STATUTORY ECOLOGICAL IMPACT ASSESSMENTS

OF

PROPOSED RESIDENTIAL SUBDIVISION OF LOT 124 DP1097510, BELLE O'CONNOR ST, SOUTH WEST ROCKS.

FOR

KING AND CAMPBELL Pty Ltd
P.O. Box 243
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Assessment Undertaken By:

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NOTE:

This report is presented on an objective basis to fulfil the stated legislative obligations, consideration and requirements in order to satisfy the client's instructions to undertake the appropriate studies and assessments. It is not directly intended to advocate the proponent's ambitions or interests, but is to provide information required in the determination of development consent by the decision-making authority for the subject proposal.

To the best of our knowledge, the proposal described in this assessment accurately represents the proponent's intentions when the report was completed and submitted. However, it is recognised and all users must acknowledge that conditions of approval at time of consent, post development application modification of the proposal's design, and the influence of unanticipated future events may modify the outcomes described in this document. Completion of this report has depended on information and documents such as surveys, plans, etc provided by the proponent. While checks were made to ensure such information was current at the time, this consultant did not independently verify the accuracy or completeness of these information sources.

The ecological information contained within this report has been gathered from field survey, literature review and assessment based on recognised scientific principles, techniques and recommendations, in a proper and scientific manner to ensure thoroughness and representativeness. The opinions expressed and conclusions drawn from this report are intended to be objective, based on the survey results and this consultant's knowledge, supported with justification from collated scientific information, references/citations or specialist advice.

Furthermore, it is clarified that all information and conclusions presented in this report apply to the subject land at the time of the assessment, and the subject proposal *only*.

This report recognises the fact, and intended users must acknowledge also, that all ecological assessments are subject to limitations such as:

- Information deficits (eg lack of scientific research into some species and availability of information)
- Influences on fauna detectability eg season in which survey is undertaken
- Influences on species occurrence eg stage of lifecycle, migratory, etc
- Time, resource and financial constraints.

All users should take into account the above information when making decisions on the basis of the findings and conclusions of this report.

For and on behalf of DARKHEART **Eco-Consultancy**,

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Principal

SUMMARY

1. Background Information:

This report presents the results of a Seven Part Test, SEPP 44 – *Koala Habitat Protection* and *Environment Protection and Biodiversity Conservation Act 1999 - Matters of National Environmental Significance* assessments of the land identified as Lot 124 DP 1097510, Belle O Conner St, South West Rocks. This survey and assessment forms part of an Environmental Assessment for a development application under Part 3A of the *Environmental Planning and Assessment Act 1979* to the Dept of Planning (DoP), NSW.

The site (the development footprint) falls on the northern footslope to midslope of a ridgeline which runs roughly east-west along the southern boundary. A spur off this ridgeline separates Lots 614-22 from the remainder. The slope grades gently to moderately steep to the north to northeast. Soils are derived from granitic parent material. The total property has been subject to grazing, with extensive clearing and underscrubbing of the mid to lower portions, leaving a ribbon of residual forest in the south to southwest on the hill.

The proposal forms the final stage in addition to the currently approved sections of the larger residential development known as Seascape Grove. The proposal is to establish a further 70 residential Lots in the residual 2(a) zone, with APZs on some Lots extending upslope into the fringes of the adjacent (7a) zone. The proposal will remove about 70 trees mostly from the agricultural woodland over a footprint of Xha. Lots will adjoin an approved road, with a new ring road to service Lots in the mid-west. The remainder of the 7(a) zone will remain as is post-development.

2. Flora Results:

Two terrestrial vegetation community and one minute area of aquatic vegetation were identified on site according to floristic formation and association, as follows:

a) **Dry Sclerophyll Forest:** Formed a ribbon on the upper slope to crest in the 7(a) zone. Predominantly even-aged, however has a high level of senescent trees. Scribbly Gum and Blackbutt are the dominant species. The sparse to moderately dense understorey consists of young eucalypts in the taller layer, with a lower understorey of Jackson Bay Pines and Black Oaks. The shrub layer is sparse but distinct with Hopbush being most common. The ground layer consists is generally a sparse covering of Bladey Grass, Wiry Panic and Bracken Fern, grading to pasture grasses in the ecotone.

b) **Agricultural Woodland:** Occurs over the footprint of the new Lots and up the mid to upper slope. This community has been derived from the adjacent forest via long term clearing, underscrubbing, grazing, cultivation, etc. The sparse to clumpy canopy consists of the same species but generally younger regrowth (especially along the western boundary). The understorey and shrub layer is all but absent, and the groundcover is dominated by pastoral grasses (Carpet Grass and Couch) and herbs with some ferns in more recently converted sections.

c) **Dam**: A small dam has been breached over at least a year ago and is drying out. True aquatic vegetation is all but extinct with a few Cyperaceace species making a last stand in the centre, and Carpet Grass dominating the remainder.

The study site/area does not contain an Endangered Ecological Community or Population.

The study area demonstrates signs of a range of at times significant disturbances. These disturbances are considered highly likely to have resulted in substantial habitat changes (eg to microclimates, soil characteristics, etc) that may have effectively precluded threatened flora species from occurring on the site. As a result of these factors and the lack of proximate records, the study site (and also the study area) is considered to have minimal potential to support a threatened flora species. No threatened species were recorded on site despite thorough searches. Consequently, no threatened plants were recorded or considered likely potential occurrences.

3. Habitat Evaluation:

The habitat evaluation is summarised below:

Table S1: Habitat evaluation summary

HABITAT ATTRIBUTE/ TYPE	SITE/STUDY AREA	POTENTIAL THREATENED SPECIES OCCURRENCES
Aquatic/wetland habitat	Small dam recently drained. Some common frogs breeding in remaining small pool about 2m wide and <20cm deep, with no significant aquatic vegetation and likely to dry up within a relatively short period (ie shorter than the period required for breeding of most species). Minimal breeding and foraging habitat in dam which is isolated from other potential habitat.	No dependant species likely to occur.
Marine/estuarine habitats eg estuarine, rocky foreshores, open beaches, open ocean.	Absent	Migratory and threatened seabirds eg Little Tern, White-Breasted Sea-Eagle, Sooty Oystercatcher, etc; marine mammals, reptiles, etc.
Caves, Cliffs, Overhangs, etc	Some exposed rock in the 7(a) zone but no significant formations or areas of good rock cover with cracks, etc. Constructed wall around water tanks offers good crevices for reptiles and small species. No caves, etc.	Only common species likely to use the artificial habitat of the rock wall. Overall limitation on occurrence of dependant species unless range widely from roosts, dens, nests, etc, located elsewhere.
Logs	Absent from site. Some small (<10-15cm diameter) in the forest. No suitable hollows observed. Limited potential for foraging.	No suitable dens for Spotted-Tail Quoll. Marginal foraging substrate for Brushtailed Phascogale, Common Planigale (latter limited by lack of groundcover however)
Groundcover	Ranges from sparse to very low (grazed pasture). Unsuitable for refuge or foraging except for common macropods	No dependant species likely to occur.
Leaf Litter	Varies from non-existent to shallow.	Limited potential for common species only
Shrub Layer/ Undergrowth	Sparse to well developed in parts of the forest. Poor to marginal for passerine birds.	Limited potential for common passerine birds which offer prey for other species eg Square-Tailed Kite.
Wattles, Callistemons and Banksias	Absent on site, uncommon in 7(a). Few Wattles, 1 Banksia and few Callistemons - Better resources in locality for dependant species qualifies area as marginal.	Very low quality potential foraging habitat for Squirrel Gliders.
Fruiting Species	Absent	No dependant species likely to occur.
Tree flowering periods	Mostly Summer-Autumn species. Limited abundance on site but hundreds in 7(a) zone, and very large extent in locality. Located in high proximity to high human presence.	Very good potential forage for Squirrel Glider, Grey Headed Flying Fox, Black Flying Fox, Yellow-Bellied Glider plus passerine birds.
Tree Hollows	About 6 trees contain hollows on the site, with many more in the 7(a) zone. Full range of apertures but mostly small to medium (<5-10cm).	Excellent potential dens, etc, for range of hollow-obligates eg Stephens Banded Snake, Pale Headed Snake, Squirrel Glider, Microchiropteran bats, Eastern Pygmy Possum Very limited for large species eg forest owls, Glossy Black Cockatoo, Quoll.

4. Wildlife Corridors and Habitat Linkages:

The site/property's forest is continuous with similar forest to the west and south (which is extensive and interconnected to Hat Head National Park in both directions. Linkage to the north/northeast is limited by the pasture land and future residential development. Linkage to the west is constrained by intensive residential development.

According to DECC modelling and mapping the site itself does not fall within a regional or subregional corridor or contain key habitat.

5. Fauna Results:

The survey period coincided with poor weather conditions and this was a limitation on both the range of techniques which could be used, and the survey results, with only a sample of expected diversity recorded. Most significantly, a Squirrel Glider was captured in the 7(a) zone which verified the consultant's expected presence of this species. Previous survey of the remainder of the property recorded the Grey Headed Flying Fox, Eastern Freetail Bat, Little and Common Bent-Wing Bat. No migratory species listed under the EPBCA were recorded.

6. Potential Impacts of the Development:

A comprehensive review was undertaken of the potential ecological impacts the proposed development may have, with specific focus on the threatened species recorded or those considered to have potential to occur.

Potential impacts were identified and divided into primary and secondary impacts as follows:

(a) **Primary Impacts**:

- ***Habitat Modification***: In total, it is estimated that approximately Xha of agricultural woodland and pasture will be modified via removal of about 70 canopy trees, including 6 hollow-bearing trees and 23 SEPP 44 Schedule 2 species.

- ***Habitat loss***: The dam will be filled resulting in complete loss of aquatic habitat on the site.

Remainder of forest in 7(a) zone to remain as is, with slashing maintained in the woodland to maintain APZs.

(b) **Secondary Impacts***:*

The following are impacts generally associated with rural development:

1) *Weed invasion*: Given the area affected, current levels of exotics in the woodland, and relative hostility of the surrounding vegetation to most exotic species, this is not considered a significant threat.

2) *Introduction of feral/introduced animals*: Feral/introduced species are likely on the site include foxes and feral cats. In addition, adjacent residences to the southeast and west may host domestic dogs and cats which may roam bushland in the area. While the proposed development may marginally increase the number of domestic dogs, cats and perhaps feral species to occur, overall this incremental increase is not considered likely to be significant given their current occurrence on site and in the general area, etc.

3) *Artificial lighting*: Lighting may potentially discourage particularly nocturnal native species from foraging near areas of development or emerging from hollows. Conversely artificial lighting may be beneficial eg to Microchiropteran bats by creating localised aggregation of insects. Given the nature of the proposal and observations in similar situations, this is not considered likely to be a substantial impact.

