

Port Stephens Council Comprehensive Koala Plan of Management (CKPoM)

Part 3: Appendices

Prepared by:

Port Stephens Council
with the Australian Koala Foundation
and NSW National Parks and Wildlife Service

June 2002



20. APPENDICES

APPENDIX 1

This appendix includes DRAFT copies of the following:

- *“Procedures for preparing Comprehensive Koala Plans of Management under State Environmental Planning Policy 44- Koala Habitat Protection”*

Prepared by D. Lunney, A. Krockenberger, A. Curtin and A. Matthews

Procedures for preparing Comprehensive Koala Plans of Management under State Environmental Planning Policy 44- Koala Habitat Protection

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This draft has been revised following review by officers of the Department of Urban Affairs and Planning in December 1996.

Note:

Underlined text currently appears in the Director's Guidelines for SEPP 44. These procedures are intended to be incorporated into those guidelines.

21 January 1997

2.2.1 Comprehensive Plan

This refers to a plan of management for koalas that covers an entire LGA, prepared in accordance with clause 11(1)(a). The policy requires that in producing such a plan the Director-General of the NPWS must be consulted, (clause 12). These procedures for the preparation of a comprehensive koala plan of management (CKPOM) have been developed in consultation with NPWS and replace the Port Stephens 1994 Draft Koala Plan of Management as the model to follow. The Port Stephens Draft does however provide useful information and shows the extent of detail to be covered.

A comprehensive KPOM should:

1. identify present koala populations and if possible past populations from historical records;
2. identify and map koala habitat based on both koala distribution and plant associations;
3. identify threatening processes and state actions to reverse koala population decline; and
4. establish procedures to secure and manage koala populations into the future.

If such a comprehensive plan has been adopted by council, no individual plan of management is required to accompany DAs applying to core habitat. This is because the requirements for DAs in relation to identified core and potential koala habitat will have already been specified in the comprehensive KPOM. These comprehensive plans must have been approved by both the Director and council before they come into force and before consideration of the DA can be completed. It is expected that these plans will be approved by council before being forwarded to the Director for approval. It must be noted that the adoption of a comprehensive KPOM does not affect the proponent's responsibility to consider whether a development or activity is likely to have a significant effect on a threatened species, including the koala, endangered population or endangered ecological community, and where significant effect is likely, to produce a Species Impact Statement. Where an action is not covered by the EP&A Act, a Section 91 Licence may be required under the *Threatened Species Conservation Act, 1995*.

Council is encouraged to undertake these comprehensive plans of management as they will both facilitate the processing of DAs and effectively meet the aims of this policy.

Completion of such a plan will also conform with the recommendation in clause 15(a) that surveys be undertaken for potential and core koala habitats within LGAs. Again it is expected that these comprehensive plans will focus on those areas where habitat destruction is most widespread, such as in areas of rapid residential expansion.

Developers should refer to the comprehensive KPOM in any development proposal in order for councils to streamline their consideration of developments under the EP&A Act. If a council is interested in undertaking a comprehensive plan of management, the appropriate local NPWS Zone Team or the Environmental Protection Unit of the NPWS should be contacted on (02) 585 6444 (ph) or (02) 585 6555 (fax). This does not, however, remove the policy requirement to formally consult the Director-General of NPWS. Council will also benefit from cooperation with neighbouring LGAs and are encouraged to liaise closely with the NPWS when developing the CKPOM, particularly with respect to the adequacy of studies and conclusions, prior to proceeding to the development of management strategies.

Included below is a list of items that should be addressed in a comprehensive KPOM. These items will form the basis of the Director's decision whether to approve the plan of management.

i) Identification of authors

People involved in preparing the plan, including field personnel, the section they were responsible for, their qualifications and current positions should be stated at the beginning of the document.

ii) Aims

The primary aim is that of clause 3. To meet this aim the CKPOM should also comply with clause 15(a).

Additional aims of the CKPOM to be considered are:

- To identify and list the koala food tree species in the local government area (LGA), derived from a) SEPP 44 Schedule 2 Feed Tree Species, b) local sources such as Council records, local Environmental Impact Statements, State Forests, National Parks and Wildlife Service and carer groups, and c) field and community surveys. Species on Schedule 2 not occurring in the LGA may be omitted from this list.
- To map koala habitat within the LGA

- To identify and reduce the threatening processes acting on the local koala population
- To identify steps to reverse the current trend of koala population decline eg. identify and conserve koala habitat, implement appropriate planning controls, institute a long term program of monitoring and reporting of koalas and koala habitat, nominate areas for restoration programs.

iii) Background

- Physical environment. This section should include a description of the physical aspects of the LGA such as climate, geology, soil types and their nutrient status, and topography as it relates to koala habitat.
- Biotic environment. This section should include a description of the biotic environment of the LGA including flora, fauna, feral animals and ecosystems as it relates to koala habitat.
- History. This section should include a summary of history of land-use (eg. clearing, development) in the LGA, and include a current map of land tenure. Particular effort should be applied to researching the history of koalas and koala habitat in the LGA.
- Regional status. This section should describe the regional status of koalas and koala habitat. This will require liaison with neighbouring Schedule 1 LGAs and NPWS, and reference to the scientific literature. This is to identify potential linkages between core habitat in the LGA and neighbouring areas and the highest priority areas of koala habitat.
- A discussion should be provided of the existing planning instruments in the LGA which are also applicable to the protection of koala habitat. Information could also be included on where copies of these instruments can be obtained.
- All sources should be fully referenced.

iv) Methodology

Thorough scientific survey and research will allow the most reliable identification of koala habitat, thus providing a strong base for management and planning decisions. The approach below relies on two independent survey techniques to determine koala distribution. The interpretation of koala habitat is based on the distribution of koalas and the related plant associations.

A comprehensive koala plan of management should be based on a survey of the LGA for potential and core koala habitat. To achieve this, the survey should include the following procedures:

1. vegetation survey to produce a vegetation map of plant associations (ie. based on both floristic and structural characteristics). (This map will also have applicability to planning and administration of other natural heritage values.);
2. community-based koala survey to provide records of both current and historical koala locations; and
3. field survey to determine which plant associations and tree species contain koalas.

A leaflet is available from the NPWS providing detailed information on these survey techniques.

A comprehensive plan will necessarily include maps of koala habitat in the LGA, including a:

1. map of potential koala habitat. This will be a map of all plant associations containing greater than 10% of koala food trees based on the list of trees generated for the LGA (see Aims).
2. map of core koala habitat. This will be a map of all plant associations identified as containing koalas from both the field and community survey. This will overlay potential koala habitat but may not include all potential koala habitat. To refine the distribution of core koala habitat, other factors identified in the background physical environment, such as soil type, may be tested for significant effect.

v) Threatening processes

The KPOM should identify and describe the threatening processes affecting koalas and koala habitat within the LGA, eg. habitat clearing, fragmentation and degradation, feral predators, roads and traffic, large extractive industries, disease and natural disasters. Current LEP zoning of koala habitat areas and the effects of activities which may be permissible under these zonings should also be considered to the extent that they facilitate or contribute to the action of threatening processes. The extent of these problems should be researched to address the importance of each in the LGA.

