shortcomings in the description of the *parviflora* sub-species (particularly within juvenile specimens), as opposed to influences from other species.

Surveys undertaken within the Cessnock LGA have shown that *G. p. parviflora* is a relatively common understorey species over a large portion of forested lands, including the HEZ study area (Harper Somers O'Sullivan 2002b; Harper Somers O'Sullivan 2002c). A number of records of the species from the locality are known from secure habitats within Werakata National Park (Bell 2004a; Atlas of NSW Wildlife 2006) and from a number of other 'unprotected' locations around Kurri Kurri, Heddon Greta (NPWS Atlas of NSW Wildlife 2006), Ellalong (Harper Somers O'Sullivan 2005) and on the western slopes of the Sugarloaf Range (HSO ecologists pers. obs.). This species is not ROTAP-listed.

Litoria brevipalmata Green-thighed Frog

The Green-thighed Frog occurs in isolated localities from the NSW Central coast to south-east Queensland. They occur in a range of habitats from rainforest and moist Eucalypt forest to dry eucalypt forest and heath.

The species is one of only a handful of eastern temperate Australian frog species that exhibit "explosive" breeding (Lemckert and Slatyer, 2002). Breeding occurs following heavy rainfall events in late spring and summer, with frogs congregating around large, temporary pools where males generally only call for one or two nights. Breeding may occur just once or twice per year or not at all and breeding success may be highly variable (Lemckert *et al*. 1997). How these frogs utilise forested environments during non-breeding times has not been documented (Lemckert and Slatyer, 2002), although it is suspected that they forage in leaf litter and dense groundcover vegetation. Although the species breeding sites have not been determined, it is considered likely that any creekline and/or low lying area capable of holding water for extended periods may provide potential habitat for this species.

This species has been recorded from only one location in the Hunter River catchment, being along creekline habitat within the HEZ study area (Harper Somers O'Sullivan 2004a). Populations of this species are also known to exist in the region within the Watagan National Park (Ehmann, 1997).

Climacteris picumnus	**Brown Treecreeper**

The eastern subspecies of the Brown Treecreeper, *Climacteris picumnus* ssp. *victoriae,* is distributed through central NSW on the western side of the Great Dividing Range and sparsely scattered to the east of the Range in drier areas such as the Cumberland Plain of Western Sydney, and in parts of the Hunter, Clarence, Richmond and Snowy River valleys.

The Brown Treecreeper is a medium-sized insectivorous bird that frequents drier forests and woodlands, particularly open woodland lacking a dense understorey, but also grasslands where there are sufficient logs, stumps and dead trees nearby. It spends up to half its time on the ground and on fallen logs, often well away from cover, pecking at the bases of grass tussocks, turning over leaves and litter, feeding on invertebrate larvae and small insects, particularly ants. It frequently hops along the entire length of logs and spirals up live and dead tree trunks, to feed on ants and flying insects. The species sleeps inside hollow branches or trunks of trees, both living and dead, sometimes at great heights, and sometimes using old nest sites (Noske, 1982).

It is a sedentary species, and lives in permanent territories, which change little in size from year to year, regardless of the number of inhabitants. Typically, the species breeds cooperatively, between May and December (Dow 1980; Noske 1980). The breeding group consists of a breeding pair and a few subordinate males, some which may also help at other nests (Schodde and Tidemann, 1986). Groups rarely contain more than one female (Noske 1982). The clutch size is two to three. Young remain with the parents for two years or more (Noske, 1982).

Brown Treecreepers are threatened by clearance and the fragmentation of the woodland habitat including removal of dead timber. Increased isolation decreases treecreeper agility and increases the vulnerability of populations to extinction as a result of stochastic events. This species appears unable to maintain viable populations in remnants less than 200ha and its abundance decreases as remnant size decreases (Barrett *et al*. 1994). Fragmentation also leads to a skewed sex ratio in Brown Treecreepers because female birds are unable to disperse to isolated remnants, increasing the chance of local extinctions. Habitat degradation, including loss of hollow bearing trees threatens brown treecreeper populations. Grazing by stock in woodland areas leads to a decrease in diversity of ground-dwelling invertebrates decreasing the availability of food for the birds (Bromham *et al*, 1999).

Within the Lower Hunter Valley, this species is known from Werakata National Park (Atlas of NSW Wildlife 2006; authors pers. obs.). Elsewhere within the region, this species has been recorded within Blue Mountains, Wollemi, Yengo and Goulburn River National Parks (Atlas of NSW Wildlife; HBOC 1996; 1998; authors pers. obs.).

Pomatostomus temporalis Grey-crowned Babbler

The eastern subspecies of the Grey-crowned Babbler ranges from Mt Lofty Range, SA to Cape York Peninsula, Qld, generally in areas receiving an average annual rainfall between 250 and 1000 mm. The Grey-crowned Babbler inhabits open Eucalypt woodlands with a grassy groundcover and sparse, tall shrub layer. This species may also be observed along streams in cleared areas and grassy road verges (Morcombe, 2000). Grey-crowned Babblers forage mainly on insects and spiders, spending the majority of their time searching through leaf litter and soil for food, but also venturing into vegetation. They live in extended families usually consisting of a pair and offspring. Pairs mate for life and are usually the only breeding birds within the group. The other group members help them build the nest and feed the young.