4) *Noise disturbance*: None of the fauna identified on the site are considered likely to be significantly affected by noise, especially given the current level of noise generated by residences, operation of machinery and traffic on and adjacent to the site. Furthermore, the subject threatened fauna have been detected in close proximity to residential dwellings site and such estates are not typically high-noise environments.

5) *Increased human presence*: Given the nature of the proposal and the extent of the habitat, current levels of human presence, most of the relevant threatened species are unlikely to be significantly affected, especially given recordings of the subject species in similar circumstances elsewhere.

6) *Bushfire risk and alteration to regimes*: The proposal has the potential to modify the remaining forest via an altered bushfire regime. However, given the recommendations of this report in conjunction with supporting legislation this is not considered likely to result in a significant modification of the site.

7) *Disease*: The proposed development is not considered likely to introduce/increase the presence of any diseases such as Psittacine Circoviral Disease or Chytridiomycosis. Furthermore, Koalas were not considered a potential occurrence on site thus the proposal will not increase the risk of stress-induced diseases to Koalas in the general area.

8) *Incremental vegetation removal*: Given that the habitat on site has known/potential values for several threatened fauna species, appropriate recommendations are provided to support existing statutory controls.

9) *Erosion and Sedimentation*: Construction of the development will increase the risk of erosion and sedimentation. Given standard erosion and sediment control measures will be required to be implemented during the construction of dwellings and driveways, the contribution of the proposal to these processes is unlikely to be substantial.

10) *Edge Effects*: Urban expansion adjacent to currently intact vegetation can have the following effects which are generally referred to as edge effects:
    - Increased ingress of feral species such as cats and dogs.
    - Ingress of weeds into areas not previously found.
    - Alterations to microclimate ie drying, altered humidity levels, increases light penetration, etc.
    - Increased exposure to wind.
    - Increased predation, competition and assemblage modifications.

The minor extent of habitat affected and the disturbed nature of this habitat indicates this is unlikely to be a significant impact.

7. Recommendations and Ameliorative Measures:

7.1 Primary Recommendations:

The following major recommendations are made to reduce or avoid potential impacts on threatened fauna either known or considered potential occurrences on the study site. These are integral to the basis of later assessment and conclusions as it is assumed these recommendations will largely be implemented in some form eg title covenants.

1. **Informed Development Design:**

To minimise the extent of required clearing, all trees within the development footprint were surveyed. This allowed retention of 18 trees within the footprint, and minimised the impacts of establishing an APZ via utilising the currently disturbed sections of the woodland.

2. Pre-Clearing Strategy and Survey:

All non-hollow bearing trees are to removed at least 24hrs before removal of hollow-bearing trees to encourage arboreal mammals to abandon the hollow.

The night before felling of these trees, a saturation trapping program is to be employed to maximise potential capture of any species which may be within hollows when felled. Any trapped fauna can be kept in a cool, dark place through the day and realised in the evening post clearing in adjacent habitat. Stag watching to identify any active bat roosting hollows is also recommended on the night before clearing. If a major roost is detected (ie >5 bats emerge), felling is to be suspended until the roost is no longer used as this roost may be used as a nursery or other key roost.

3. Hollow-Bearing Tree Removal Protocol:

Hollow bearing trees must be removed via application of a protocol that minimises risk of direct mortality of resident fauna. This method is best utilised in conjunction with a pre-clearing trap night and stag watching carried out by an appropriately qualified person. Any injured fauna are to be taken in care at the proponent's expense. Rehabilitated and rescued animals are to be released into the remaining habitat in the 7(a) zone.

4. Retained Tree Protection:

The following tree/habitat protection measures will be required to be undertaken to protect the retained habitat/trees during construction. These include:

- All trees/habitat to be retained or removed should be clearly mapped on a site plan (ie a clearing plan) and marked on site (eg with a specific coloured flagging tape or fencing off) to ensure construction activities do not result in accidental damage or removal.

- All practical measures possible are to be undertaken to protect retained trees/habitat to maintain long term health eg fencing off temporary fencing during the length of the construction period. Appropriate guards approved by an arborist are to be installed to prevent physical damage to the trunk where setback via fencing is not practical/possible, and other additional measures (eg mulch placed over roots) are to be implemented to protect the health of the tree. Appropriate measures approved by an arborist are to be taken when roots must be trimmed during any excavation works.

- Machinery and vehicles should avoid being used or parked directly adjacent to trees which are to be retained to avoid soil compaction. If unavoidable, soil compaction and tree protection measures will be required.

- Specific instruction to staff/contractors on what trees and habitat is to be retained, their significance and measures to be undertaken to avoid damage to them. Contracts are to contain clauses for penalty for non-compliance.

- No disposal of cement wastes, construction material or washdown near the retained vegetation.

- Mixing of imported soils with site soils outside the development/dwelling footprint should be avoided to minimise risk of disease and pathogenic fungus transfer.

Contract conditions with contractors are to provide for compliance mechanisms (eg financial penalties) for breeching of the above eg accidental tree removal (including of replacement plantings), and to compensatory measures eg replacement plantings.

7.2 Secondary Recommendations

The following are provided for optional consideration by the determining authority as conditions of consent. The conclusions of this assessment do not assume that these recommendations are adopted as conditions of consent, but it is desired that the proponent at least be advised to consider adopting them to minimise overall impact and maintain biodiversity as per the principles of Ecologically Sustainable Development:

1. *General Landscaping*: Gardens and any other areas which are to be planted for aesthetics should generally include native potential forage species such as eucalypts, banksias, acacias and grevilleas to attract and support fauna. This will not only offer more habitat for species capable of facilitating such areas, but also increase the aesthetics of the area. Use of garden chemicals should be limited a much as possible.

2. *Artificial Lighting*: To ensure anthropogenic impacts are minimised, it is recommended that artificial lighting generally be kept to a minimum and be of a localised and low luminosity, with light directed to the ground and not into trees/vegetation.

3. *Predator Management*: All stray cats and dogs should be reported by residents to Council as applicable under the provisions of the *Companion Animals Act 1997*. Any pet cats and dogs should be restricted to the development envelopes. Cats should be confined to enclosures or indoors during the night. Pets should not to be allowed to roam through the regeneration area or bushland in the general area.

   Residents are to report sightings of foxes, feral cats and wild dogs to the Rural Lands Protection Board and DECC, and through on-going liaison with the RLPB, DECC and adjacent landowners, undertake a regular coordinated pest control program to allow suppression of feral species populations in the area, and eliminate reservoir populations

4. *Bushfire Regime*: Any hazard reduction burning should take into consideration the ecological constraints of the forest remaining in the 7(a) zone.

8. EPBCA 1999 – *Matters of National Environmental Significance* Assessment:

The provisions of the EPBCA require determination of whether the proposal has, will or is likely to have a significant impact on a "*matter of national environmental significance"*. These matters are listed and addressed as follows:

i) **World Heritage Properties**: The site is not listed as a World Heritage area nor does the proposal affect any such area.

ii) **Ramsar Wetlands of International Significance**: No Ramsar wetland occurs on the site, nor does the proposal affect a Ramsar Wetland.

iii) **EPBCA listed Threatened Species and Communities**: No EPBCA listed threatened flora species or community, etc, were found on the site, nor considered a significant likelihood of occurrence. No EPBCA listed threatened fauna species were detected by the survey, though the Grey-Headed Flying Fox and Spotted-Tail Quoll are considered potential occurrences utilising the site as part of a much larger foraging rage. Assessment under the MNES guidelines determined the impacts of the proposal were not considered likely to be a sufficient order of magnitude to be considered significant.

iv) **Migratory Species Protected under International Agreements**: NO EPBCA listed migratory species were recorded during the survey but a number of other species are considered at least a fair potential occurrences at some stage on the property overall. Assessment under the MNES guidelines determined the impacts of the proposal were not considered likely to be a sufficient order of magnitude to be considered significant.

v) **Nuclear Actions**: The proposal is not a nuclear action.

vi) **The Commonwealth Marine Environment (CME)**: The site is not within the CME nor does it affect such.

vii) **National Heritage**: The site is not on the National Heritage list.

The proposal was not considered to require referral to the Department of Environment, Water, Heritage and Arts (DEWHA) for approval under the EPBCA.

9. Seven Part Tests Assessment:

In addition to the threatened species recorded on the property (Squirrel Glider, Little & Common Bent Wing Bats, Eastern Freetail Bat, Grey Headed Flying Fox), a significant number of other threatened species have also been recorded in the locality. Some other regionally recorded threatened species were considered likely to occur in the locality based on existence of potential habitat and regional records in such habitat. These were all evaluated for their likelihood of occurrence on the

site/property, the potential for impact upon them, and if the impacts were likely to be significant enough to require a Seven Part Test assessment. Of the species evaluated, the following were considered to require Seven Part Test evaluation to assess the significance of potential impacts:

- **Mammals**: Grey-Headed Flying Fox, Squirrel Glider, Greater Broad-Nosed Bat, Yellow-Bellied Sheathtail Bat, Hoary Bat, Eastern False Pipistrelle, Beccari's Freetail Bat, Black Flying Fox, Brushtailed Phascogale, Spotted-Tail Quoll, Koala.

- **Birds**: Square-Tailed Kite, Powerful Owl, Masked Owl, Barking Owl.

The 7 Part Tests are summarised below.

Given the ecology of most of the subject threatened species, the habitat on site/directly adjacent to the site (on the remainder of the property) and the extent of known/potential habitat in the general area; the range of the known/potential local population of all of the subject species would extend well beyond the confines of the study area.

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

The proposed development may see up to approximately Xha of agricultural woodland habitat potentially removed/modified under the proposal from the site, as well as the adjacent area of woodland maintained for APZs. This will remove some 70 trees, including some 6 hollow-bearing trees which have potential as roosts sites for the Microchiropteran bats, Squirrel Glider and Brushtailed Phascogale. About 23 primary preferred Koala browse species will also be removed.

This habitat loss/modification will result in a reduction of the property's carrying capacity for all the subject species. However, given the limited quality of the habitat affected, the extent of more optimum habitat in the 7(a) zone, and mobility and ranges of the majority of the subject species, this would represent a very minor reduction in potential habitat available in the area, as well as locally and regionally.

For the Squirrel Glider which has the smallest range, the habitat reduction proposed represents a contraction of the marginal fringe towards the core area, hence is also considered relatively insignificant. This is due to the retention of the majority of known or potential habitat together with links to surrounding land; and the retention of most of the key habitat components ie tree hollows are most abundant in the 7(a) zone.