vi) Management

- Management principles and policies. General management principles and policies for koala management in the LGA should be clearly outlined. For example, koala protection or management should not be limited to forested areas but should extend over areas of fragmented habitat which support a koala population.
- Planning controls and regulation. When preparing a comprehensive KPOM the recommendations in Section 2.4 and 2.5 of these guidelines regarding the recording of koala habitat in local environmental plans and the preparation of development control plans should be applied. These planning controls and regulations provide the option for the creation of koala management zones based on geographical units or for the purpose of dealing with management issues unique to a particular area (eg. urban area, mining lease area, major koala habitat area). All areas mapped as core or potential koala habitat in the LGA should be included in these legislative provisions.
- Management of koala habitat. A KPOM should encourage land owners to enhance and protect koala habitat on their land and include a section on pro-active measures that may be taken.
- Management of threatening processes. It is recommended that threatening processes, outlined in part v), be addressed by appropriate management actions to negate or ameliorate the current threats. Management actions should be described in detail. These could include acquisition of areas of koala habitat for permanent protection, revegetation and tree planting, buffer areas, weed control, fire control strategies, dog control measures and traffic calming. A list of potential threats and suggested management strategies are provided in the draft Port Stephens Koala Plan of Management and the ANZECC (Australia and New Zealand Environment and Conservation Council) National Koala Conservation Strategy (available through the Australian Nature Conservation Agency). Meetings of relevant parties may help to address the most appropriate management of these threats.
- Koala welfare. Management of sick and injured koalas placed in care for rehabilitation and release should form part of the comprehensive KPOM. Welfare issues should include medical treatment, handling protocol, housing, rehabilitation procedures taking into account the time in care and protocol for return to the wild. Local koala care groups should be identified and included in the development of these issues.

- **Research.** Scientific research is important to guide koala management practices and should involve the local community and research institutions. The KPOM should identify areas requiring further research that will assist in the long-term management of koalas in the LGA.
- **Public education and information.** The KPOM should identify strategies to educate and inform the public of the management and conservation of the local koala population. Community groups should play an important role in raising awareness of major koala issues to the general public.
- **Coordination.** Management recommendations of the KPOM will benefit from a coordinated approach with neighbouring LGAs and across land tenures (including State Forests, NPWS lands, Crown Lands) and should be considered.
- **Implementation of plan.** This should identify how the plan is to be implemented including time-frames and the responsibilities for each section.

vii) Review

- **Steering committee.** Formation of a steering committee may be useful to facilitate the production and implementation of the KPOM as well as ongoing monitoring and review of the KPOM. Appropriate members of such a committee could include representatives from Council, the NPWS, the DUAP, species specialists and the community. The committee's role would not be in production of the plan, but in the control of its direction (eg. establishing time-frames for implementation) and content and assigning responsibilities and resources.
- **Performance indicators.** Detailed performance indicators, with incorporated time-frames, are recommended to assess the success or failure to meet the aims of the CKPOM. These indicators will guide the monitoring program. Appropriate indicators should include rates of habitat loss and/or creation, feedback from community groups and achievement of deadlines.
- **Monitoring.** Following the completion of the plan an ongoing program of monitoring of the koalas and koala habitat is recommended. The aims of the program should be defined by the performance indicators. This section should include a procedure to follow in the event of failing to meet the aims of the program. It should also include a contingency to alter the plan to incorporate new information, such as new koala records, up to date scientific knowledge and impacts of threatening processes. The source of funding for program monitoring should also be indicated.

- Reporting. Reporting of the status of koalas in the LGA is an essential part of the process. This might best be done in the annual State Of the Environment Report already required under the *Local Government Act* 1993. The views of the community should be obtained through public exhibition of a draft CKPOM. These comments could then be collated and made available for public inspection along with the revised CKPOM to facilitate community acceptance. If the decision is made to develop or change a DCP or LEP then these must be advertised.

APPENDIX 2

Proposed amending clause of the Port Stephens LEP

ENVIRONMENTAL PLANNING AND ASSESSMENT ACT 1979

PORT STEPHENS LOCAL ENVIRONMENTAL PLAN (DRAFT AMENDMENT No. #)

I, the Minister for Urban Affairs and Planning, in pursuance of section 70 of the Environmental Planning and Assessment Act 1979, make the local environmental plan set out hereunder.

Minister for Urban Affairs and Planning

Sydney, 1999.

Citation

1. This plan may be cited as Port Stephens Local Environmental Plan (Amendment No.#).

Land to which this plan applies

2. This plan applies to all land within the local government area of Port Stephens.

Objectives

3. This plan aims to amend Port Stephens Local Environmental Plan in order to activate the provisions of the Port Stephens Comprehensive Koala Plan of Management and thereby ensure the long term sustainability of the local koala population.

Relationship to other environmental planning instruments

4. This plan amends Port Stephens Local Environmental Plan in the manner shown in clause 5.

Amendment of Port Stephens Local Environmental Plan

5. Port Stephens Local Environmental Plan 1987 is amended by inserting the following clause:

Port Stephens Comprehensive Koala Plan of Management

- (1) This clause applies to all land within the Port Stephens Local Government Area.
 - (2) All development applications within the Port Stephens Local Government Area must comply with the provisions of the Port Stephens Comprehensive Koala Plan of Management. Compliance with the provisions of the Port Stephens Comprehensive Koala Plan of Management will constitute compliance with the provisions of State Environmental Planning Policy No. 44 – Koala Habitat Protection.
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Appendix 3 – SWOT Analyses

SWOT Analysis #1: Tilligerry Peninsula Koala Management Unit

Description

The Tilligerry Peninsula Koala Management Unit (KMU) covers most of the Tilligerry Peninsula (Figure A.1). It includes the urban areas of Tanilba Bay, Lemon Tree Passage, Mallabulla and Oyster Cove. It is bounded by Port Stephens in the north and east, by the Tilligerry Creek in the south and extends west to the mouth of Twelve Mile Creek at Big Swan Bay. The boundary of this KMU is shown in Figure A.1.

Land use zoning in this KMU includes: water catchment areas (23% of the KMU; see Table A.1), agriculture (23%), flora and fauna conservation (17%), defence purposes (over 11%-majority of the Special Uses 5a zone), residential (9%) and public recreation (9%). Past (and possibly future) land use has involved, among other things, mineral sand mining and sand extraction.

Table A.1. Area (in hectares) and proportion of total area of the Koala Management Unit (KMU) for each of the land use zones for the Tilligerry Peninsula KMU.

Land Use Zone	Area (ha)	Proportion (% of total area of management unit)
Rural 1a	548	23
Residential 2a	200	8
Residential 2b Medium Density	2	<1
Residential 2d Future Residential	23	1
Business 3a General Business	8	<1
Business 3b Waterfront Business	<1	<1
Industrial 4b Light Industrial	5	<1
Industrial 4c Waterfront Industrial	23	1
Special Uses 5a	282	12
Special Uses 5d Local Roads	4	<1
Recreation 6a Public Recreation	224	9
Environmental Protection 7c Water Catchment Areas	548	23
Environmental Protection 7f1 Coastal Lands Protection	8	<1
Environmental Protection 7k Flora & Fauna Conservation	405	17
Residual (not tagged)	107	4
TOTAL	2388	

Table A.2 shows the area of land within the Tilligerry Peninsula Koala Management Unit covered by each koala habitat category, as well as the percentage of the total area of the KMU each of these categories comprise.