Breeding occurs between July and February. Their large domed nests (up to 50cm wide) are constructed in trees at a height of about 4-7m. They tend to be built into an upward sloping or horizontal, multiple forked branches in the trees upper outer foliage and have a side entrance tunnel (Morcombe, 2000). Nest-like structures are also used for overnight roosts. The group as a whole defends a territory (usually about 12 hectares) all the year (Frith, 1977).

Although common in the Qld part of its range, *P. temporalis* is one of several woodland birds known to be declining in South-eastern Australia. The key threat is the highly fragmented nature of remnant habitat. The cause of declines due to fragmentation seems to be related to population dynamics such as reduced breeding success, less effective immigration and stochastic effects (Garnett *et al*, 2000). However, within the Lower Hunter Valley this species appears to be coping with habitat fragmentation / modification to a greater extent than populations elsewhere within its range. In this area it has been noted to occur regularly within partially cleared areas and in some situations, where only scattered trees remain in proximity to more suitable habitat. It has also been noted from human-inhabited areas, including areas where domestic pets are present.

Within the Lower Hunter Valley, this species is known from Werakata National Park (University of Newcastle 2001; authors pers. obs.). It has been recorded in Wollemi, Goulburn River and Yengo National Parks (Atlas of NSW Wildlife 2006; authors pers. obs.).

Chthonicola sagittata Speckled Warbler

The Speckled Warbler ranges from South-Eastern Australia, from South-West Victoria through eastern New South Wales to Central Queensland, mostly on the western slopes and tablelands of the Great Dividing Range, and on the driest sections of coast. Speckled warblers live in a wide range of Eucalypt dominated vegetation that has a grassy understorey often on rocky ridges or gullies (Garnett *et al*, 2000).

The Speckled Warbler is a sedentary species with a home range that varies from 6-12 hectares (Readers Digest, 1982). This species appears to be extinct from areas without vegetation fragments larger than 100ha. The Speckled Warbler appears to prefer woodland

areas where ground cover consists of grass, fallen leaves and bark. This ground foraging bird feeds on insects, insect larvae and small seeds (Readers Digest, 1982). A study from the Armidale area indicated that beetles were a major food source, ants were often eaten and larvae, flies and spiders were also taken (Ford, 1985). The Speckled Warbler congregate in small family groups of two or three and breed from September to March. Dome shaped nests are constructed of dried grasses and bark strips and are camouflaged under a tuft of grass usually beneath fallen branches or at the base of a small shrub (Hoskin, 1991; Readers Digest, 1982). This species is one of the most common hosts of Black-eared Cuckoo chicks.

Within the Lower Hunter Valley, this species is known from Werakata National Park (Harper Somers O'Sullivan 2004a; University of Newcastle 2001; authors pers. obs.). Records also exist from Wollemi, Goulburn River, Dharug and Yengo National Parks (Atlas of NSW Wildlife 2006; authors pers. obs.).

Xanthomyza phrygia	**Regent Honeyeater**

The Regent Honeyeater is a medium-sized, unique honeyeater. It is nomadic, although it does seem to return to nesting areas sporadically. Small flocks regularly, sometimes annually, visit the northern tablelands, the north-western and central western slopes of NSW in the spring and summer. Individuals also appear on the NSW coast at most times of year but primarily in winter. It occurs in temperate woodlands and open forest, including forest edges. Once commonly observed in flocks of hundreds, it is thought that the current population may not number more than 1000 individuals. Regent Honeyeaters are now seldom seen west of Bendigo, Victoria and are only occasionally observed in southern Qld.

Seasonal movements appear to be dictated by the flowering of various species of Eucalypts that are characteristic of the dry forests and woodlands of South-Eastern Australia. The Regent Honeyeater prefers to forage on large-flowered Eucalypts (e.g. *Eucalyptus sideroxylon*, *E. melliodora*, *E. albens, E. leucoxylon*), particularly where these trees grow in more productive areas and yield plentiful and predictable nectar flows. They also forage on mistletoe and Banksia flowers, and arthropods. In parts of coastal NSW they are also attracted to stands of *Eucalyptus robusta* (Swamp Mahogany). The decline of the Regent Honeyeater appears to be due to a steady reduction in the extent and quality of its habitat. Many of the remaining stands of the 'key' Eucalypt species have suffered in the past from harvesting of timber and the very slow growth rates of replacement trees. Lack of regeneration due to grazing by stock and hence a lack of new trees to replace dying trees in farmland is also a serious concern.