Thus given the site/property's disturbance history, current modified state and records of all of the subject species in/adjacent to urban and rural/rural-residential habitats elsewhere; the remaining habitat on the property's current carrying capacity for all of the subject species should largely be retained at sufficient levels to maintain population viability. Other threats to the subject species or their habitat (ie domestic pets, road kill, fire) should not be significantly increased by the proposal beyond current threat status given statutory controls.

Overall following consideration of the above, the proposal is not considered likely to result in an impact that may significantly affect the lifecycle of the local population of any of the subject species to the point of increasing extinction risk, especially given the extent of alternative known/potential (and generally better quality) foraging and/or roosting/nesting habitat available to the local population of the subject species on the property and interlinked to adjacent habitat.

(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 relevant populations are currently listed under the TSCA.

(c) in the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

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

No EECs occur on site or in the study area, hence this question is not relevant.

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

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

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

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

The proposal will remove/modify about Xha including 70 trees on the property which lies on the fringe of X ha of forest remaining on the property's southern boundary. For the majority of the subject species, the habitat potentially requiring removal as part of the proposal provides only marginal habitat on the fringe of the core area and/or a minute fraction of their range, and the majority of habitat on the property will be retained.

All the subject species are generally at least relatively highly mobile (provided suitable habitat exists eg canopy cover), thus the relatively minor area of habitat loss will not impose any barrier to movement as current linkages to the south and west will remain.

The affected areas of habitat for all the subject species comprises known or potential foraging habitat and potential denning/roosting habitat in tree hollows. While its loss/modification is a negative impact to the carrying capacity of the property, as about Xha of forest and woodland on the property will remain as is, the affected area is not crucial to the long term survival of any threatened species population.

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

No relevant areas of critical habitat have been declared, as yet, under Part 3 of the TSCA.

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

The *Recovery Plan for the Barking Owl* outlines the loss of native vegetation/habitat as a key threatening process for the Barking Owl. While the proposal will remove native vegetation, the extent of clearance is relatively minute compared to remaining habitat in the area and its home range, and will not significantly impact on the species. Hence only via strict definition is the proposal inconsistent with objectives of the plan.

A draft *Recovery Plan for Forest Owls* has been exhibited for the Masked and Powerful Owl. As for the Barking Owl, the proposal will remove a minute area of potential foraging habitat and only via strict definition is the proposal inconsistent with objectives of the plan.

The draft Recovery Plan for Koalas specifies actions considered to be key threats to Koalas. This plan specifies "*Habitat loss and Fragmentation*" and "*Habitat Degradation*" as "*the most important threats to Koalas throughout their range*". The proposal is thus inconsistent with this plan as it will remove 23 potential browse species and contribute to these threats. Dogs and traffic are also key threats, and the proposal will incrementally add to these impacts. While negative, as no Koala population has an association with the site, the conflict with the objectives of the recovery plan is relatively limited.

At present no recovery/threat abatement plan is in place for the other species. The proposal may remove about Xha of habitat including 70 trees (and 6 hollow-bearing trees) which by strict interpretation could be considered as adding to the main threatening process affecting these species (habitat loss), and hence is inconsistent with the recovery of the species. However, given the relatively marginal quality of the habitat to be affected, the minor area of habitat to be removed, the extent of habitat to be retained on the property, and the abundance of similar habitat on adjacent land and in the direct locality; the loss is considered to be insignificant to the long term recovery of these species.

Overall the proposed development is considered unlikely to have a substantial affect on the long-term recovery of any of the subject species.

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

The TSCA defines a "*threatening process*" as "*a process that threatens, or may have the capability to threaten, the survival or evolutionary development of species, populations or ecological communities*".

"*Clearing of native vegetation*" has been listed as a Key Threatening Process and is a recognised threat to a number of species, communities and populations listed under the TSCA 1995 (NSWSC 2001d). Loss of habitat via development for residential and urban land use is also recognised as a threatening process for all of the subject species (Smith *et al* 1995, NPWS 2003d, DEC 2006b, etc). The proposed development will contribute to this process via the removal/modification of habitat to establish development envelopes and potentially during the clearing of boundary lines. However the majority of the property's forest vegetation will be retained post-development with protection under statutory instruments.

Human-induced climate change is a Key Threatening Process that the proposed development will contribute to via removal of up to Xha of vegetation and possible burning of this material; and/or establishment of a residential development utilising fossil fuels for energy.

"Predation by foxes and feral cats" are other Key Threatening Processes likely to be currently existing on the site, which impose a risk to potential prey, and several potentially occurring threatened species. The increase in human presence on site may see greater controls on these pests. Considering that any potential pet cats and dogs will largely be retained in close vicinity of the dwellings, and that the threat posed by domestic cats and dogs is already high (given the abundance of both species on land to the west) the increase in this threat induced by the proposal is not considered likely to be substantial.

Inappropriate fire regimes are also a threatening process eg by increasing risk of wildfire by poor management; prescription burning of too much habitat at one time (or key areas at a particular time eg breeding season). The proposal may result in a modified fire regime due to increased frequency of hazard reduction burning to protect assets. This report recommends that future fire regimes consider the ecological constraints of the site. In addition, threatened species have been recorded on the site thus any burning for the purpose of hazard reduction should require a Bush Fire Hazard Reduction Certificate (BFHRC) under the RFA 1997 which may include measures to protect the habitats of the threatened species. Thus the potential for an altered fire regime to reduce the site's carrying capacity for the threatened species should be controlled by the legislation and recommendations discussed above.

A number of other Key Threatening Processes may also be incrementally increased by the proposal via edge effects, eg:

- *Invasion of native plant communities by exotic perennial grasses.*
- *Invasion and establishment of exotic vines and scramblers.*
- *Invasion of native plant communities by Lantana camara.*

These Key Threatening Processes may be exacerbated by the proposal due to edge effects as a result of clearing easements.

10. Conclusion:

This survey and assessment has found that while the site is generally evident of a substantial disturbance history, it has retained some significant ecological values. This conclusion is made that, on the provision of the final design and implementation of the proposed development is according to the recommendations and ameliorative measures proposed in this assessment (for the express purpose of ensuring such an outcome is significantly reduced if not unlikely), and that statutory provisions are effectively enforced, the proposed development is not considered likely to significantly adversely affect any threatened species, endangered population or EEC.

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INTRODUCTION

This firm has been requested to undertake an ecological survey, Seven Part Tests and EPBCA – Matters of National Environmental Significance Assessments of the land identified as Lot 124 DP 1097510, Belle O Conner St, South West Rocks. This survey and assessment forms part of an Environmental Assessment for a development application under Part 3A of the *Environmental Planning and Assessment Act 1979* to the Dept of Planning (DoP), NSW.

The proposal forms the final stage in addition to the currently approved sections of the larger residential development known as Seascape Grove (ERM 2006a, 2006b, Umwelt 2004). The DoP has issued Director General's Requirements (DGRs) for the Environmental Assessment of the proposed staged subdivision of the site into 70 residential Lots. This assessment addresses the *Ecological Impact*s requirements section of the DGRs ie a flora and fauna survey, and an assessment of the proposal under Section 5A of the *Environmental Planning and Assessment Act 1979*, as amended by the *Threatened Species Conservation (TSCA) Act 1995* which in turn has been amended by the *Threatened Species Conservation Legislation Amendments Act 2002* (Seven Part Test for Significance). In addition, an assessment of Matters of National Environmental Significance under the Commonwealth *Environment Protection and Biodiversity Conservation (EPBCA) Act 1999* has also been provided to satisfy other statutory requirements.

The survey and assessment was performed in consideration of the draft *Threatened Species Survey and Assessment – Guidelines for Developments and Activities* (DEC 2004a), *Guidelines for Threatened Species Assessmen*t (DEC/DPI 2005) and the *Threatened Species Assessment Guidelines – Assessment of Significance* (DECC 2007c). The assessment has also been undertaken in accordance with the *Ecological Consultants Association of NSW – Code of Ethics* (2002) available at www.ecansw.org.au.

1.0 BACKGROUND INFORMATION

1.1 LOCATION AND ACCESS

South West Rocks is located approximately 37 kilometres northeast of Kempsey on the South West Rocks Road, falling into the Kempsey Shire Council (KSC) Local Government Area (LGA).

Seascape Grove is located at the southeastern end of the village of South West Rocks, south of the golf course. The subdivision is accessed via Gregory St onto Belle O Connor Street. Figure 1 shows the general location of the study site which lies at the southern end of the existing subdivision.

1.2 PROPOSED DEVELOPMENT

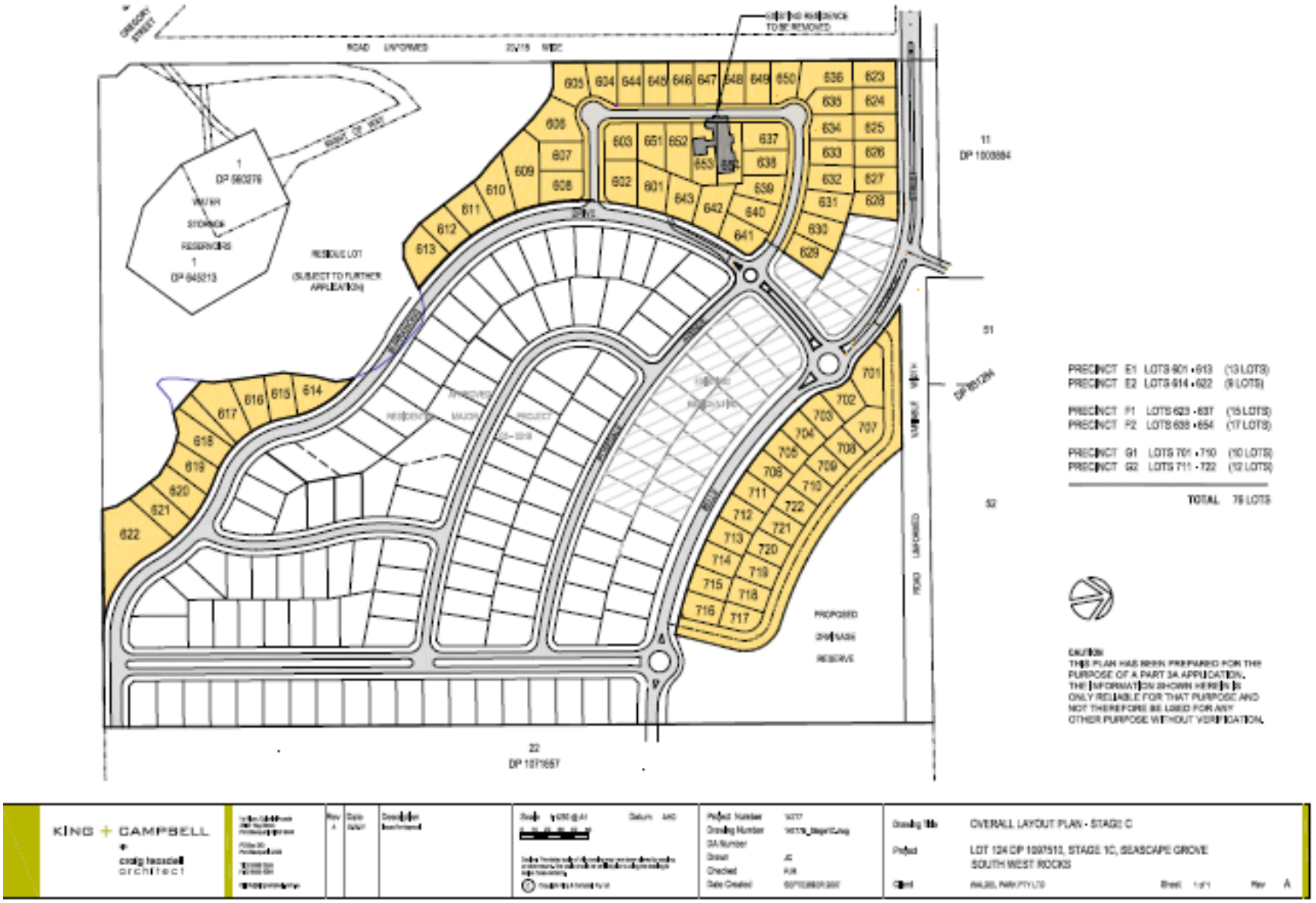
The proposal is a 70 Lot residential subdivision of the residual portion of Lot 21 zoned 2(a) residential (the remainder is zoned 7(a) Scenic Protection). This area is Xha, with Xha of 7(a) to remain post-development.