Table A.2. Area (in hectares) and proportion of total area of each of the categories of koala habitat for the Tilligerry Peninsula Koala Management Unit. Also given is the proportion of the total area of Habitat Linking Areas constituted by each category of habitat linking area (e.g. Link over Other Vegetation). Note:

- Koala Habitat has been abbreviated to KH in the table.
- Quantitative figures can not be provided for Habitat Buffer areas as the width of these is determined on a case by case basis.

Habitat category	Area (ha)	Proportion (% of total area of KMU)		Habitat Linking Areas (% of area of all linking areas)
Preferred KH	426	18		-
Supplementary KH	152	6		-
Marginal KH	10	<1		-
Unknown KH Value	0	0		-
Mainly Cleared	539	23		-
Other Vegetation	828	35		-
Link over Supplementary KH	45	2		21
Link over Marginal KH	21	1		10
Link over Mainly Cleared Land	91	4		42
Link over Other Vegetation	57	2		27
Link over Unknown KH Value	0.0	0		0
Residual (not tagged-N/T)	1	<1		-
TOTAL	2388			

Table A.3. Overlap between each of the following koala habitat categories: Preferred and Supplementary Koala Habitat and all Habitat Linking Areas and each land use zone in the Tilligerry Peninsula Koala Management Unit. Shown are the area (in hectares) of overlap between these koala habitat categories and land use zones as well as the percentage of the total area within each koala habitat category that each land use zone comprises. Refer to Table A.1 for an explanation of the land use zone codes. Note:

- Koala Habitat has been abbreviated to KH in the table.
- Quantitative figures can not be provided for Habitat Buffer areas as the width of these is determined on a case by case basis.

Land Use Zone	Koala Habitat Category							
	Preferred KH		Supplementary KH				Habitat Linking Areas	
	Area (ha)	% of hab. cat.	Area (ha)	% of hab. cat.			Area (ha)	% of hab. cat.
1a	108	25	46	30			58	27
2a	11	2	5	3			45	21
2b	-	-	-	-			-	-
2d	-	-	-	-			-	-
3a	-	-	-	-			<1	<1
3b	-	-	-	-			-	-
4b	-	-	<1	<1			<1	<1
4c	1	<1	-	-			9	4
5a	2	<1	1	1			-	-
5d	<1	<1	1	1			<1	<1
6a	80	19	34	23			38	18
7c	1	<1	2	2			<1	<1
7f1	<1	<1	-	-			<1	<1
7k	217	51	58	38			47	22
Residual N.T	8	2	4	3			17	8
TOTAL	426		152				214	

Table A.4. Overlap between each of four major land use zone groups: Rural Small Holdings 1c (1c1, 1c2, 1c3, 1c4 and 1c5), Residential 2 (2a, 2b, 2c1,2c2,2d,2e), Business 3 (3a, 3b and 3d) and Industrial 4 (4a, 4b and 4c) which generally constitute the most intense land use zones, and Preferred Koala Habitat, Supplementary Koala Habitat and Habitat Linking Areas. Shown is the area (in hectares) of overlap as well as the percentage of the total area of the land use zones comprised by these categories of koala habitat (e.g. 11ha (or 5%) of the 226ha of land zoned Residential in this management unit overlaps with Preferred Koala Habitat). The total area of each land use zone is given at the top of the table. Note: Quantitative figures can not be provided in relation to overlap with Habitat Buffer areas as the width of these is determined on a case by case basis.

Koala Habitat Category	Land Use Zones							
	Rural Small Holdings 1c (0)		Residential 2 (226ha)		Business 3 (8ha)		Industrial 4 (28ha)	
	Area (ha)	% of zone	Area (ha)	% of zone	Area (ha)	% of zone	Area (ha)	% of zone
Preferred KH	-	-	11	5	-	-	1	4
Supplementary KH	-	-	5	2	-	-	<1	1
Habitat Linking Areas	-	-	45	20	<1	2	10	34
TOTAL	-	-	60	27	<1	2	11	39

Strengths

Existing Koala Habitat

Preferred Koala Habitat

- Preferred Koala Habitat (426ha in total) comprises 18% of the total area of the Tilligerry Peninsula KMU.
- In the southern part of this KMU, between Lemon Tree Passage Road and Tilligerry Creek, there is a large contiguous patch of Preferred Koala Habitat, which is the largest on the Tilligerry Peninsula.
- There are small patches of Preferred Koala Habitat located in the north of this KMU, along the coastal fringe of Port Stephens. There are small patches of Preferred Koala Habitat abutting or within the urban areas of Tanilba Bay, Lemon Tree Passage and Mallabulla.
- While areas along the coastal fringe in the north that were likely to have supported Preferred Koala Habitat in the past have been sand mined, in some instances twice, attempts at revegetation have been made with varying success over the last three decades. This has included extensive replanting of *Eucalyptus robusta*. This has occurred on land between Tanilba Bay and the north western boundary of the KMU that has been revegetated by RZM Pty Ltd and land to the east of Tanilba Bay that is being revegetated by the Tilligerry Habitat Association.
- Given the relative importance of the Tilligerry Peninsula to the Port Stephens koala population, as noted by Callaghan *et al.* (1994) and Phillips *et al.* (1996), and the extent of Preferred Koala Habitat in this KMU, the existing Preferred Koala Habitat (and other categories of koala habitat) in this KMU assumes Shire-wide significance.
- Note: There is a strip of land along the foreshore of Tilligerry Creek that is zoned Public Recreation and which is mapped as part of the large contiguous patch of Preferred Koala Habitat in the south of the KMU. However, recent site inspections that this land should in

fact be mapped as Other Vegetation. This land will be more extensively ground truthed and the Koala Habitat Planning Map amended accordingly.

Supplementary Koala Habitat

- There is 152ha of Supplementary Koala Habitat in the Tilligerry Peninsula KMU, which comprises 6% of the total area of this KMU.

Mainly Cleared Land

- Some of the larger areas of Mainly Cleared Land, such as the Tanilba Bay, Mallabulla and Lemon Tree Passage urban areas and the Tanilba Bay Golf Course contain scattered trees or clumps of trees, which may be of value to koalas either as part of their home range or for use during movement between patches of habitat.

Other vegetation

- Although there are large tracts of Other Vegetation (moist heathland/sedgeland) throughout this KMU (35% of total area), it is likely that there will be scattered emergent trees in places, which may be of value to koalas either as part of their home range or for use during movement between patches of habitat. This habitat type includes areas along the northern coastal fringe that have been sand mined in the past and have been the subject of revegetation efforts, including some replanting of *E. robusta*.

Habitat Buffers

- Among other things Habitat Buffers aim to protect Preferred Koala Habitat from the detrimental impact of 'edge effects'. Ecological criteria have been established to determine the appropriate width of Habitat Buffers on a case by case basis. These criteria are contained in Appendix 9 of the Port Stephens Council CKPoM.

Habitat Linking Areas

- Approximately 22% of the Habitat Linking Areas in this KMU overlap with Supplementary Koala Habitat and another 10% of Habitat Linking Areas extend over Marginal Koala Habitat. Habitat Linking Areas that extend over such habitat are likely to facilitate the successful movement of koalas between patches of Preferred Koala Habitat.

Existing Land Use Zonings

Figure A.2 shows the overlap between the koala habitat categories (boundaries shown by black line) and the land use zones in the Tilligerry Peninsula KMU.