During winter, Regent Honeyeaters disperse widely in small groups. In spring they concentrate into the main breeding areas around Chiltern and Benalla in Victoria and the Capertee Valley, Bundarra District and the Warrumbungles in NSW. Breeding was also noted from the Upper Hunter (Widden Valley) during 2005 (HBOC pers. comm.). Other recent records have noted breeding attempts in the vicinity of Quorrobolong, near Cessnock, NSW (D. Geering; A. Morris pers. comms.). Nests are constructed of strips of Eucalypt bark, dried grass and other plant material. They are place in an upright fork 4 to 25m above ground, and 2-3 eggs are laid. Nesting occurs mainly between November and January, but breeding has been recorded in all months between July and February.

This species has been recorded in Werakata National Park (Atlas of NSW Wildlife 2006) and has also been recorded over several seasons (including 2005) within Aberdare State Forest. Regionally, records exist from a number of conservation reserves including Cattai,

Scheyville, Blue Mountains, Brisbane Water, Dharug, Bouddi, Wollemi and Yengo National Parks and Muogamarra Nature Reserve (Atlas of NSW Wildlife 2006).

Melithreptus gularis Black-chinned Honeyeater

This species occurs in eastern Australia, along the inland slopes of the Great Dividing Range, extending to coast between Sydney and Newcastle, NSW, and again between Brisbane and Rockhampton, Qld. It also occurs westward into South-Eastern South Australia. Black-chinned Honeyeaters occupy dry Eucalypt woodland within an annual rainfall range between 400-700 mm, particularly within associations containing Ironbark and Box species (Garnett *et al*, 2000). Although often irregular and unpredictable, it also often occurs in flocks of six to fifteen birds, though it also may occur in mixed-species flocks, particularly with the *M. lunatus* (White-naped Honeyeater) and *M. brevirostris* (Brown-headed Honeyeater) (Frith, 1977).

It is estimated that the Black-chinned Honeyeater spends 60% of its time searching foliage for such food as insects, nectar and lerp. It breeds from July-December in a cup shaped nest of bark strips and grasses, suspended from a branch. They usually lay two eggs (Frith, 1977). It is considered that the majority of potential habitat for this species has been cleared and that the remainder of this habitat is now extremely fragmented (Garnett *et al*, 2000).

Within the Lower Hunter Valley, this species is known from Werakata National Park (Harper Somers O'Sullivan 2004a; authors pers. obs.). Records in the wider locality exist from Blue Mountains, Ku-ring-gai Chase, Wollemi, Goulburn River and Yengo National Parks (Atlas of NSW Wildlife 2006; authors pers. obs; HBOC 1998). Additionally, substantial and regular records of this species were noted from the Spotted Gum / Ironbark associations in the Cessnock / Kurri Kurri area during 2005 (HSO Ecologists pers. obs.).

Ninox strenua Powerful Owl

The Powerful Owl is found in the coastal areas and adjacent ranges of eastern Australia from South Australia to around Rockhampton in Queensland, generally within 200km from the coast. Within NSW, Powerful Owls are distributed throughout the length of the Great Dividing Range, which is their stronghold, and extend from the coast to the western slopes where they occur in much lower numbers. The Powerful Owl inhabits a wide range of vegetation types from wet Eucalypt forests with a rainforest understorey to dry open forests and woodlands. The species has been recorded using disturbed habitats such as exotic pine plantations and large trees in parks and gardens. The Powerful Owl is the largest predator of nocturnal forest-dwelling animals in Australian forests. Major prey species in NSW forests are the Greater Glider, Common Ringtail Possum, Sugar Glider, Grey-headed Fruit Bat, and several species of diurnal birds, including the Pied Currawong, Magpie and Lorikeets. It rests during the day amid thick foliage, often grasping food-remains. The male of the species employs a slow, far-carrying 'whoo-hoo' call, more deliberate than the female's call, which is higher pitched with the second note slightly higher than the first.

Powerful Owls nest in a slight depression in the wood-mould on the base of a cavity in a large old tree, sometimes in excess of 25 metres above the ground. These trees are usually found growing on a hillside in heavy forest and may be used intermittently for several years. The breeding season of the Powerful Owl is highly synchronised, being strictly winter breeders.

One or two young are produced, although some pairs do not breed in every year. Pairs appear to mate for life and occupy exclusive territories in the order of 1000 ha in size.

Records of this species in the region are known from many conservation reserve areas. These include the Gardens of Stone National Park and Tingira Heights Munghorn Gap Nature Reserves (authors pers. obs.) as well as Wollemi, Botany Bay, Brisbane Water, Bouddi, Marramarra, Nattai, Blue Mountains, Cattai, Heathcote, Goulburn River, Kanangra Boyd, Ku-ring-gai Chase and Yengo National Parks (Atlas of NSW Wildlife 2006). A well-documented resident breeding pair of *N. strenua* has established in Blackbutt Council Reserve, in the outer suburbs of Newcastle.