The subject land forms the peripheral strip of 2(a1) zoned land on the south to southwestern end of the property, abutting the 7(d) zone which encompasses the ridgeline and adjacent water towers (ERM 2006, Umwelt 2004). These Lots form Precinct E1, E2, F1 and F2 of Seascape Grove (see figure 2), comprising Stage 1(c) of the total development.

Burrawong Rd will provide access to these Lots. This road will be constructed under previous approvals.

Figure 1: Location of the study site
Source: www.maps.nsw.gov.au © 2007).

Figure 2: Proposed subdivision layout
(Source: King and Campbell 2007)



1.3 CLIMATE AND WEATHER

1.3.1 Climate of the Bioregion

The climate of the north coast of the North Coast Bioregion from just north of Newcastle to the Queensland border is generally warm temperate. The main influence is the latitudinal position of subtropical anticyclone centres which more easterly across Australia.

In Summer, warm moisture-laden east to south east winds predominate, sometimes bringing rain, with the heaviest in the form of thunderstorms or depressions from subtropical cyclones moving south. In Winter, the northern movement of the anticyclones leads to a dominance of usually dry west to south winds, often leading to fine sunny days and cool nights. Rainfall is usually associated with cold fronts and the coldest temperatures.

Rainfall tends to be distributed more in Summer in the north of the region, to relatively evenly distributed in the south. Annual rainfall is most influenced by distance from the coast and topographic position, with a general decrease from east to west. Annual rainfall in the coastal Macleay area is around 1457mm pa (http://northern.cma.nsw.gov.au/pdf/coastalmacleayrc.pdf.), falling predominantly in Summer and Autumn.

Temperature over the region primarily varies with altitude, decreasing about 5^{o} per 300m rise, and about 2-3^{o}C from north to south in areas of similar altitude. The average annual temperature on the coast is typically 16-20^{o}C, while the annual range is 18-22^{o}C (Australian Bureau of Meteorology, cited in Hager and Benson 1994).

1.3.2 Weather Conditions During Survey

The main survey was conducted between the 5-9^{th} of November 2007. This period coincided with a low pressure trough bringing light to heavy rain over most of the survey period. Most days were overcast with limited sunny breaks mainly toward the end of the week. Temperatures however were warm ranging from about 18-28^{o}C with high levels of humidity. Wind was very limited.

1.4 TOPOGRAPHY, GEOLOGY AND SOILS

1.4.1 Topography

Refer to the topographic map in figure 1.

The site falls on the northern footslope to midslope of a ridgeline which runs roughly east-west along the southern boundary. A spur off this ridgeline separates Lots 614-22 from the remainder. The slope grades gently to the north to northeast. The area encompassed by Lots 601-654 is largely flat with drainage tending north to northeast.

1.4.2 Geology and Soils

The Macksville and Nambucca Soil Landscape maps (DLWC 2000) map the site as occurring on granitic parent material. Derived soils consist of well drained Brown or Yellow Kurosols (red podsolic soils) and Dermosols. Localised outcropping is common on the mid to upper slopes of the parent material.

1.5 LANDUSE AND DISTURBANCE HISTORY

1.5.1 Pastoralism

The total property has undergone increased pastoral improvement activity over the last 10yrs (pers. obs) – as notable by review of aerial photos from 1997-2007, with immature regrowth and lower stratums of vegetation removed via slashing and underscrubbing. Open areas have also been maintained by regular slashing to form low pasture. The end result is that the vegetation over most of the property has been converted to parkland with only a ribbon of intact forest retained along the upper slope around the water tanks. Horses are grazed on the property, with cattle also noted at times (pers. obs.).

1.5.2 Fire

The property evidenced very little signs of a fire. The majority of the site appears not to have been burnt for at least 10yrs, however fuel loading is low to negligible in most areas due to management or the natural sparseness of vegetation (eg in the 7(a) zone).

1.5.3 Weeds and Exotic Species

Overall, aside from pastoral species, exotic plant species are not particularly common. Some minor lantana occur in the upper 7(a) zone.

1.5.4 Existing Dwellings

A large dwelling with associated guest house/managers dwelling, tennis court, pool, sheds, and gardens occurs in the northwest corner of the site.

1.6 ADJACENT DEVELOPMENTS AND ACTIVITIES

The general area is subject to a variety of land uses from rural, rural-residential to urban and recreational.

Residential development links directly to the west. Several rural-residential dwellings lie to the south. Rural land lies to the east (under common ownership) and to the northeast. The South West Rocks Golf Course adjoins to the north.

Two Council-owned water supply reservoirs are located within on separate Lots (Lot 1 DP 560726 and Lot 1 DP 645213) within the 7(d) zone on the ridgeline in the southwest

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1.7 PREVIOUS AND RELEVANT STUDIES

1.7.1 Previous Ecological Assessments

1.7.1.1 Umwelt 2004

Umwelt (2004) assessed the entirety of Lot 21 for 210 residential Lots (the currently approved portions of the Seascape Grove subdivision).

1.7.1.1.1 Flora

The flora survey consisted of 6 walking transects (approximately 150m long) over the approximately 30ha site, and a single 400m^2 quadrat in the modified woodland only. This effort meets the minimum recommended for the size of the site as per DEC (2004) guidelines.

No threatened flora species were recorded. It is noted that the site's Scribbly Gum has been incorrectly identified as the Southern Scribbly Gum (*E. racemosa*). The species present is the Northern Scribbly Gum (*E. signata* - Harden 1991).

1.7.1.1.2 Fauna

The fauna survey was conducted from 19-21st May, hence not in the optimum period of Spring-Summer (DEC 2004).

Fauna survey methods consisted of:

- Herpetofauna habitat searches
- Spotlighting via walking and slow moving vehicle.
- Scat and scratches identification.
- Microchiropteran bat call recording (45 minutes periods) for an unspecified total.
- Spot Assessment Technique assessment for Koala activity levels (no specification of sampling regime eg grid based system or all trees inspected).

No trapping or hair tubing was undertaken and inadequate explanation is provided other than for terrestrial species, which conflicts with the DEC (2004) requirements. While it is accepted that terrestrial Elliot A and wire cage trapping was redundant due to lack of habitat and hence minimal potential for target species to occur, the failure to conduct an arboreal trapping/tube survey is considered a major shortcoming of the assessment given this consultant has recorded Squirrel Gliders and Brushtailed Phascogales in habitat identical to this situation in South West Rocks (Darkheart 2004f, Berrigan 2000a, 2000b, 2000c, 2002a), and other areas (Berrigan 2003a), and Umwelt (2004) consider these species as unlikely to occur. Hollow-bearing trees are also common in the remaining stands of vegetation which these species are highly likely to utilise.

Owl (and presumedly Bush-Stone Curlew and mammal though not specified) call playback was not undertaken due to proximity to residences. This is not considered acceptable given the property is 30ha and hence more than sufficient area was available to minimise disturbance to residents and dogs, and several of the target species have been recorded in the locality and potential habitat occurs on site (ie Powerful Owl and Koala – DECC 2007a, Bionet 2007, Macleay Argus 2002, Darkheart 2006f).

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Umwelt recorded the following threatened species on-site:

- Common Bent-Wing Bat (Vulnerable –TSCA)
- Little Bent-Wing Bat (V-TSCA)
- Eastern Freetail Bat (V-TSCA)
- Grey-Headed Flying Fox (V-TSCA, EPBCA)

A review of potential occurrences derived from a search of the DEC Atlas of Wildlife (2004) was undertaken. This list is considered inadequate as per DEC (2004) standards as it does not consider any other public records (eg Birds Australia – Atlas of Birds); review any available literature (eg Hat Head National Park Management Plan); or consider species not yet recorded in the locality (to public knowledge) but whose range includes the area *and* for which potentially suitable habitat may occur on site eg Masked Owl. The evaluation of likelihood to occur is also considered very poor eg Brushtailed Phascogales and Squirrel Gliders are not considered potential occurrences despite being recorded <1km from the site (eg Darkheart 2004f, Berrigan 2000a, 2000b, 2000c, 2002a, 2003a, O'Neil and Williams 2003, Smith 1995, DECC Atlas of Wildlife 2007, Bionet 2007), suggesting limited knowledge of the species' ecology.

Umwelt also fails to comply with the DEC (2004) requirements to consider impacts on potential habitat, not just potential or known occurrences of threatened species eg the site is Potential Koala Habitat, hence the Koala should have been assessed in the 8 Part Tests even though the survey results suggest the site is not Core Koala Habitat (ie as it offers potential value as linkage or habitat a future recovering population could expand into).

The impact assessment is very brief and provides minimal scientific justification for its conclusion.

1.7.1.2 ERM 2006b

ERM were engaged to provide a 7 Part Assessment for stormwater treatment infrastructure and a bushfire perimeter road on Lot 22 comprising a 25m strip adjacent to the study area assessed by Umwelt (2006).