Overlap with Environmental Protection Zones

- There is very substantial overlap of Preferred Koala Habitat with land zoned Environmental Protection 7 in the Tilligerry Peninsula KMU (51% of Preferred Koala Habitat; see Table A.3), the vast majority of which is zoned Environmental Protection 7k Flora and Fauna Conservation. This includes much of the Preferred Koala Habitat along the northern foreshore and a substantial part of the large patch of Preferred Koala Habitat in the southern part of the KMU;
- Similarly, there is substantial overlap of Environmental Protection zones with land identified as Supplementary Koala Habitat, and Habitat Linking Areas (40%, and 23% of each of these habitat categories respectively). This is particularly the case along the northern foreshore and in the southern part of the KMU, as well as between Lemon Tree Passage and Mallabulla.

Overlap with other zones that are compatible with habitat conservation

- Land zoned Public Recreation 6a overlaps with Preferred Koala Habitat (19% of this habitat category; see Table A.3), Supplementary Koala Habitat (23%), and Habitat Linking Areas (18%). While this zoning aims to ensure that land is developed for open space recreation, and permits a range of development with the consent of council, it is still likely to afford greater protection to koala habitat than, for instance, land zoned Residential;
- Land zoned Rural 1a overlaps with Preferred Koala Habitat (25%; Table A.3), particularly in the north and south of the KMU. There is also substantial overlap between this land use zone and Supplementary koala Habitat (30%) and Habitat Linking Areas (27%). This zoning could afford some protection to koala habitat inasmuch as it generally precludes subdivision to small lot sizes, for example for rural residential subdivision (cf. land zoned Rural Small Holdings; especially 1c3, 1c4 or 1c5)

Known Koala Populations

- Koala sightings obtained from the community survey and from the databases of the Native Animal Trust Fund and Hunter Koala Preservation Society confirm that there is an extant koala population in this KMU. Moreover, these sources, on the basis of sightings and other records of females koalas with young, confirm the existence of breeding females in the Tilligerry Peninsula KMU.

Likely Community Support

There are several community groups that are actively involved in koala conservation in the Tilligerry Peninsula KMU. These include the Hunter Koala Preservation Society, the Native Animal Trust Fund, the Tilligerry Habitat Association, and several Tidy Towns Associations. These groups are already involved in activities such as caring for injured koalas, community education, habitat conservation, habitat restoration, and monitoring (recording koala sightings and koalas killed or taken into care). The existence of such groups indicates that there is strong community support for koala conservation in this KMU.

Weaknesses

Existing Koala Habitat

Preferred Koala Habitat

- There has been substantial clearing of koala habitat on the Tilligerry Peninsula, primarily because of silica and mineral sand mining and urban development, since 1954 (Worth 1996). Given that much of this clearing occurred along the coastal fringe in the north or, albeit to a lesser extent, along the Tilligerry Creek in the south, it is likely that considerable amounts of Preferred Koala Habitat were lost during this period.
- The largest patch of remaining contiguous Preferred Koala Habitat along Tilligerry Creek is located adjacent to or in the vicinity of Lemon Tree Passage Road, a noted koala “black spot” where there is a speed zone of 100km/h (recently reduced to 90km/h in parts) along a stretch that is long and straight and likely to encourage even higher speeds. Ten of the 16 koalas hit along this section of road in the last four years died as a result.
- A small patch of Preferred Koala Habitat located in the Tilligerry Habitat Reserve is currently designated to allow dogs to be exercised on lead.
- The small patches of Preferred Koala Habitat located in the north and east of the KMU are fragments within a matrix of land that has been cleared for urban development or sand mining, or consists of heathland, with occasional emergent trees; which provides sub-

optimal conditions for the safe movement of koalas between habitat patches.

- There are small patches of Preferred Koala Habitat that occur within or adjacent to the urban areas of Tanilba Bay, Mallabulla and Lemon Tree Passage. Koalas using this habitat are at risk of being attacked by dogs or hit by cars.

Supplementary Koala Habitat

- There are patches of Supplementary Koala Habitat within or adjacent to the urban areas of Tanilba Bay, Mallabulla and Lemon Tree Passage. Koalas occupying this habitat would be at risk of being attacked by dogs or hit by cars.

Mainly Cleared Land

- There are substantial tracts of mainly cleared land in the Tilligerry Peninsula KMU (539ha); representing 23% of the total land area. This includes the urban areas of Tanilba Bay, Mallabulla, Lemon Tree Passage and Oyster Cove, the Tanilba Bay Golf Course and the RAAF drop zone (south east of Oyster Cove).

Habitat Buffers

- Ecological criteria have been established to determine the appropriate width of Habitat Buffers on a case by case basis. These criteria are contained in Appendix 9 of the Port Stephens Council CKPoM. Among other things Habitat Buffers aim to protect Preferred Koala Habitat from the detrimental impact of 'edge effects'. However, it is disadvantageous for koalas where these Habitat Buffers overlap with mostly cleared land, , for although koalas may use scattered trees occurring across cleared land, this is not an optimal situation, particularly where there are no trees or the buffer overlaps with residential development. In such circumstances koalas are likely to be more vulnerable to attack by dogs or collision with motor vehicles. Furthermore, Habitat Buffers over Mainly Cleared Land are less likely to effectively protect Preferred Koala Habitat from the detrimental impacts of edge effects.

Habitat Linking Areas

- 42% of the of the Habitat Linking Areas in this KMU overlap with Mainly Cleared Land. This situation has several of the disadvantages outlined above for Habitat Buffers that overlap with Mainly Cleared Land. Table A.3 shows that 21% of the Habitat Linking Areas in this KMU overlap with land zoned Residential, which potentially renders koalas using such areas more vulnerable to attack by dogs or collision with motor vehicles.

Existing Zonings

- Parts of the large contiguous patch of Preferred Koala Habitat in the south of the KMU are zoned Rural 1a. While such a land use zoning is likely to afford more protection to koala habitat than zones such as Rural Small Holdings Zones (eg 1c3, 1c4, or 1c5) or Residential, it does not confer as much protection to koala habitat as an Environmental Protection zoning. In particular, mineral sand mining and sand extraction are permitted on land zoned Rural 1a, whereas under the proposed Draft LEP 1999, such activities will not be permitted in the Environmental Protection 7a zone;
- Other parts of the large contiguous patch of Preferred Koala Habitat in the south of the KMU are zoned Public Recreation. Again, while such a land use zoning is likely to afford more protection to koala habitat than zones such as Rural Small Holdings Zones (eg 1c3, 1c4, or 1c5) or Residential, it does not confer as much protection to koala habitat as an

Environmental Protection zoning;

- Substantial parts of the land in the north of the KMU that were revegetated by RZM with *E. robusta* are currently zoned Rural 1a. This includes land identified as Habitat Buffer over Other Vegetation or Habitat Linking Area over Mainly Cleared. It is proposed to rezone most of this land to Environmental Protection 7a in the Draft LEP 1999; and
- There are small patches of Preferred and Supplementary Koala Habitat within or adjacent to the urban areas of Oyster Cove and Tanilba Bay and, in particular, Mallabulla and Lemon Tree Passage. While only a small proportion of the total area of these habitat categories in this KMU overlaps with land zoned Residential (2 % and 3% respectively), the long term conservation of such patches of koala habitat and the koalas they support is endangered because of this situation. The small lot sizes and subsequently high density of housing in Residential zones inhibits (but does not completely preclude) the retention of existing trees and the growth or replanting of new trees. Added to this is the high level threat to koalas that inhabit such areas posed by dogs and motor vehicles.
- 27% of the land in this KMU that is zoned Residential overlaps with either Preferred or Supplementary Koala Habitat, or Habitat Linking Areas (Table A.4). This includes substantial parts of the urban areas of Lemon Tree Passage and Mallabulla. 60% of the land in this KMU that is zoned Industrial overlaps with these same koala habitat categories (Table A.4). This occurs at Oyster Cove and Lemon Tree Passage, and near Tanilba Bay. The development standards and assessment criteria for rezoning proposals and development applications outlined in chapters 4 and 5 of this CKPoM will apply to such land.