Lathamus discolor	**Swift Parrot**

During winter the Swift Parrot inhabits mainland Australia from Adelaide (S.A.) through Victoria, and up the east coast to South-East Queensland, as well as visiting the South and Central Western Slopes and the Riverina in NSW. The Swift Parrot returns to eastern Tasmania in spring to breed. In NSW, Swift Parrots occur in a range of habitat types from coastal forests and heaths to dry open woodlands on the western slopes (Swift Parrot Recovery Team, 2002). Key habitat for Swift Parrots on the coast and coastal plains of NSW include Spotted Gum (*Corymbia maculata),* Swamp Mahogany (*Eucalyptus robusta)* and Forest Red Gum (*E. tereticornis*) Forests. Swift Parrots are dependent on habitats that provide winter foraging resources such as nectar and lerps (sugary exudates from leaf insects). Within these habitats, Swift Parrots prefer foraging in mature trees that provide a higher quality and quantity of nectar than regrowth trees. Swift Parrots have previously been found to select mature trees over 40 cm DBH with an emphasis on trees greater than 60cm DBH (Swift Parrot Recovery Team, 2002).

Given that the Swift Parrot is a migratory species dependent on the availability of winter foraging resources, their distribution is largely influenced by environmental conditions. This means that in any one year this species may be solely dependent on resources (such as nectar and/or lerps) within a particular region such as the Lower Hunter Region. Swift Parrots have a high level of site fidelity and are known to return to sites that have previously been used. In the Lower Hunter, the occurrence of Swift Parrots appears to be associated with the flowering of these Eucalypt species with the exception of the Swamp Mahogany (hence the large number of records in 2000 and again in 2005), although evidence suggests that the species may also utilise the locality irrespective of the availability of these resources (D. Saunders pers. comm.).

The species appears to have declined greatly in the northern and eastern parts of its over-wintering range to the extent that the NSW Scientific Committee upgraded the listing of the Swift Parrot from Schedule 2 (Vulnerable) to Schedule 1 (Endangered) (NSW Scientific Committee, 2000). The Swift Parrot is also listed under the Environmental Protection and Biodiversity Conservation Act (1999) as 'Endangered'. The Swift Parrot population estimate is 2000 mature birds (Swift Parrot Recovery Team 2001). The continued loss of foraging resources, in particular winter-flowering Eucalypt species, appears to be most serious short term threat to this species in NSW.

A number of records for the Swift Parrot are well-documented from the Lower Hunter Region, including significant records from 2005 from areas including Aberdare State Forest and Werakata National Park (Harper Somers O'Sullivan 2004a; 2002b; Atlas of NSW Wildlife 2006; HBOC records; D. Saunders pers. comm.; authors pers. obs.).

Petaurus norfolcensis Squirrel Glider

P. norfolcensis is distributed throughout the dry sclerophyll forests and woodlands of eastern Australia from SA to Cairns. In Vic its range was considered to be narrow where it inhabited remnant woodlands and open forests that have mature or mixed-age stands of more than one Eucalypt species. It is absent from the dense coastal ranges in the south, but is present in coastal forests and wet areas bordering rainforests in NSW (north of Sydney) and in Qld (Suckling, 1995). This species usually inhabits dry open sclerophyll forests and woodland but there have been some observations in moist regenerating forest, moist gullies and coastal forest. Recent studies have identified the coastal Lake Macquarie / Wyong regional population as the largest known population of this species (Smith and Murray [in print] in Forest Fauna Surveys 2002) and this area as containing the highest density and quality habitat for this species (Smith *et al,* 2002). Other studies conducted in Vic have shown that this species can occur in equal densities in linear remnant networks as in continuous forested areas and that such linear remnants can support viable populations of *P. norfolcensis* (van der Ree, 2001).

Individuals have been recorded in a diverse range of vegetation communities, including Blackbutt Forest, Red Gum and Red Bloodwood Forests, Coastal Banksia heathland and Grey Gum / Spotted Gum / Grey Ironbark dry hardwood forests of the Central NSW Coast (Quin, 1995). Important habitat includes areas where one or more Eucalypt species occur that flower heavily in winter, or the presence of good stands of winter-flowering Banksias (Quin, 1995). The Squirrel Gliders preference for mixed-species Eucalypt open forest may be related to the more predictable availability of pollen and nectar in such communities. Where *Acacias* are present, the gum of these species may compensate for any unreliability in nectar flows, and might explain the apparent link between *P. norfolcensis* and the presence of certain *Acacia* species in some localities. Other known food items include Eucalypt sap, nectar, honeydew, manna, pollen, sugary extracts from fruits and berries, and a range of insects (Quin 1995).

The breeding biology of *P. norfolcensis* is similar to that of *P. breviceps* (Sugar Glider). The two species are sometimes found living together in the same area and when this situation exists the larger *P. norfolcensis* usually dominates and there is evidence to suggest that interbreeding may result in the outbreeding of the smaller *P. breviceps* (Quin, 1995). It nests in a leaf-lined hollow in a tree or stump. Tree hollows, when available, are the preferred nesting site, particularly those with a tight entrance diameter, presumably to exclude potential predators. It is possible that disused Ringtail Possum dreys and bird nests are used in the absence of suitable hollows.