ERM considered the subject area to have minimal habitat values, and recorded no threatened species.

A number of botanical misidentifications are noted in this report eg the *Grevillea* spp referred to is actually Crinklebush (*Lomatia silaifolia*).

1.7.1.3 ERM 2007

ERM were engaged to conduct a habitat assessment of the 7(d) *Scenic Protection Zone* south of the residential area on Seascape Grove. This assessment provided supporting information to the Umwelt (2004) assessment in regard to the relatively higher ecological values for threatened species (such as Squirrel Gliders) of this area relative to the proposed residential area. Umwelt (2004) justified their conclusion that no significant impact was likely due to the presence of sufficient alternative resources the land adjacent to the subject site.

ERM demonstrated that the 7(d) zone, which is less modified in structure, has relatively higher habitat values in terms of hollow abundance and diversity, vegetation structure, and terrestrial habitat components (exfoliating rocky outcrops and hollow-logs). ERM however also reiterate the error that Squirrel Gliders and Phascogales are not likely to use the modified woodland.

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1.7.3 Other Ecological Assessments

This firm has undertaken the following assessments undertaken in the South West Rocks area:

- Berrigan, J.A. (2004). *Threatened Species, EPBCA Act and SEPP 44 Assessment for Proposed Rural-Residential Dwelling on Lot 3 Palm Grove, Arakoon***.** Unpublished report to Mid Coast Environmental Services. Darkheart Eco-Consultancy, Port Macquarie.

- Berrigan, J.A. (2003). *Threatened Species, EPBCA Act and SEPP 44 Assessment for Proposed Residential Subdivision on Lot 1 DP 871437, Frank Cooper St, South West Rocks.* Unpublished report to Covey and Associates. Darkheart Eco-Consultancy, Port Macquarie.

- Berrigan, J. A. (2002). *Flora and Fauna Investigations on Lot 42 DP 8788 , Gregory St, South West Rocks*. Memorandum to Hopkins Consultants. Darkheart Eco-Consultancy, Port Macquarie.

- Berrigan, J.A. (2000). *Threatened Species and SEPP 44 - Koala Habitat Assessment For Proposed Residential Subdivision Of Lot 229 DP 754396, Spencers Creek Rd, South West Rocks*. Unpublished report to Hadlow Design Services. Darkheart Eco-Consultancy, Port Macquarie.

- Berrigan, J.A. (2000). *Threatened Species and SEPP 44 - Koala Habitat Assessment For Proposed Residential Subdivision Of Lot 224 DP 754396, Spencers Creek Rd, South West Rocks*. Unpublished report to Hadlow Design Services. Darkheart Eco-Consultancy, Port Macquarie.

- Berrigan, J.A. (2000). *Threatened Species and SEPP 44 - Koala Habitat Assessment For Proposed 12 Lot Residential Subdivision Of Lot 17 and part Lot 16 DP 868688, Arakoon, South West Rocks*. Unpublished report to REALM. Darkheart Eco-Consultancy, Port Macquarie.

- Berrigan, J.A. (2000).*Threatened Species Management Plan for Lot 961, DP 1009907, Spencers Creek Rd, South West Rocks*. Unpublished report to Cavanaghs Bus Company, Kempsey. Darkheart Eco-Consultancy, Port Macquarie.

- Berrigan, J.A. (1999). *Consideration of Potential Impacts on Threatened Species for a Modified Proposal to Establish a Dwelling on Lot 2, DP 718544, Off Gilbert Cory and Bel O'Connor St, South West Rocks*. Letter to Kempsey Shire Council on behalf of Mr J. and Mrs M. Holmes. Darkheart Eco-Consultancy, Port Macquarie.

- Berrigan, J.A. (1998). *Proposed Tourist Facility, Lot 1, D.P. 853056, DA T4-98-62, Arakoon, South West Rocks.* Unpublished report to Glen Petersen Architect, Kingscliffe. Darkheart Eco-Consultancy, Port Macquarie.

- Berrigan, J.A. (1998). *Eight Point Test, EPBCA Act and SEPP 44 Koala Habitat Assessment for Proposed Residential Subdivision, Lot 2 DP 7185, Cabbage Tree Lane, South West R*ocks. Unpublished report for Mr and Mrs J. Holmes. Darkheart Eco-Consultancy, Port Macquarie.

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- Berrigan, J.A. (1998). *Eight Point Test and SEPP 44 Koala Habitat Assessment for Proposed Residential Dwelling on Lot 11, Gap Beach Rd, Arakoon*. Unpublished report to Hadlow Design Services. Darkheart Eco-Consultancy, Port Macquarie.

- Berrigan, J. A. (1997). *Threatened Fauna Assessment for Proposed Retail Complex on Lot 231, DP 753396, Gregory St, South West Rocks*. Unpublished report to Hadlow Design Services. Darkheart Eco-Consultancy, Port Macquarie.

- Berrigan, J. A. (1997). *Flora and Fauna Assessment for Residential Subdivision on Lots 226, 227 and 228, DP 754396, Gregory St, South West Rocks*. Unpublished report to Hadlow Design Services. Darkheart Eco-Consultancy, Port Macquarie.

- Darkheart Eco-Consultancy (2006). *Commonwealth EPBCA Act 1999, NSW Threatened Species Conservation Act, NSW Fisheries Management (Amendments) Act 1997and SEPP 44 - Koala Habitat Assessments of Proposed Eco-Tourism Facility (Meriki Sanctuary) on Portions 73, 77, 78, 79, & 80 DP752409, Rainbow Reach*. Unpublished report to Dutton Consulting. Darkheart Eco-Consultancy, Laurieton.

- Darkheart Eco-Consultancy (2005). *Commonwealth EPBCA Act 1999, NSW Threatened Species Act and SEPP 44 - Koala Habitat Assessments of Proposed Subdivision Of Lot 5 DP 22502, Gregory Street, South West Rocks*. Unpublished report to Mr Robert Martin. Darkheart Eco-Consultancy, Laurieton.

- Darkheart Eco-Consultancy (2004). *Flora and Fauna Survey for Proposed Western Distributor Rd, South West Rocks.* Unpublished report to King and Campbell Pty Ltd. Darkheart Eco-Consultancy, Port Macquarie.

- Darkheart Eco-Consultancy (2004). *Threatened Species, EPBCA Act and SEPP 44 Assessments for Proposed Residential Development on Former Oil Terminal Site, Phillip Drive, South West Rocks*. Unpublished report to Hopkins Consultants Pty Ltd, Darkheart Eco-Consultancy, Port Macquarie

This firm also has access to the following assessments undertaken by other consultants in the South West Rocks area:

- Australian Wetlands Pty Ltd (2005). *Boyters Lane Playing Fields: Plan of Management*. Unpublished report prepared for Kempsey Shire Council. Australian Wetlands Pty Ltd, Bryon Bay.

- Bray, D. (1999). *Threatened Species and SEPP 44 Assessment for Proposed Subdivision and Industrial Development on Lot 961 (part Lot 96 DP 754396), off Spencers Creek Rd, South West Rocks*. David Bray Flora and Fauna Surveys, Port Macquarie.

- Kendall and Kendall (2003). *Saltwater Creek Catchment Flora and Fauna Study South, West Rocks*. Kendall and Kendall Pty Ltd.

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- Mackay, K. and Bray, D. (1995). *Fauna Impact Assessment for Lot 8, DP 813532, Arakoon Rd, for Blyth, Hadlow and Assoc*. Unpublished report to Blyth and Hadlow. Kel Mackay Flora and Fauna Surveys, Port Macquarie.

- Mackay, K. and Bray, D. (1995). *Fauna Impact Assessment for Proposed Subdivision on Portions 135, 136 and 137, Parish of Arakoon, for Blyth, Hadlow and Assoc.* Unpublished report to Blyth and Hadlow. Kel Mackay Flora and Fauna Surveys, Port Macquarie

- Salter, B.J. (1997). *Report on Part 1- SEPP 44 Assessment and Part 2 - Section 5A (EP&A Act) Assessment of Lot 2252 DP 616771 for Proposed Subdivision into 41 Lots, Gregory St South West Rocks*. Unpublished report to Blyth and Hadlow. North Coast Forestry and Environmental Consultants, Kendall.

- Sandpiper Environmental (2005). *Boyters Lane Playing Fields and Wetland Management Plan: Fauna Component*. Unpublished report prepared for Australian Wetlands Pty Ltd. Sandpiper Environmental, Alstonville.

- O'Neill, M. and Williams, J. (2003). *Species Impact Statement for Proposed Residential Subdivision on Lot 223 DP 754396 and Lot 511 DP 1048157*. Prepared for Machro Pty Ltd and Eric Norman Developments. Northern NSW Forestry Services, Casino.

These studies have collectively recorded numerous threatened species, especially Squirrel Gliders and Phascogales. The most significant study is Darkheart (2004f) which was the move extensive (studying a total of approximately 72ha of habitat in western South West Rocks), and determined indicative densities of Squirrel Gliders which have not been determined in any other local studies.

PART A: FLORA AND FAUNA SURVEY

2.0 SURVEY METHODS

2.1 GENERAL INFORMATION

Following an initial inspection to determine the threatened species potentially occurring and the appropriate survey techniques, the main survey was conducted from the 5-9th of November 2007. In addition, the available relevant literature and the Department of Environment and Climate Change (DECC) Atlas of Wildlife (http://wildlifeatlas.nationalparks.nsw.gov.au/wildlifeatlas) and Rare or Threatened Plants databases (www.plantnet.rbgsyd.nsw.gov.au/search) were consulted for records of threatened species on the Grafton, Bare Point, Bulahdelah, Camden Haven, Kempsey, Korogoro, Coffs Harbour, Dorrigo, Nambucca and Macksville 1:100 000 topographical maps. The Bionet (www.bionet.nsw.gov.au) website was also searched for records in proximity to the site.

As per DECC (2007c) definitions, the **study site** is defined as the land subject to the development proposal ie the 2(a) area). The **study area** consisted of the study site and the adjacent land within 100m of the site which may be subject to indirect impacts (generally the 7(a) area). The **locality** is defined as land within a 10km radius of the study site.

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2.2 FLORA

2.2.1 Threatened Flora Records

A search of the DECC Rare or Threatened Plants (ROTAP) database (2007a), Bionet (2007) and available literature (Campbell 1997) indicated that the following threatened flora species occur within 10km of the site:

1. ***Acronychia littoralis*** (Hat Head NP)
2. ***Cynanchum elegans*** (Hat Head NP)

2.2.2 Survey Methods

The flora survey essentially routinely consists of two components:

- Identification, description and mapping of the major vegetation communities and any Endangered Ecological Communities: Section 2.2.2.1.
- Searches for, identification of, and (if found) mapping of any threatened species and their habitat: Section 2.2.2.2.