Opportunities

Habitat Conservation

Development Standards and Assessment Criteria

These have been developed for the whole LGA and are presented in Chapters 4 and 5. It is essential that these standards be applied to protect koala habitat throughout the Tilligerry Peninsula.

Incentives-based conservation measures

The application of incentives-based conservation measures should be investigated in all instances where landholders are willing to consider setting land aside for the conservation of koala habitat, the following should be investigated in particular:

- The patch of Preferred Koala Habitat and defined Habitat Buffers surrounding this and Habitat Linking Areas to the south east of Tanilba Bay. This patch is in close proximity to the largest patch of Preferred Koala Habitat on the Tilligerry Peninsula.

Land managed by State Government Agencies

In light of the importance of protecting koala habitat where it occurs on public land, the following actions are recommended:

- Rezone public lands not zoned 7c containing Preferred Koala Habitat, Supplementary Koala Habitat, Habitat Buffer Areas and Habitat Linking Areas to Environmental Protection 7a, and
- Seek the agreement of relevant public authorities to manage their land for conservation of koala habitat

Crown Land

There are several portions of Crown Land in the Tilligerry Peninsula KMU. Crown Land is administered by the Department of Land and Water Conservation (DLWC). The Reserves Management Officer, Hunter Region, DLWC has been liaising with the AKF Field Biologist regarding the identification of areas of koala habitat on the Tilligerry Peninsula that occur on Vacant or Reserved Crown Land. Land assessments (as per the Crown Lands Act 1989) will potentially be undertaken for such areas. Pending the outcome of this assessment, Crown Land which contains significant koala habitat may be reserved for Environmental Protection/Conservation. Following such reservation, it is proposed that private reserve trusts be established to manage these areas.

National Parks Estate

The National Parks and Wildlife Service will continue to investigate the potential of Crown Land on the Tilligerry Peninsula for acquisition for as National Parks estate.

Hunter Water Corporation

In managing public land on the Tilligerry Peninsula for water catchment purposes, the Hunter Water Corporation should continue to give due consideration to the conservation of koala habitat.

Habitat restoration

As mentioned previously, RZM Pty Ltd has regenerated large areas of sand mined land along the northern foreshore of the Tilligerry Peninsula. The habitat restoration strategy for the Tilligerry Peninsula KMU should include provision for the long term protection and management of these revegetated areas. As much of this land is under lease from the Crown, the aforementioned procedure for reserving Crown Land that is of significance as koala habitat should be applied to these areas.

Other areas in the Tilligerry Peninsula KMU that should be targeted for habitat restoration projects include:

- the cleared areas within or adjacent to the large patch of Preferred Koala Habitat in the south of the KMU, including defined Habitat Buffers and Habitat Linking Areas that overlap with Mainly Cleared Land;
-
- the Tanilba Bay Golf Course, particularly in those areas that abut the large patch of Preferred Koala Habitat in the south;
- parts of any defined Habitat Buffer or Habitat Linking Area over Mainly Cleared Land in the north and east, including (pending the effective abatement of the threat posed by cars and dogs) those in and around the urban areas of Tanilba Bay, Mallabulla and Lemon Tree Passage; and
- Other Vegetation on and near the Tilligerry Habitat Reserve which surrounds Preferred Koala Habitat (which is already being undertaken by the Tilligerry Habitat Association).

Community commitment

As mentioned previously, several community groups (Hunter Koala Preservation Society, the Native Animal Trust Fund, the Tilligerry Habitat Association, and several Tidy Towns Associations) are actively involved in koala conservation in this KMU. Future community education, koala monitoring and habitat restoration projects on the Tilligerry Peninsula should expand on the existing work being done by these organisations, and projects should be planned in conjunction with these groups.

These groups should be approached for support and assistance with the habitat restoration projects outlined above as well as participation in the monitoring program outlined in chapter 15. The Tilligerry Habitat Association has already made a commitment (as documented in the Individual Koala Plan of Management for the Tilligerry Habitat Reserve) to monitor the koala population and koala habitat utilisation on that site.

Education

Existing education programs, such as that being run by the Tilligerry Habitat Association at its Habitat Centre, and brochures such as those prepared by the Tilligerry Habitat Association and the Hunter Koala Preservation Society could be used as a starting point for educating the community about koala conservation. Other organisations, such as Tidy Towns committees and precinct committees should also be approached to participate in education programs.

Sites in the Tilligerry Peninsula KMU where koala conservation strategies are being implemented should be used to assist with community education programs. This should include areas that currently exist, such as the Tilligerry Habitat Reserve and other sites where habitat is being restored, but should also be expanded to include the sites of other projects where such strategies are being implemented (potential examples could include the proposed Landcom subdivision and future areas of reserved Crown Land that may be managed for koala conservation). Visits to such sites should help demonstrate to members of the wider community how they can assist with koala conservation.

Ecotourism

Given the widespread appeal of the koala, the fact that koalas can regularly be seen in the Tilligerry Peninsula KMU and the overall natural beauty of the Tilligerry Peninsula, there are opportunities for ecotourism activities in this KMU. Such activities are already being run by organisations such as the Tilligerry Habitat Association. Provided ecotourism ventures are properly managed to minimise their impact on the environment, they can contribute substantially to koala conservation by raising public awareness, assigning value to the koala in addition to its intrinsic worth, and potentially providing funds for the implementation of conservation initiatives.

Threats

Habitat Disturbance

Potential future development that could involve the clearing of koala habitat in this KMU includes:

- The proposal by ACI to extract silica from the Northern Dune of the Tilligerry Peninsula, which would involve removal of the vegetation of the dune. The extent to which this could impact upon koala habitat will depend on the exact location of the silica extraction. This matter is currently under determination by the Land & Environment Court.

In addition to the above, there is likely to be a gradual loss of koala habitat that occurs within residential development as mature trees die or are removed and are not replaced by natural regeneration or replanted trees. This is likely to occur in patches of Preferred and Supplementary Koala Habitat within Mallabulla and Lemon Tree Passage.

Motor vehicles

Parts of Lemon Tree Passage Road, which runs the length of Tilligerry Peninsula, have been identified as koala black spots on the basis of data recorded by the Native Animal Trust Fund for the period 1/1/94 to 26/3/98. The stretch of Lemon Tree Passage Road between the western Rookes Road intersection and the start of the Tanilba Bay urban area is the first of these black spots, with sixteen koalas (ten of which died as a result) being hit during this period. The other black spot is the stretch of Lemon Tree Passage Road between the western edge of the Tanilba Bay urban area and Lemon Tree Passage. Six koalas were reported hit along this part of the road. Five of these died as a result. This highlights the fact that motor vehicles pose a significant threat to koalas in this KMU, particularly given the proximity of Lemon Tree Passage Road to the largest patch of Preferred Koala Habitat on the Tilligerry Peninsula.