Movements of up to one kilometre from foraging sites to a favoured den hollow have been recorded. Recent research on the home ranges and movements of this species indicate a home range of about 13 ha and population densities of 0.4 - 1 per ha is reported for a Vic population and 3.0 - 3.5 ha with a density of 0.89 - 1.54 per ha in a central north coast population (Quin, 1995). Radio-tracking studies at Tingira Heights, near Lake Macquarie, estimated home ranges of between 6 and 7.5 ha for this species (Shortland Wetlands Consultancy, 1996).

It has been reported that *P. norfolcensis* is consistently preyed upon by cats and foxes and it has been believed that an increase in this predation may result from the opening up of bushland through rural-residential or other development. While this increased predation may adversely impact upon populations of this species it may not be the only impact causing the extinction of populations in developed areas. However, in the absence of detailed studies, it

is believed that provided domestic cats are excluded, a rural-residential subdivision with a minimal amount of clearing and retention of adequate habitat connections may not have a significantly deleterious effect upon a population of this species.

Records of this species are known from a large number of conservation reserves within the region including Wollemi, Blue Mountains, Bouddi, Popran, Wyrrabolong, Brisbane Water, Ku-ring-gai Chase and Dharug National Parks (Atlas of NSW Wildlife 2006).

Mormopterus norfolkensis	**Eastern Freetail-bat**

This species is distributed along the east coast of NSW from south of Sydney extending north into south-eastern Qld, near Brisbane. There are no records west from the Great Dividing Range. Although the habitat preferences are not clear (and critical or specific habitat for this species is not known), most records of this species have been reported from dry Eucalypt forest and woodland. Individuals have, however, been recorded flying low over a rocky watercourse in rainforest and foraging in clearings on the edge of forested land. It is expected that open forested areas and the cleared land adjacent to bushland, constitutes important habitat for this species, and specific foraging activity may be concentrated over small areas of open water, such as dams and creeks, in and near forests.

It is a predominantly tree-dwelling species (roosting in hollows or behind loose bark in mature Eucalypts), but one individual was recorded roosting in the roof of a hut, together with a number of Gould's Wattled Bats and an Eastern Broad-nosed Bat (Allison & Hoye, 1995). The diet is thought to consist of small insects including leafhoppers, chafers, weevils and other beetles. Foraging is apparently undertaken above the tree canopy or in clearings on forest edges. Examination of wing morphology indicates that the bat has a direct and fast flight more suited for foraging in open habitats, above the canopy and along watercourses.

Within the Lower Hunter Valley, this species has been recorded in Werakata National Park, and elsewhere the species is known from Yengo, Wollemi, Blue Mountains and Dharug National Parks (Atlas of NSW Wildlife 2006).

Scoteanax rueppellii	**Greater Broad-nosed Bat**

The Greater Broad-nosed Bat occurs only along the eastern coastal strip of Qld and NSW where it is restricted to the coast and adjacent areas of the Great Dividing Range. In NSW it extends as far south as the Bega Plain. They are only found at low altitudes (below 500m).

This species apparently feeds on large moths and beetles, and some small vertebrates, emerging just after sundown, flying slowly and directly at a height of 3-6 m, deviating only slightly to catch larger insects. It is also predatory on vertebrates including other bats, and is a noted carnivore on other bats captured in bat traps. *S. rueppellii* is known to hunt along tree-lined creeks, the junction of woodland and cleared paddocks, and low along rainforest creeks. It may have a preference for wet gullies in tall timber country.

The species roosts mainly in tree hollows but it has also been found in the roof spaces of old buildings. Little is known of the reproductive cycle, but it is suggested that the species follows the typical vespertilionid pattern. What is known is that females congregate in maternity colonies and single young are born in January, slightly later than the other

Vespertilionid bats that share its range. Males appear to be excluded from the colony during the birthing and rearing of the young.

The species has been recorded in a number of reserves including Wollemi, Dharug, Wyrrabalong and Yengo National Parks (Atlas of NSW Wildlife 2006).

Kurri Sand Swamp Woodland in the Sydney Basin Bioregion

Kurri Sand Swamp Woodland in the Sydney Basin Bioregion vegetation assemblage is listed as an Endangered Ecological Community under Part 3 of Schedule 1 of the *TSC Act 1995*. Kurri Sand Swamp Woodland is or has been known to occur in the Kurri Kurri – Cessnock area in the Lower Hunter Valley. It occurs only within the Cessnock LGA. This community is classified by the Lower Hunter central Coast Regional Biodiversity Conservation Strategy (REMS) as Map Unit (MU) 35 'Kurri Sand Swamp woodland'.

Kurri Sand Swamp Woodland generally ranges from low open-woodland to low woodland and open scrub with a low open canopy rarely exceeding 15m in height, dominated by *Eucalyptus parramattensis* ssp*. decadens*, *Angophora bakeri* and occasionally *E. signata* and *E. agglomerata*. The lower stratum is typified by *Melaleuca nodosa, Banksia spinulosa, Dillwynia retorta, Jacksonia scoparia, Hakea dactyloides, Acacia ulicifolia* and *Lambertia formosa* and merges into the ground layer. The ground layer contains grasses and low shrubs such as *Entolasia stricta, Pimelea linifolia, Lissanthe strigosa* and *Melaleuca thymifolia*. KSSW also provides potential habitat for a number of threatened flora species such as *Eucalyptus parramattensis* ssp. *decadens, Grevillea parviflora* ssp. *parviflora* and *Acacia bynoeana*. ROTAP-listed species such as *Macrozamia flexuosa* and *Grevillea montana* (coded 2K and 2KC respectively) have also been widely recorded in KSSW.