For the purposes of this assessment, the vegetation of the riparian Crown Reserve along the Macleay River was also identified, assessed and mapped as driveways will cross through this area.

2.2.2.1 Vegetation Mapping and Species Identification

The formal flora survey was carried out over the study area over 3 days. This time was dedicated to undertaking plot sampling, threatened species searches and random walking transects as per DEC (2004a) guidelines.

The limited extent of the study area allowed for thorough searches of the site's vegetation communities to identify vegetation types and assess the potential for threatened species to occur.

2.2.2.1.1 Field Methodology

2.2.2.1.1.1 General

A combination of random walking transects and plot based surveys were used as this sampling methodology is considered most suitable for the following reasons:

- Provide the most amount of information for a given input.
- Provide a means to sample vegetation boundaries.
- Provide means for assessing floristic diversity and possible presence of threatened species (Forest Fauna Surveys *et al* 1997).

2.2.2.1.1.2 Plot–Based Sampling

The stratification of the site/study area for plot-based sampling was determined using vegetation patterns observed from preliminary viewing of air photos and site inspection. Correspondingly, sample sites (quadrats) were assigned to sample the range of different vegetation types within the study site/area. Floristic data for this assessment was collected for 4 quadrats of fixed size of 400m^2.

The following attributes were measured or estimated at each quadrat:

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- Australian Map Grid Reference (GDA-94)
- Vegetation structure, including the height and foliage cover of each stratum.
- Location, aspect, elevation and slope.
- Geology and general soil characteristics.
- Topographic position.
- Approximate time since last fire and characterisation of intensity (ground cover burnt, shrubs burnt, tree tops burnt).
- Forms of disturbance other than fire.
- Presence of environmental weed species and severity of infestation.

2.2.2.1.1.3 Walking Transects

In addition to the data collected at each quadrat site, another hour was spent undertaking a random meander walking transect. This was undertaken to check for species not recorded in quadrats, possible presence of threatened species, vegetation boundaries and confirm vegetation attributes over a larger area than the sample quadrat site.

2.2.2.1.1.4 Opportunistic records

Opportunistic records of plant species while working on the study site/area during other activities (eg trapping) were also recorded. This significantly expanded the species list via acquiring species occurring at lower abundance on the site/area.

2.2.2.1.1.5 Identification and Classification

Species identification was made with the assistance of Bale (1993), Beadle (1982), Harden (1990, 91, 92, 93, 2000), Williams and Harden (1980), Robinson (1994), and Brooker and Kleinig (1999). Plant species were identified to species or subspecies level and nomenclature conforms to that currently recognized by the Royal Botanic Gardens and follows Harden and PlantNET for changes since Harden. Any species unable to be confidently identified is routinely sent to the Royal Botanic Gardens Herbarium for confirmation.

2.2.2.1.2 Air Photo Interpretation and Mapping

The vegetation within the study site/area was ultimately mapped by using a combination of aerial photo interpretation, plot sampling and field truthing. Initially, vegetation types were stratified into types with reference to such diagnostic features as colour, texture, crown architecture, aspect and topographic position. A process of selective field sampling and interpretation adjustment was continued until a satisfactory level of confidence in type recognition was reached. The boundaries of each type, which are generally analogous to the plant communities, were digitised onto a digital orthographic image supplied by the Land and Property Information Centre via Arcview GIS v9.1 software.

2.2.2.1.3 Vegetation Classification

The vegetation communities were described by interpreting data collected during plot-based surveys. Sub-formation names for vegetation types are adapted from the classification proposed by Beadle and Costin (1952) eg ‘Dry Sclerophyll Forest’ to assist the fauna habitat evaluation and to follow Keith (2004). Structural classification is also used for the community descriptions as per Walker and Hopkins (1984) to allow for comparison with other surveys using this system. Crown cover classes are defined by the following:

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- **Closed or dense**: crowns touching to overlapping (crown separation ratio <0).
- **Mid-dense:** crowns touching or slightly separated (crown separation ratio 0– 0.25).
- **Sparse**: crowns clearly separated (crown separation 0.25–1).
- **Very Sparse:** crowns well separated (crown separation 1–20).
- **Isolated plants:** trees greater than 100 m apart, shrubs about 25m apart (crown separation >20).
- **Isolated clumps**: clump of two to five woody plants 200 metres apart (crown separation >20)

2.2.2.1.4 Vegetation Community Conservation Significance

The conservation significance of the vegetation communities within the subject site was determined by comparing equivalent phytosociological associations and their conservation significance on the North Coast of NSW (Hager and Benson 1994, Northern Zone NPWS 1999, Griffith 1993, DEC 2004a, 2004b, 2004c, 2004d, 2004e, 2005f, etc). In addition, the condition and continuity of vegetation within the study site relative to larger areas off site was considered when determining significance.

Identification of possible Endangered Ecological Communities was based on the data collected by the survey and review of the relevant listings on the DECC website (www.nationalparks.nsw.gov.au).

2.2.2.2 Threatened Flora Species Searches and Occurrence Assessment

2.2.2.2.1 Searches

Searches for threatened flora recorded in the Local Government Area (LGA) and/or in regionally similar habitats to that on the site/area (see section 3.2 and Appendix 1) were carried out as detailed above. A total of 3 dedicated hours was spent on searches for threatened flora on the site/area (ie the site and adjacent sections of the 7(a) zone), with incidental searches during other activities eg trapping and scat searches.

2.2.2.2.2 Potential Occurrence Assessment

Potential occurrence assessment of threatened flora species is provided in section 3.2 and Appendix 1. This section assesses all threatened species listed as threatened under the TSCA and EPBCA for their potential to occur on site/study area based on the following factors:

- Presence/absence of literature-cited suitable habitat (vegetation community, climate, altitude, soils, geology, drainage, fire regime, etc).
- Condition and disturbance history of habitat.
- Local and regional records.
- Location of site within known distribution of the species.

2.3 FAUNA

2.3.1 Threatened Fauna Records

The following significant fauna species listed in Table 1 below (excluding marine birds, fish and marine organisms, due to lack of suitable habitat in the study area) have been recorded or reported to occur within 10km of the study site (DECC Atlas of Wildlife 2007, Bionet 2007, Darkheart 2007g, 2006f, 2006j, 2006k, 2006f, 2004f, 2004j, 2004x, Berrigan 1997c, 2000a, 2000b, 2000c, 2002a, 2003a, Standing 1990; Mackay and Bray 1995a, 1995b, Bray 1999, Shortlands Wetlands Consultancy 1995, Sandpiper Environmental 2005, personal observations, O'Neil and Williams 2003). Those in bold are dually listed under the EPBCA.

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Table 1: Threatened fauna species recorded in the locality

The following table lists all threatened fauna species recorded in the locality.

GROUP	COMMON NAME	SPECIES	LEGAL STATUS	SOURCE	DISTANCE FROM STUDY SITE/GENERAL LOCATION
MAMMALS	Squirrel Glider	*Petaurus norfolcensis*	V-TSCA	Berrigan 2000a, 2000b, 2000c, 2003a, 2002a, Darkheart 2004g, 2007g, 2006k, O'Neil and Williams 2003, Bray 1999, Atlas of Wildlife	<500m south of site, <1km east of site, Arakoon area, west South West Rocks, Arakoon, Fishermans Reach, Stuarts Point
	Brushtailed Phascogale	*Phascogale tapoatafa*	V-TSCA	Berrigan 2000a, 2000b, 2000c, 2003a, 2002a, Darkheart 2004g, O'Neil and Williams 2003, Atlas of Wildlife	Hat Head National Park, Arakoon Rd, <500m south of site.
	Koala	*Phascolarctos cinereus*	V-TSCA	Atlas of Wildlife, Standing 1990, Kempsey Argus 2002	3km at Smokey Cape area. Unconfirmed report in western South West Rocks (Darkheart 2004f)
	Little Bent-Wing Bat	*Miniopterus australis*	V-TSCA	Atlas of Wildlife, Umwelt 2004, Darkheart 2006k, 2004f, 2007g, 2006f.	Yarrahappini-Broadwater, western South West Rocks, Rainbow Reach area
	Common Bent-Wing Bat	*M. schreibersii*	V-TSCA	Atlas of Wildlife, Umwelt 2004	*possible* recording in industrial estate; west South West Rocks, Yarrahappini-Broadwater, Trial Bay, Rainbow Reach area
	Eastern Freetail Bat	*Mormopterus norfolkensis*	V-TSCA	Atlas of Wildlife, Umwelt 2004, Darkheart 2006k, 2004f, 2007g	Yarrahappini-Broadwater, Arakoon, Hat Head National Park, Rainbow Reach area
	Beccari's Freetail Bat	*M. beccarii*	V-TSCA	Darkheart 2004f	*Possible* record in west South West Rocks
	Hoary Bat	*Chalinobus nigrogriseus*	V-TSCA	SWC 1995, Darkheart 2004f	Yarrahappini-Broadwater, *probable*" call in South West Rocks
	Golden Tipped Bat	*Phoniscus papuensis*	V-TSCA	Atlas of Wildlife	unknown
	Eastern Cave Bat	*Vespadelus troughtoni*	V-TSCA	Atlas of Wildlife	1km south of site
	Eastern Blossom Bat	*Syconycteris australis*	V-TSCA	Atlas of Wildlife	South West Rocks
	Grey Headed Flying Fox	*Pteropus poliocephalus*	V-TSCA, V-EPBCA	Atlas for Wildlife, Darkheart 2004f, 2006k, 2007g, Berrigan 2000a, 2000b, 2000c, 2003a.	all South West Rocks and Hat Head National Park
	Black Flying Fox	*P. alecto*	V-TSCA	Kempsey Argus 2004	West South West Rocks
	Southern Myotis	*Myotis macropus*	V-TSCA	Darkheart 2007g	Rainbow Reach area
	Northern Long-Eared Bat	*Nyctophilus bifax*	V-TSCA	Atlas of Wildlife	Hat Head National Park
	Yellow-Bellied Sheathtail-Bat	*Saccolaimus flaviventris*	V-TSCA	Atlas of Wildlife	Unknown
	Greater Broad-Nosed Bat	*Scoteanax rueppellii*	V-TSCA	Atlas of Wildlife, Berrigan 2000c	3km
	Humpback Whale		V-TSCA	Atlas of Wildlife	offshore
	Sperm Whale		V-TSCA	Atlas of Wildlife	offshore
	Australian Fur Seal		V_TSCA	Atlas of Wildlife	offshore
BIRDS	Glossy Black-Cockatoo	*Calyptorhynchus lathamii*	V-TSCA	Berrigan 2000a, 2000b, 2000c, 2003a, 2002a, Darkheart 2004g, 2004f, 2007g, 2006k, 2006f, O'Neil and Williams 2003,Atlas of Wildlife	Smoky Cape, Arakoon, Shark Island, Yarrahappini-Broadwater, Hat Head National Park, west South West Rocks, Pelican Island, Saltwater Lagoon, Fisherman's Reach
	Swift Parrot	*Lathumus discolor*	E-TSCA, E-EPBCA and Migratory	Kempsey Argus 2004	<2km
	Powerful Owl	*Ninox strenua*	V-TSCA	Darkheart 2006f, Atlas of Wildlife	Arakoon, Hat Head National Park, Rainbow Reach
	Masked Owl	*Tyto novaehollandiae*	V-TSCA	Atlas of Wildlife	South West Rocks Golf Course