The Native Animal Trust Fund also record six koalas being hit by motor vehicles on other roads on the Tilligerry Peninsula during the same period. Three of these were killed

Domestic/Feral Dogs

Because there is Preferred Koala Habitat both within and adjacent to the urban areas of this KMU and koalas are known to occur within these urban areas (as demonstrated by the high numbers of koala sightings reported by the community-based survey), means that domestic dogs are likely to pose a significant threat to koalas in the Tilligerry Peninsula KMU. Indeed, between 1/1/94 and 26/3/98 the Native Animal Trust Fund recorded 19 koalas attacked by dogs on the Tilligerry Peninsula, 14 of which died as a result.

A study of predator scats by Lees *et al.* (1997) recorded a high number of dog scats along tracks in vegetated areas to the west and south of Tanilba Bay. When analysed, the majority of these scats were found to contain domestic dog food, indicating that the scats were likely to have been deposited by roaming domestic dogs or dogs being walked by their owners. This emphasises the fact that the potential impact of domestic dogs on koalas extends beyond urban areas.

SWOT Analysis #2: Balickera Koala Management Unit

Description

The Balickera Koala Management Unit (KMU) is found in the northern part of the Port Stephens LGA. It is bounded to the north by the boundary between the Port Stephens and Dungog LGAs, in the south by the Raymond Terrace urban area (and Raymond Terrace KMU), to the west by the Williams River and in the east the Pacific Highway (with a small exception near the Medowie Road intersection; Figure A.3).

Agriculture is the main land use of this KMU (74% of the total area is zoned either Rural 1a or Rural 1g; Table A.5). A further 21% (located predominantly in the northern part of the KMU) is zoned Rural 1f Forestry, although this includes State Forests which have recently been transferred into National Parks Estate. There is also some water catchment areas along the Balickera Canal (in the centre of the KMU) and at the Irrawang Spillway (in the south east) that are zoned Environmental Protection 7c Water Catchment Areas.

Table A.5. Area (in hectares) and proportion of total area of the management unit for each of the land use zones in the Balickera Koala Management Unit. Residual (not tagged), which is abbreviated to N/T in other tables refers to land, such as waterways and roads, that has both been assigned to a land use zone (or in some cases a koala habitat category).

Land Use Zone	Area (ha)	Proportion (% of total area of management unit)
Rural 1a	4766	50
Rural 1f Forestry	2276	24
Rural 1g Flood Prone	1989	21
Residential 2d Future Residential	4	<1
Recreation 6a Public Recreation	16	<1
Environmental Protection 7c Water Catchment Areas	265	3
Residual (not tagged – N/T)	275	3
TOTAL	9592	

Table A.6 shows the area of land within the Balickera KMU covered by each koala habitat category, as well as the percentage of the total area of the KMU which each category encompasses.

Table A.6. . Area (in hectares) and proportion of total area of each of the categories of koala habitat for the Balickera Koala Management Unit. Also given is the proportion of the total area of Habitat Linking Areas constituted by each category of habitat linking area (e.g. Link over Other Vegetation). Note:

- Koala Habitat has been abbreviated to KH in the table.
- Quantitative figures can not be provided for Habitat Buffer areas as the width of these is determined on a case by case basis.

Habitat category	Area (ha)	Proportion (% of total area of KMU)		Habitat Linking Areas (% of area of all linking areas)
Preferred KH	594	6		-
Supplementary KH	0	0		-
Marginal KH	3962	41		-
Unknown KH Value	20	<1		-
Mainly Cleared	2575	27		-
Other Vegetation	15	<1		-
Table A.6 cont.				
		Proportion		Habitat Linking

Habitat category	Area (ha)	(% of total area of KMU)		Areas (% of area of all linking areas)
Link over Supplementary KH	0	0		0
Link over Marginal KH	479	5		47
Link over Mainly Cleared Land	533	6		52
Link over Other Vegetation	0	0		0
Link over Unknown KH Value	8	<1		<1
Residual (not tagged-N/T)	7	<1		-
TOTAL	9592			

Table A.7. Overlap between each of the following koala habitat categories: Preferred and Supplementary Koala Habitat and all Habitat Linking Areas and each land use zone in the Balickera Koala Management Unit. Shown are the area (in hectares) of overlap between these koala habitat categories and land use zones as well as the percentage of the total area within each koala habitat category that each land use zone comprises. Refer to Table A.5 for an explanation of the land use zone codes. **Note:**

- Koala Habitat has been abbreviated to KH in the table.
- Quantitative figures can not be provided for Habitat Buffer areas as the width of these is determined on a case by case basis.

Land Use Zone	Koala Habitat Category							
	<i>Preferred KH</i>		<i>Supplementary KH</i>				<i>Habitat Linking Areas</i>	
	Area (ha)	% of hab. cat.	Area (ha)	% of hab. cat.			Area (ha)	% of hab. cat.
1a	147	25	-	-			283	28
1f	100	17	-	-			329	32
1g	245	41	-	-			332	33
2d	0	0	-	-			<1	<1
6a	0	0	-	-			0	0
7c	27	5	-	-			46	5
N/T	76	13	-	-			29	3
TOTAL	594		-	-			1019	

Table A.8. Overlap between each of four major land use zone groups: Rural Small Holdings 1c (1c1, 1c2, 1c3, 1c4 and 1c5), Residential 2 (2a, 2b, 2c1,2c2,2d,2e), Business 3 (3a, 3b and 3d) and Industrial 4 (4a, 4b and 4c) which generally constitute the most intense land use zones, and Preferred Koala Habitat, Supplementary Koala Habitat and Habitat Linking Areas. Shown is the area (in hectares) of overlap as well as the percentage of the total area of the land use zones comprised by these categories of koala habitat (e.g. <1ha (or 5%) of the 4ha of land zoned Residential in this management unit overlaps with Preferred Koala Habitat). The total area of each land use zone is given at the top of the table. Note: Quantitative figures can not be provided in relation to overlap with Habitat Buffer areas as the width of these is determined on a case by case basis.

Koala Habitat Category	Land Use Zones							
	Rural Small Holdings 1c (0ha)		Residential 2 (4ha)		Business 3 (0ha)		Industrial 4 (0ha)	
	Area (ha)	% of zone	Area (ha)	% of zone	Area (ha)	% of zone	Area (ha)	% of zone
Preferred KH	-	-	-	-	-	-	-	-
Supplementary KH	-	-	-	-	-	-	-	-
Habitat Linking Areas	-	-	<1	3	-	-	-	-
TOTAL	-	-	<1	3	-	-	-	-

Strengths

Existing Koala Habitat

Preferred Koala Habitat

- The largest patches of Preferred Koala Habitat in this KMU are located along the Williams River flood plain in the north, west and south. One other large patch of Preferred Koala Habitat is situated in a swampy area adjacent to the Balickera Canal.
- There are small scattered patches of Preferred Koala Habitat along the Williams River floodplain. There is also a thin strip of Preferred Koala Habitat along the bank of the Williams River and strips of Preferred Koala Habitat along the network of watercourses that run off of the hills in the eastern part of the KMU.