This community appears to be highly variable in species composition and dominance ratios. Recent work has revealed that up to ten (10) variants of KSSW may occur in the HEZ study area alone area (Bell 2004b). Other examples of variance within KSSW include the noted dominance of *E. signata* tree in some areas (HSO Ecologists pers. obs.).

The total known extent of KSSW is only 2385 hectares (NPWS 2000a; House 2003). Of this, 435ha is conserved in the Werakata National Park section that is contained within the bounds of the HEZ study area (Bell 2004b). A further 97.5ha is conserved within the remaining two portions of this reserve (NPWS 2000; House 2003). Therefore, a total of 532.5ha exists in Werakata National Park. This represents 22.45% of the total known distribution of this community. A further 231.4ha occurs within 7(b) Habitat Protection Zone within the HEZ study area. This brings the amount of KSSW contained in reserve areas to 763.9ha (approximately 32% of the total known area), with the remainder primarily being located on private or crown lands (such as that found on the subject study area). Negotiations are currently occurring between the RTA, DEC and landholders near Kurri Kurri that would further bolster the conservation status of the community.

A Recovery Plan for this community is currently in production, which includes a detailed review of its status / ecology / distribution within the area. Production of a draft document is expected to be finalised by the KSSW Recovery Team and ready for public comment in early 2006 (T. Hogbin pers. comm.).

Lower Hunter Spotted Gum - Ironbark Forest in the Sydney Basin Bioregion

Lower Hunter Spotted Gum – Ironbark Forest (LHSGIF) is widespread throughout the central to lower Hunter Valley, with forests between Cessnock and Beresfield forming the core of its distribution. This community is dominated by *Corymbia maculata* (Spotted Gum) and *Eucalyptus fibrosa* (Broad-leaved Ironbark) with occasional occurrences of *E. punctata* (Grey Gum) and *E. crebra* (Grey Ironbark). Several distinctions have been noted within the LHCCREMS community profiles between this community and other Spotted Gum / Ironbark associations, often characterised by the dominant canopy composition, range, soil type and topography (NPWS 2000).

Within the Lower Hunter, the peak of distribution occurs within the forested areas between Beresfield and Cessnock. On the basis of revised vegetation mapping conducted in 2002, a total of 32,366ha of LHSGIF has been mapped within the LHCCREMS study area boundary, representing a significant proportion of forested areas found within the Lower Hunter Valley, and in particular within the bounds of the Cessnock City Council Local Government Area (NPWS 2000a; House 2003).

The relatively small area of reservation of the community in the locality along with ongoing threats from urban and industrial development, logging, inappropriate fire regimes, etc., suggests that this community may be under substantial threat. 2,541ha of this community is currently known to be reserved within Werakata National Park, representing the most widespread community within that reserve. Although not classified as a direct reservation, 2,762ha occurs within State Forests, of which 99% occurs in the Cessnock LGA. Some areas have been mapped within Wallaroo State Forest (NPWS 2000; House 2003), although this could be erroneous (being more likely to be Seaham Spotted Gum Ironbark Forest). Within the HEZ study area, 461.4ha of LHSGIF is proposed to be reserved within the 7(b) conservation zone.

Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner Bio-regions

Freshwater wetland on coastal floodplains typically occur on silts, muds or humic loams in depressions, flats, drainage lines, backswamps, lagoons and lakes associated with coastal floodplains. Floodplains are level landform patterns on which there may be active erosion and aggradation by channelled and overbank stream flow with an average recurrence interval of 100 years or less (adapted from Speight 1990). Freshwater Wetlands on Coastal Floodplains generally occur below 20 m elevation in the NSW North Coast, Sydney Basin and South East Corner bioregions. The structure of the community may vary from sedgelands and reedlands to herbfields, and woody species of plants are generally scarce. Typically these wetlands form mosaics with other floodplain communities, and often they include or are associated with ephemeral or semi-permanent standing water. The composition of Freshwater Wetlands on Coastal Floodplains is primarily determined by the frequency, duration and depth of waterlogging and may be influenced by the level of nutrients and salinity in the water and substrate.

Within the Lower Hunter, this community is associated with permanently or inundated swamps or wetlands along the floodplain of the Hunter Valley. A distinct vegetation complex dominated by various sedge, rush and obligate waterplants exists within this assemblage.

Significant examples include Hexham Swamp, Ellalong Lagoon and wetlands situated along the Wallis Creek floodplain.