	Grass Owl	*Tyto capensis*	V-TSCA	Atlas of Wildlife	Hat Head National Park, Boyters Lane
	Osprey	*Pandion haliaetus*	V-TSCA, EPBCA-Migratory	Atlas of Wildlife, Berrigan 2000a, 2000b, 2000c, Darkheart 2004g, 2004f, 2006f, Sandpiper Environmental 2005, O'Neil and Williams 2003, EPBCA-website, pers. obs.	Macleay River, Spencers Creek, Shark Island, Fisherman's Reach, Stuarts Point, all South West Rocks, Kinchela, etc
	Square Tailed Kite	*Lophoictinia isura*	V-TSCA	Atlas of Wildlife, Darkheart 2004f, 2006f, Sandpiper Environmental 2005	west South West Rocks, Boyters Lane
	Barred Cuckoo-Shrike	*Coracina lineata*	V-TSCA	Atlas of Wildlife	Shark Island area
	Wompoo Fruit Dove	*Ptilinopus magnificus*	V-TSCA	Atlas of Wildlife	west South West Rocks, Hat Head National Park, Arakoon
	Rose-Crowned Fruit Dove	*Ptilinopus regina*	V-TSCA	Atlas of Wildlife	Saltwater Lagoon - 1km
	Mangrove Honeyeater	*Lichenostomus fasciogularis*	V-TSCA	Atlas of Wildlife	Stewarts Point
	Magpie Goose	*Anseranas semipalmata*	V-TSCA	Atlas of Wildlife	Atlas of Wildlife
	Black-Tailed Godwit	*Limosa limosa*	V-TSCA	Atlas of Wildlife, Sandpiper Ecological 2005	Boyters Lane
	Black Bittern	*Dupetor flavicollis*	V-TSCA	Atlas of Wildlife, Darkheart 2006f	
	Australasian Bittern	*Botaurus poiciloptilus*	V-TSCA	Sandpiper Ecological	Boyters Lane
	Terek Sandpiper	*Xenus cinereus*	V-TSCA	Atlas of Wildlife, Darkheart 2006f	Meriki Island
	Sooty Oystercatcher	*H. fuliginosus*	V-TSCA	Atlas of Wildlife, Darkheart 2006f	Trial Bay, Meriki Island
	Pied Oystercatcher	*Haematopus longirostris*	V-TSCA	Atlas of Wildlife, Darkheart 2006f	Meriki Island, Fishermans Reach, Trial Bay
	Little Tern	*Sterna albifrons*	E-TSCA	Atlas of Wildlife	Shark Island
	Brolga	*Grus rubicunda*		Sandpiper Ecological 2005	Boyters Lane
	Jabiru/Black Necked Stork	*Ephippiorhynchus asiaticus*	E-TSCA	Atlas of Wildlife, Sandpiper Ecological 2005, Darkheart 2006f	Pelican Island, Macleay River, Kinchela, Boyters Lane
	Comb-Crested Jacana	*Irediparra gallinacea*	V-TSCA	Atlas of Wildlife, Sandpiper Ecological 2005	Pelican Island, Boyters Lane
REPTILES	**Green Turtle**	*Chelonia midas*	V-TSCA, EPCBA	Atlas of Wildlife	Macleay River
	Loggerhead Turtle	*Caretta caretta*	E-TSCA, EPCA	Atlas of Wildlife	offshore, South West Rocks locality
	Leathery Turtle	*Dermochelys coriacea*	E-TSCA, V-EPBCA	Atlas of Wildlife	offshore, South West Rocks locality
FROGS	Wallum Froglet	*Crinia tinnula*	V-TSCA	Atlas of Wildlife, Berrigan 2003a, 2002a	Yarrahapinni-Broadwater, Trial Bay, Hat Head National Park, swamp forest north of Frank Cooper St, Lot 46 Gregory St.
	Stuttering Frog	*Mixophyes balbus*	E-EPBCA, E-TSCA	SWC 1995, EPBCA-website	Yarrahapinni-Broadwater
	Green and Golden Bell Frog	*Litoria aurea*	V-EPBCA	EPBCA-website	Recorded at Crescent Head and swamp between Crescent Head and Hat Head.
INSECTS	Giant Dragonfly	*Petalura gigantea*	E-TSCA	Atlas of Wildlife	Unknown

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The following species are considered likely to occur in the locality due to suitable habitat and regional records (some have been recorded within 20km):

1. *Mammals:* **Spotted-Tail Quoll, Long-Nosed Potoroo,** Common Planigale, Eastern Chestnut Mouse, Eastern Pygmy Possum, **Dwyer's Bat**.

2. *Birds*: Brown Treecreeper, Grey-Crowned Babbler, Hooded Robin, Speckled Warbler, Diamond Firetail, **Regent Honeyeater**, Painted Honeyeater, **Red Goshawk,** Barking Owl, **Painted Snipe**, Bush Stone-Curlew,

3. *Frogs:* ***Litoria olongburensis***, *L. brevipalmata****, L. aurea***, ***Mixophyes iteratus***

4. *Reptiles*: Stephens Banded Snake, Pale Headed Snake, **Three-Toed Snake-Toothed Skink**.

2.3.2 Fauna Survey Methodology

2.3.2.1 Habitat Evaluation

The site and adjacent 7(a) zone was initially inspected to determine the available potential habitats, and the support value of these habitats for threatened species. Habitats were defined according to parameters such as:

- structural and floristic characteristics of the vegetation eg understorey type and development, crown depth, groundcover density, etc.
- degree and extent of disturbance eg fire, logging, weed invasion, modification to structure and diversity, etc.
- presence of sandbanks, shallow wading areas, overhanging trees, rock walls, roost areas, etc.
- soil type and suitability eg for digging and burrowing.
- presence of water in any form eg dams, creeks, drainage lines, soaks.
- size and abundance of hollows and fallen timber.
- availability of shelter eg rocks, logs, hollows, undergrowth.
- wildlife corridors, refuges and proximate habitat types.
- presence of mistletoe, nectar, gum, seed, sap, etc sources.

In consideration of the threatened species recorded in the locality, available habitats and potentially occurring species, the following survey methods were employed:

- Spotlighting by walking with a 50w/100w focusable hand-held spotlight over the study site.
- Trapping with 30 arboreal Elliot B traps.
- Trapping with 100 Elliot A traps
- Hair sampling via 40 hair tubes (20 terrestrial and 20 arboreal)
- ANABAT call recording of Microchiropteran bats.
- Torch searches around the dam for frogs.
- Scat, burrow and hollow inspections (where possible).
- Call playback, detection and recording.
- Physical searches of habitat eg debris, etc.
- Opportunistic sighting.

All field surveying was conducted as per the conditions of the consultant's Animal Research Authority and Section 132c Scientific License.

2.3.2.2 Trapping

2.3.2.2.1 General

Methods such as sand pads, wire cage, harp, mist-net and pitfall trapping were not undertaken due to:

- Lack of suitable habitat for target species (eg Eastern Blossom Bat, Common Planigale)
- The site's extensive disturbance history;
- Extremely limited or unlikely potential for target species to occur;
- High likelihood of other methods detecting target species; and/or
- Conservative use of habitat evaluation.
- Relatively limited extent of habitat loss.
- Adverse weather during the survey period.

The fauna survey was extended to cover habitat beyond the 2(a) zone into the 7(a) zone up to the fenceline on the edge of the ridge to encompass sufficient representative habitat to allow sound scientifically based deductions and conclusions. As this land falls in the same ownership, permission from another landholder was not required. No survey was undertaken around the dwellings on site.

2.3.2.2.2 Arboreal Elliot B Trapping

Thirty Elliot B traps were mounted on platforms to trees with hollows and/or exuding sap (thus potential forage sources), or on trees adjacent to several of the latter across the length of the linear shaped site/study area where natural forest/woodland occurred. The traps were baited with honey soaked rolled oats and peanut butter and set for 4 nights. Due to the rain which occurred during the survey period, all traps were placed in plastic bags. All traps were mounted on platforms so as to allow drainage out the entrance and contained dry leaf litter for nesting material. The main target species were the Eastern Pygmy Possum, Squirrel Glider and Brushtailed Phascogale. The trunk of Elliot B trap trees were spayed with a honey-water solution from a pressure sprayer as an attractant. A total of 120 trap nights were performed.

2.3.2.2.3 Terrestrial Elliot A Trapping

Fifty Elliot A traps were set along the ridge line as this was the only area not subjected to slashing and thus contained shrub and ground vegetation, with some fallen timber and rocky outcroppings. Traps were baited with a honey soaked rolled oats and peanut butter mix and set for 3 nights. Traps were placed within plastic bags with dry leaf litter due to inclement weather. The target species was the Common Planigale. A total of 150 trap nights were undertaken.

2.3.2.2.4 Terrestrial and Arboreal Hair Tubes

Twenty arboreal and twenty terrestrial hair tubes were set over 8 nights. Traps were baited with a honey soaked rolled oats mixture. Arboreal tubes were mounted on platforms to trees with hollows; that were exuding sap (thus potential forage sources); or on trees adjacent to several of the latter across the site. Terrestrial traps were set along the ridge line due to the reasons outlines in section 2.3.2.2.3. A total of 320 trap nights were performed.

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2.3.2.3 Spotlighting/ Torch Searches and Den Watches

Spotlighting and torch searches were conducted for at least 1.5 hours per night for 5 nights. Spotlighting involved observing all habitat components ie understorey/canopy trees for arboreal fauna, the ground and terrestrial strata (eg logs, areas with good leaf litter accumulations, etc) for terrestrial fauna, etc. It was also periodically conducted during call playback (as detailed in 2.3.2.5). Torch searches were conducted along the drainage line and around the dam and pools/ponds along the drainage line. A total of 9hrs was spent on spotlighting/torch search activities.