Marginal Koala Habitat

- Marginal Koala Habitat covers 41% of the Balickera KMU.
- Very large contiguous areas of Marginal Koala Habitat are found on the hills in the northern and eastern parts of this KMU.
- Smaller patches of Marginal Koala Habitat, which are often surrounded by cleared land occur on hills and ridges close to the Williams River.

Mainly Cleared

- While large tracts of Mainly Cleared land occur along the alluvial flats of the Williams River, there has only been localised clearing in the northern and eastern parts of the KMU. In particular, there has been little clearing of the vegetation on the hills.

Habitat Buffers

- Ecological criteria have been established to determine the appropriate width of Habitat Buffers on a case by case basis. These criteria are contained in Appendix 9 of the Port Stephens Council CKPoM. Habitat Buffer that overlaps with Marginal Koala Habitat, is likely to be of significance to any koalas occupying these areas, as it would provide for the extension of koala activity beyond the boundary of the Preferred Koala Habitat, as well as protecting the Preferred Koala Habitat from the detrimental impacts of “edge effects”.

Habitat Linking Areas

- Approximately 47% of the total area of the Habitat Linking Areas in this KMU overlap with Marginal Koala Habitat. These also occur predominantly in the north and east of the KMU. These Habitat Linking Areas are likely to adequately facilitate the movement of koalas between areas of Preferred Koala Habitat.

Existing Land Use Zonings

Overlap with Environmental Protection Zones

- The land along the Balickera Canal and near the Irrawang Spillway is the only land in this KMU zoned Environmental Protection. This land is zoned Environmental Protection 7c Water Catchment Areas. This zoning overlaps with small amounts of Preferred and Marginal Koala Habitat, and Habitat Linking Areas over Marginal Koala Habitat, and Habitat Linking Areas over Mainly Cleared Land.

Overlap with other zones that are compatible with habitat conservation

- There is a block of land zoned Recreation 6a Public Recreation located at the intersection of East Seaham Road and an unnamed Forestry road to the north of Italia Rd. All of this land is Marginal Koala Habitat and is part of a Travelling Stock Route. This zoning aims to ensure that land is developed for open space recreation, and although it permits a range of development with the consent of council it is still likely to afford greater protection to koala habitat than for instance, residential zonings;
- The vast majority of the KMU is zoned Rural 1a or Rural 1g (Flood Prone). These land use zones overlap with 66% of Preferred Koala Habitat, and 61% of Habitat Linking Areas. Quantitative figures can not be provided in relation to overlap with Habitat Buffer areas as the width of these is determined on a case by case basis. While such a zoning does not confer as much protection as an Environmental Protection zoning, it does offer a higher level of protection than Rural Small Holding Zones (especially 1c2, 1c3, 1c4 and 1c5) and Residential zones. In particular, rural residential subdivision is not permitted within the Rural 1g zone, nor in the Rural 1a zone on land east of the Williams River.
- There is land in the north of this KMU that is currently zoned Rural 1f Forestry and was formerly managed by State Forests of NSW. However, large parts this land were recently transferred into the National Parks estate as part of the NSW Lower North East Regional Forestry Agreement and are included in the newly gazetted Wallaroo Nature Reserve. This includes strips of Preferred Koala Habitat along drainage lines as well as Marginal Koala Habitat and Links over Marginal Koala Habitat.

Overlap between “development zones” and Preferred or Supplementary Koala Habitat, and Habitat Linking Areas

Only a very small proportion of the “development zones” (Rural 1c Small Holdings, Residential 2, Business 3 and Industrial 4) overlap with either Preferred or Supplementary Koala Habitat, or Habitat Linking Areas; 3% of the land zoned Residential and no overlap with Rural 1c, Business and Industrial (Table A.8).

Other protection conferred under the EP&A Act

SEPP 14 Wetlands

State Environmental Planning Policy No. 14 - Coastal Wetlands aims “to ensure that the coastal wetlands are preserved and protected in the environmental and economic interests of the State”. This policy applies to land that has been mapped as coastal wetland for the purposes of this SEPP. In respect to such land, a person cannot: clear the land; construct a levee on that land; drain that land; or fill that land, except with the consent of council and the concurrence of the Director General of Urban Affairs and Planning. Development proposed for such land is considered to be designated development, which requires an Environmental Impact Statement. In deciding whether to grant concurrence, the Director General of Urban Affairs and Planning should consider, among other things: the effect of the proposed development on the growth of native plant communities, the survival of native wildlife populations, and the provision and quality of habitats for both indigenous and migratory species, as well as any representations made by the Director of National Parks and Wildlife. Hence, the potential impact of any proposed development on koalas or koala habitat in areas designated as coastal wetlands would need to be formally taken into account under SEPP 14. (It is perhaps more appropriate to include this discussion in the Habitat Conservation chapter of the CKPoM).

There are several areas mapped as coastal wetlands under SEPP 14 that occur within the Balickera Koala Management Unit. There are two wetlands so designated between the Williams River and East Seaham Road (to the west of the intersection with Italia Road), two on swampy areas to the north of Balickera Canal and one to the north of the Canal. There is also a large SEPP 14 wetland between the Irrawang Spillway and the East Seaham Road and another two SEPP 14 wetlands along the Williams River approximately 3km north of the southern boundary of the KMU. There is overlap between these SEPP 14 wetlands and Preferred Koala Habitat, particularly in the south of the KMU. Also, a considerable proportion of the large patch of Preferred Koala Habitat adjacent to the Balickera Canal is part of a SEPP 14 wetland, as is some of the Preferred Koala Habitat on the Williams River flood plain to the west of the Italia Road-East Seaham Road intersection. There is also overlap with areas of Habitat Linking Areas over Mainly Cleared Land and Marginal Koala Habitat.

Known Koala Populations

The community-based survey recorded a few koala sightings in this KMU (Figure 2.1 of the CKPoM Resource Document), including three sightings of a female with young (Figure 2.2 of the CKPoM Resource Document). There have also been a few recent sightings of koalas in the East Seaham vicinity, including one in July 1998 (reported to Steve Wilson, PSC). The fact that there has only been intermittent sightings of koalas in this KMU suggests that there may be low numbers of koalas in this area. Such a conclusion is substantiated by the results of the field surveys conducted in this area (Phillips *et al.* 1996), as well as historical work which has indicated that the koala populations along the Hunter and Williams Rivers have been drastically reduced since European settlement (Knott *et al.* 1998).

However, based on interviews with long term residents and review of historical records, together with the reconstruction of the pre-European vegetation interpreted in the context of the known tree species preferences of koalas in the Port Stephens LGA, Knott *et al.* (1998) demonstrated the historical importance of the flood plains along the Williams River to koalas. These flood plains were once covered by a mosaic of vegetation communities, including Shrubby Tall Open Forest and Open Swamp Forest that would have contained preferred koala food trees, such as *Eucalyptus tereticornis* and *E. robusta*. Historical records and interviews note that koalas were plentiful in forests elsewhere on the flood plains of the Hunter and Williams Rivers (Knott *et al.* 1998).

Hence, while existing koala habitat in the Balickera KMU may be largely unoccupied by koalas at present, it has the potential to again support stable koala populations, provided there is effective abatement of any threats (both past and present) to koalas. The most obvious of the threats that needs to be addressed is the habitat destruction and consequent habitat fragmentation that occurred by the late 1800's (Knott *et al.* 1998). Therefore, restoration of koala habitat along the Williams River and

associated flood plains, along with effective management of traffic and dogs, may permit the re-establishment of koala populations in these formerly very important areas.