Of these, the community is protected within Hexham Swamp and Pambalong Nature Reserves. Approximately 3,098 hectares of this community 'Wetland Complex' has been has been mapped within the LHCCREMS study area boundary (NPWS 2000; House 2003). The largest portion of this community occurs within Hexham Swamp Nature Reserve, containing approximately 2,250 hectares of this community. Elsewhere, areas of this community are protected within conservation reserves such as Pitt Town Nature Reserve and Scheyville, Wyrrabalong, Myall Lakes, Botany Bay, Royal and Seven Mile Beach National Parks. However, these are unevenly distributed throughout the range and unlikely to represent the full diversity of the community. In addition, wetlands within protected areas are exposed to hydrological changes that were, and continue to be initiated outside their boundaries. Some Freshwater Wetlands on Coastal Floodplains are protected by State Environmental Planning Policy (SEPP) 14, although this has not always precluded impacts on wetlands from the development of major infrastructure (NSW Scientific Committee 2004).

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APPENDIX I: QUALIFICATIONS AND EXPERIENCE OF PERSONNEL

MICHAEL RODERICK BAPPSC(EAM)

Senior Ecologist

Principal author and field ecologist for this Species Impact Statement and has been involved in several ecological HEZ projects such as fieldwork for the Ecological Constraints Master Plan and reviewing of Environmental Management Strategies.

Date of Birth 26th December 1972

Qualifications B.App.Sc. (Environmental Assessment and Management) University of Newcastle, New South Wales (1992-94).

Fields of Special Competence
Environmental Impact Assessment and mediation
Flora, fauna and habitat survey method, design and identification
Threatened species plans of management
Detailed understanding of environmental legislation and threatened species issues
Reviewing of Environmental Reports and Ecological Studies
Threatened and migratory wildlife monitoring
Project management
Bushfire Threat Assessment & management reporting
Volunteer co-ordination and training
Bush regeneration

Professional and Other Affiliations
Hunter Bird Observers Club (HBOC)
Australasian Wader Study Group (AWSG)
Birds Australia (BA)

Credentials
RFS / PIA NSW Consulting Planners Bushfire Training Course
Occupational Health and Safety Induction Training
NSW Driver's Licence: Car (Class "C")
NSW NPWS Scientific Investigation Licence (No. A2428)

EMPLOYMENT HISTORY

Nov 2002 – current Ecologist / Senior Ecologist
Harper Somers O'Sullivan, Broadmeadow, NSW

Dec 2002 – Nov 2003 Senior Project Officer
Ekerlogic Consulting Services, Wallsend, NSW

Jan 2003 - current Leader - Coastcare Summer Festival Walks / Gosford City Council
The Wetlands Centre / Kooragang NR; Empire Bay / Brisbane Water NP

Mar 2002 Field Assistant (Mistnetting avifauna - 'Wings of America' project)
Podocarpus National Park, Ecuador

Jan – Mar 2002 Compiling Baseline Avifauna and Amphibian Inventories
Cotacachi Cloud Forest Reserve and Cerro Seco Dry Rainforest Reserve, Ecuador

Mar 2001 - Oct 2001 Senior Ecologist
Wildthing Environmental Consultants, Salt Ash, NSW

Aug 2000 – Mar 2001 Ecologist
Wildthing Environmental Consultants, Salt Ash, NSW

June - July 2001 Contract Ornithologist
Connell Wagner Pty Ltd

Dec 2000 – Sept 2001 Part-time Ecologist
Shortland Wetlands Consultancy, Shortland, NSW

Mar 1998 – Aug 2000 Contract Ecologist
Wildthing Environmental Consultants, Salt Ash, NSW

1994 –2002 Ecologist / Field Assistant / Animal Carer, paid and voluntary conservation projects for:

- Irish Wildlife Trust
- Inti Wara Yassi Animal Refuge, Bolivia
- New South Wales National Parks and Wildlife Service (various projects)
- NSW State Forests (various projects)
- Northern Territory Conservation Commission (various projects)
- Territory Wildlife Park (Berry Springs, Northern Territory)
- Western Australia Conservation and Land Management (various projects)
- Environment Australia
- CSIRO
- Sydney University Zoology Department
- Birds Australia
- Australasian Wader Study Group

LUCAS GRENADIER BAPPSC(EAM)(HONS)

Senior Ecologist (not employed by Harper Somers O'Sullivan at time of writing)

Co-authored and undertook fieldwork for this Species Impact Statement and was the principal author for the Link Road Ecological Constraints Study, Species Impact Statements for the HEZ Spine Roads and Ecological Constraints Master Plan for the HEZ.

Date of Birth 17th May 1974

Qualifications B.App.Sc. (Environmental Assessment and Management) University of Newcastle, New South Wales (1994)
B.App.Sc. (Hons) (Environmental Assessment and Management) University of Newcastle, New South Wales (1995)

Fields of Special Competence
Environmental Impact Assessment and mediation
Flora, fauna and habitat survey method, design and identification
Threatened species plans of management
Terrestrial and aquatic flora and fauna surveys
Geographical Information Systems project design and mapping
Project management

Professional Affiliations Hunter Bird Observers Club (HBOC)

Academic Awards 1995 Flora and Fauna Society of the University of Newcastle Honours Scholarship

Credentials
RFS / PIA NSW Consulting Planners Bushfire Training Course
Occupational Health and Safety Induction Training
NSW Driver's Licence: Car (Class "C")
NSW NPWS Scientific Investigation Licences (A2698 and A3408)

EMPLOYMENT HISTORY

Aug 2001 – current Ecologist / Senior Ecologist
Harper Somers O'Sullivan

Jan - Jun 2001 Ecologist (casual)
Environmental Resources Management Australia (ERM).