2.3.2.4 Microchiropteran Bat Call Detection

Anabat call detection was not undertaken due to the wet weather experienced during the survey and risk of damage to the equipment.

2.3.2.5 Recorded Call Playback

Recorded calls of the following species were routinely played back on site:

- Koala
- Masked, Barking and Powerful Owls
- Bush-Stone Curlew
- Yellow-Bellied Glider and Squirrel Glider
- Green-Thighed Frog and Green and Golden Bell Frog

Calls were played either through a portable CD player via a 30W PA system from the rear of a utility at a level approximating natural intensities of the species, or a discman connected to a 10W portable amplifier carried by the consultant. The general methodology involved playback of the call simulating a natural pattern, followed by 5-10 minutes of listening; 10-15 minutes spotlighting for owls attracted by the calls (but not responding vocally), within 100m radius of the playback point; and playback of the next call, etc. Calls were generally played at dusk, when such calls are normally heard.

Call playback was conducted for 1 hour per night for 4 nights (4 hours in total). While this is below the level of call playback recommended in the draft *Threatened Species Survey and Assessment – Guidelines for Developments and Activities* (ie which requires at least 8 nights of call playback for owls – DEC 2004a), this level of surveying was considered adequate given the limited extent and modified state of the habitat on site, as well as the conservative use of habitat evaluation.

2.3.2.6 Herpetofauna and Bird Surveys and Secondary Evidence Searches

Physical habitat searches were undertaken opportunistically during other activities, as well as for several hours which were dedicated merely to this task. This involved lifting up of timber and debris, inspection of dense vegetation and leaf litter for frogs and reptiles, binocular inspection of potential hollows, observation of likely basking sites and searches for scats, tracks and scratches. This time also included searching under preferred forage species for Koala scats; and opportunistically for owl regurgitation pellets. A total of 10 hours was spent on habitat and secondary evidence searches.

Birds were generally surveyed by detecting calls and searching by binoculars at dawn and dusk (when call chorus and peak activity occurs); while walking around the entire site; and opportunistically during other activities. Diurnal species such as the Brown Treecreeper (eastern subspecies), etc, were the main species routinely searched for.

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Species identification was assisted by Simpson and Day (1996), Wilson and Knowles (1992), Strahan (1992), Briggs (1996), Robinson (1996), and Schode and Tideman 1990).

2.4 SURVEY LIMITATIONS

All surveys are limited in their ability to fully document all species of flora and fauna likely or actually occurring on a site. Surveys such as these are merely "snapshots" in time, and can only be expected to provide an indicative not absolutely comprehensive representation of a site's species assemblage (DEC 2004a). To counter this limitation, this survey has employed methods recommended in literature and known from personal experience to best detect the target species. Furthermore evaluation of the habitat present on the site enabled the determination of species potentially likely occur on site.

2.4.1 Flora

Flora detection is limited by the lifecycle stage of the plant eg no conspicuous above-ground components of the plant or lack of flowers and leaves. Some plants may thus escape detection by camouflaging in dense vegetation or not being physically visible at the time of the survey (DEC 2004a). Identification limitations for species possibly being of conservation significance are routinely dealt with by referring samples to other consultants, NPWS or the Royal Botanical Gardens Herbarium Identifications Service.

Flora detectability was considered to be potentially limited by slashing disturbances, predominantly for groundcover species (eg native sedges and grasses) in some parts of the 2(a) zone, but overall due to the high accessibility of the site and relatively simplistic assemblage, detection was considered very high.

2.4.2 Fauna

Fauna detectability is limited by seasonal, behavioural or lifecycle of each species, and even habitat variations (eg flowering periods), which can vary within a year, between years, decades, etc (DEC 2004a). Habitat evaluation is used to counter this limitation by assessing the potential occurrence of threatened species based on potentially suitable habitat in the study area and local records.

The survey period fell in Spring which is generally a period of high activity for most fauna (eg Summer seasonal migrants, Koalas, etc – DEC 2004a, Churchill 1998, Martin and Lee 1984). However there is limited potential to record Winter migrants (eg Swift Parrot – Smith *et al* 1995, NPWS 2000) and breeding frogs during this period.

Anabat call detection was not undertaken due the wet weather experienced during the survey period, thus eliminating the potential to detect threatened Microchiropteran bats. Persistent rainfall during the week also hampered the effectiveness of call playback/detection, reptile activity and trapping (DEC 2004a). However, these limitations are balanced by conservative habitat evaluation and plethora of studies undertaken in the South West Rocks area in similar to identical habitats to those on site which provide an excellent inventory of local biodiversity.

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3.0 SURVEY RESULTS

3.1 VEGETATION COMMUNITIES

Refer to the site layout in figure 2, vegetation map in figure 3, appendix 3 for the species list, and the following photos (see appendix 4 for more site photos).

The site contains three vegetation communities (one natural, one modified, one artificial) which were identified according to structural form and dominant canopy/understorey species. The identified communities are derived from edaphic (eg slope, moisture, soil type, drainage and aspect) and landuse/disturbance factors. A small dam was also noted to contain some aquatic vegetation.

3.1.1 Very Tall Open Dry Sclerophyll Forest

Distribution: This community generally occupies the upper slope and crest of the hill in the 7(a) zone, merging over a broad ecotone with the agricultural woodland.

Structure and Species Composition:

(a) Canopy:

Structure and species: Varying slightly with position, the dominant species was Scribbly Gum (*Eucalyptus signata*) and Blackbutt (*E. pilularis*). Common associates included Pink Bloodwood (*Corymbia intermedia*), Tallowwood (*E. microcorys*) and Needlebark Stringybark (*E. planchoniana*).

Canopy height is 20-25m, with about 50-70% canopy cover. Trunk DBH (diameter at breast height) ranges from 40cm-1m; though most trees are 40-80cm (hence it is predominantly even aged).

(b) Understorey:

Structure and Species: Ranges from poorly developed to open, with two stratums. The upper stratum is generally open and consists of younger eucalypts 10-18m tall. The lower stratum (3-8m) is sparse to dense, and consists of a mix of Jackson Bay Pine (*Callitrus rhomboidea*) Black Oaks (*Allocasuarina littoralis*).

(c) Shrub layer:

Structure: Generally sparse but persistent; 0.5 to 2m high.

Species: Dominated by Hopbush (*Dodonaea triquetra*) and Flat Pea (*Platylobium formosum*). Some other common species include Dogwood (*Jacksonia scoparia*), Black Oak, mixed eucalypts (mostly Scribbly Gum), Cheese Tree *(Glochidion ferdinandi*), Maidens Wattle (*Acacia maidenii*), Broad-Leaved Geebung, *Lomatia silaifolia*, Slender Rice Flower (*Pimelea linifolia*), Hard Quandong and *Daviesia squarrosa*.

(d) Ground-layer:

Structure: Sparse with a small dense patch, or very low, depending on species and canopy cover. Height ranging from 0.02-0.5m

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Species: Grades from pastoral grasses such as Carpet Grass (*Axonopus affinus*) and Couch (*Cynodon dactylon*) upslope into a sparse cover of Wiry Panic (*Entolasia marginata*), Bladey Grass (*Imperata cylindrica*), Bracken Fern (*Pteridium esculentum*). Spiny-Headed Matrush (*Lomandra longifolia*), Kangaroo Grass (*Themeda australis*) and Basket Grass (*Oplismenus aemulus*).

(e) **Climbers and Scramblers**

Climbers and scramblers were very limited with a few *Smilax australis, Smilax glyciphylla*, Wombat Berry (*Eustrephus latifolius*), *Glycine microphylla, Hardenbergia violacea*, Scrambling Lilly (*Geitonoplesium cymosum*), and Climbing Guinea Flower (*Hibbertia scandens*) noted in more protected areas.

Comments: Floristic and structural changes throughout this community have been influenced by edaphic factors such as drainage, soil moisture content, soil depth, canopy cover, etc, and disturbances particularly underscrubbing and pastoralism.

3.1.2 Dry Sclerophyll Parkland/Agricultural Woodland

Distribution: This community generally occupies the 2(a) zone and lower half of the 7(a) zone.

Structure and Species Composition:

(a) Canopy:

Structure and species: Very open, with most trees yet to reach maturity. Consist of similar mix to the adjacent forest from which it has been derived via selective clearing and underscrubbing associated with pastoralism. Height and trunk diameter in similar ranges.

(b) Understorey:

Structure and species: Very poorly defined and open, generally limited to band of trees along the midwest and some denser clumps of trees (eg around the dam). Generally 4-12m high with trunk DBH<20cm. Consist of a mix of species including young canopy species, Geebung (*Persoonia conjuncta*), Hickory Wattle (*Acacia implexa*), White Sally (*Acacia floribunda*) and *Jacksonia scoparia* is an occasional occurrence.

(c) Shrub layer:

Structure and Species: Generally absent but for a few young Acacias (ie Hickory Wattle, Sally Wattle and *Acacia suaveolens*) and Hopbush at bases of trees.

(d) Groundcover:

Structure and Species: Generally reasonably dense except in the more recently disturbed and/or shaded areas. Height ranging <0.3m. Dominated by pastoral grasses such as Carpet Grass and Couch, with common herbs and weeds eg Fireweed (*Senecio madagascariensis*) and Dandelion (*Taraxacum officinale*). In less disturbed sections, Bracken Fern and Gristlefern (*Blechnum indicum*) are common.

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Photo: 1 - Dry sclerophyll forest

Photo: 2 - Classic agricultural woodland

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(**e**) **Climbers and Scramblers**

Absent.

Comments: This community has been derived from dry sclerophyll forest by active management to establish improved pasture species and suppress regrowth.

3.1.3 Ornamental Gardens and Lawns

This "community" is simply the ornamental lawns and gardens around the existing dwelling. No description is given as this community has no conservation or habitat significance.

3.1.4 Aquatic Vegetation

Occurrence and Size:

A small dam occurs under the densest clump of trees within the 2(a) zone. The wall has been breached to drain the dam over at least a year ago, thus only a small pool of ephemeral water may now form during wet periods. The dam has a diameter of approximately 10m, though only an area <2m diameter may contain water. Water depth is approximately 20cm.

Water Quality:

At the time of the survey the water in the dam was of low quality(ie black) as it consisted of rain that fell consistently over the survey period stained with tannins.

Vegetation:

The majority of the dam floor is covered by Carpet Grass with some pioneer shrub species ie wattles and Hopbush. Around the central pool is a small patch of *Juncus* spp with some *Isolepis* spp <20cm high

Comments: This dam is likely to be dry at most times, as evident by colonisation of Carpet Grass and the aquatic vegetation consisting of species which can tolerate ephemeral drying.

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