Jan – Jun 2001 Contract Ecologist
University of Newcastle.

Jul 1999 – Dec 2000 Environmental Scientist / Ecologist
WBM Oceanics Australia.

Nov 1998 – Jun 1999 Contract Ecologist
University of Newcastle, Dept. of Land & Water Conservation.

Jan 1996 – Aug 1998 Ecologist / Field Assistant, various paid and voluntary projects, throughout Australia and SE Asia.

Jan – Feb 1995 Ranger, National Parks and Wildlife Service, Gosford, NSW.

CRAIG ANDERSON BAPPSC(EAM)

Director

Co-authored this Species Impact Statement, the Ecological Constraints Study and has been involved in many HEZ ecological projects, including as co-author of the Species Impact Statements for the HEZ Spine Roads and Project Manager for the Ecological Constraints Master Plan for the HEZ.

Date of Birth	5th November 1971
Qualifications	B.App.Sc. (Environmental Assessment & Management) University of Newcastle, New South Wales (1994) Currently undertaking Graduate Diploma in Archaeological Heritage through University of New England
Fields of Special Competence	Production of complex ecological impact assessment documents Detailed understanding of environmental legislation Conflict resolution and environmental impact mediation Land and Environment Court hearings Flora, habitat, and fauna surveys including threatened species Bushfire Threat Assessment & Management reporting Project Management (including areas outside environmental concern)
Professional Affiliations/ Study Groups	Planning Institute of Australia (PIA) Society for Growing Australian Plants (SGAP) Frog and Tadpole Study Group (FATS) Hunter Birds Observers Club (HBOC) Bird Observers Club of Australia (BOCA) Australasian Bat Society (ABS) Hunter Heritage Network (HHN)
Credentials	RFS / PIA NSW Consulting Planners Bushfire Training Course Occupational Health and Safety Induction Training NSW Driver's Licence: Car (Class "C") NSW NPWS Scientific Investigation Licence (No. A2092)

EMPLOYMENT HISTORY

2001 – current	Manager – Ecology Unit Harper Somers O'Sullivan, Newcastle. (Company Director as of July 2003)
2000 – 2001	Senior Ecologist & NSW Projects Manager Wildthing Environmental Consultants, Salt Ash.
1996 – 1999	Ecologist Wildthing Environmental Consultants, Salt Ash.
1995 – 1996	Ecologist / Environmental Officer Pulver Cooper & Blackley, Newcastle.
1995	Environmental Officer / Survey Assistant Kel Nagle Cooper & Associates, Newcastle.

MARK EVANS BAPPSC(ERM)

Ecologist (not employed by Harper Somers O'Sullivan at time of writing)

Undertook fieldwork for this Species Impact Statement and co-authored the Ecological Constraints Study, the Species Impact Statement for the HEZ Stage 1 Spine Road and other HEZ ecological projects such as the Grevillea parviflora ssp. parviflora study.

Date of Birth 10th May 1970

Qualifications
B.App.Sc. (Environmental Resource Management) Southern Cross University, Lismore, New South Wales (1997).
Part completion, Biological Museum Techniques II,
Sydney Institute of TAFE, Ultimo College.
Bushcare - Propagation and Seed Collection, Newcastle City Council Community Greening Centre, Kotara.
Permaculture Design Certificate, Permaculture Institute, Tyalgum.

Fields of Special Competence
Environmental Impact Assessment and mediation
Flora, fauna and habitat survey method, design and identification
Threatened species plans of management
Detailed understanding of environmental legislation and threatened species issues
Geographical Information Systems mapping
Bushfire Threat Assessment & management reporting
Bush regeneration

Credentials
RFS / PIA NSW Consulting Planners Bushfire Training Course
Occupational Health and Safety Induction Training
NSW Driver's Licence: Car (Class "C")
NSW NPWS Scientific Investigation Licence (No. A2675)

EMPLOYMENT HISTORY

Jan 2002 – Jan 2004 Ecologist
Harper Somers O'Sullivan, Broadmeadow, NSW

June 2000 – current Volunteer
Community Greening Centre, Kotara, NSW

Mar 2001 - Dec 2001 Senior Ecologist
Wildthing Environmental Consultants, Salt Ash, NSW

Aug 2000 – Mar 2001 Ecologist
Wildthing Environmental Consultants, Salt Ash, NSW

May 1999 – Aug 2000 Contract Ecologist
Wildthing Environmental Consultants, Salt Ash, NSW

Nov 1996 – Jan 1997 Intern Ecologist
Ecology Australia Pty. Ltd., Fairfield, VIC