Likely Community Support

One organisation in the Balickera KMU that is undertaking projects compatible with koala conservation is the Williams River-Care Association. This organisation has undertaken revegetation projects in the riparian zone of the Williams River in the north of the KMU and has fenced off sections of the river bank to protect vegetation from livestock. Many of the local farmers in the area, including those on hobby farms, are also revegetating parts of their properties. The Clarencetown Landcare Group also undertakes projects in the northern parts of this KMU. Given that protection of existing koala habitat and restoration of previously cleared koala habitat are the two most important actions to be undertaken in this KMU, there is likely to be support from organisations and individuals already undertaking such actions.

Weaknesses

Existing Koala Habitat

Preferred Koala Habitat

- Only 6% of the total area of the Balickera KMU is Preferred Koala Habitat;
- There has been extensive clearing of vegetation on the alluvial flats of the Williams River since European settlement in the area (Knott *et al.* 1998), which most likely included large areas of Preferred Koala Habitat. The Preferred Koala Habitat that remains in the Balickera KMU, particularly along the alluvial flats of the Williams River, is extremely fragmented;
- The fact that the Preferred Koala Habitat along the Williams River occurs as fragments in a matrix of cleared land represents a sub-optimal situation for the safe movement of koalas between areas of Preferred Koala Habitat. Also, the small size and largely fragmented nature of these patches of Preferred Koala Habitat renders them vulnerable to edge effects.

Supplementary Koala Habitat

There is no Supplementary Koala Habitat within the Balickera KMU.

Mainly Cleared

- Mainly Cleared Land represents 27% of this KMU.
- The vast majority of the Mainly Cleared land occurs in the western and southern parts of this KMU, along the banks and alluvial flats of the Williams River (cf. the hills in the east of the KMU). Most of this land along the Williams River had been cleared by the late 1800s (Knott *et al.* 1998).
- The fact that much of the vegetation along the Williams River has been cleared, while the vegetation on the hills in the east has not, has meant that habitat of lesser value to koalas has been retained while much of the Preferred Koala Habitat has been lost.

Habitat Buffers

- Ecological criteria have been established to determine the appropriate width of Habitat Buffers on a case by case basis. Where such Habitat Buffers in the Balickera KMU fall over Mainly Cleared Land they are less likely to fulfil their joint function of protecting the adjacent Preferred Koala Habitat from deleterious “edge effects” and providing for the

likely extension of significant koala activity beyond the boundary of the Preferred Koala Habitat.

Habitat Linking Areas

- With the majority (52%) of the Habitat Linking Areas in this KMU falling over Mainly Cleared Land, the safe movement of koalas between patches of Preferred Koala Habitat is jeopardised, particular if there are few trees remaining in such areas. For although koalas can move considerable distances on the ground between trees, doing so makes them more vulnerable to injury from dogs or collision with motor vehicles and can deplete their reserves of energy, causing them nutrient stress (Hume 1990).

Existing Land Use Zonings

The majority (74%) of the land in the Balickera KMU (including the majority (66%) of Preferred Koala Habitat) is currently zoned Rural 1a or Rural 1g. As mentioned previously, such zonings confer some protection to koala habitat (by generally precluding subdivision to smaller lot sizes, e.g. rural residential subdivisions), but not to the same level as an Environmental Protection zoning. However, in addressing this as a weakness, consideration needs to be given to the need for the additional protection that an Environmental Protection zoning would confer. While it is difficult to predict the behaviour of individual land holders, it seems likely that there will be little future clearing in the Balickera KMU. Rather, the trend is for revegetation of previously cleared land. Also, there are generally lower development pressures on land in the west of the LGA compared to land in the east.

Koala Population Status

- As mentioned previously, there are few koalas left along the William River flood plain. While it will require considerable efforts over the long term to facilitate the re-establishment of stable koala populations in this area, given the past importance of the Williams River flood plain to koalas, this is considered to be worth the effort. In particular, this will require a commitment by the local community to not only protect existing koala habitat over the long term, but also to undertake restoration of the large tracts of koala habitat cleared last century. If existing koala habitat is protected and cleared habitat effectively restored, and potential threats such as motor vehicles and dogs effectively abated, serious consideration should be given to investigating the potential for active management to either augment existing or establish new koala populations in this area.

Opportunities

Habitat Conservation

Land managed by State Government Agencies

In light of the importance of protecting koala habitat where it occurs on public land, the following actions are recommended:

- Rezone public lands not zoned 7c containing Preferred Koala Habitat, Supplementary Koala Habitat, Habitat Buffer Areas and Habitat Linking Areas to Environmental Protection 7a, and
- Seek the agreement of relevant public authorities to manage their land for conservation of koala habitat

Development standards and Assessment Criteria

These have been developed for the whole LGA and presented in chapters 4 and 5. They must be applied rigorously to land in the Balickera KMU.

Incentives-based conservation measures

While the application of incentives-based conservation measures should be investigated in all instances where landholders are willing to consider setting land aside for the conservation of koala habitat, the following should be investigated in particular:

- Preferred Koala Habitat along the Williams River floodplain, particularly the larger patches;
- Defined Habitat Buffers and Habitat Linking Areas (including those over Mainly Cleared Land, where there is a commitment by landholders to revegetate) along the Williams River; and
- Preferred Koala Habitat and associated Habitat Buffers (as defined by the ecological criteria) and Habitat Linking Areas along the drainage lines in the north and east of the KMU.

Habitat restoration

Because large areas of koala habitat were removed in the past and the remaining koala habitat is highly fragmented, restoration of koala habitat is an essential component of the koala conservation strategy for the Balickera KMU. As mentioned elsewhere, it is appropriate that habitat restoration projects be linked into the existing Landcare and River-Care network. The following represents the priorities (from highest to lowest) for the restoration of koala habitat in the Balickera KMU:

1. Enhance existing Preferred Koala Habitat along the Williams River flood plain and adjacent low lying areas. This should include supplementary planting of preferred koala food trees, such as *E. tereticornis* and *E. robusta*, as well as fencing to exclude livestock to protect such plantings and to facilitate natural regeneration. The objective is to increase the density of preferred koala food trees within remnant Preferred Koala Habitat and to ensure the long term existence of such species in these remnants;
2. Restore koala habitat on land identified by the ecological criteria as Habitat Buffer over Mainly Cleared Land or Habitat Linking Area over Mainly Cleared Land along the Williams River flood plain and adjacent low lying areas. Again this should involve planting *E. tereticornis* or *E. robusta* where appropriate, as well as fencing to exclude livestock;
3. Restore koala habitat on land identified by the ecological criteria as Buffer over Mainly Cleared Land or Linking Area over Mainly Cleared Land in the vicinity of the Preferred Koala Habitat along drainage lines in the hills in the north and east of the KMU. This should include planting of *E. tereticornis* as well as appropriate mixes of species found in nearby forest; and
4. Restore (as much as possible) koala habitat on land identified as Mainly Cleared along the Williams River flood plain and adjacent low lying areas. Ultimately, this should be linked with the network of koala habitat restored in accordance with the priorities outlined above.

Community support

The existing River-Care/Landcare network could be used as the basis for enlisting community support in the Balickera KMU. This will involve co-operation with the Williams River-Care Association,

Clarencetown Landcare Group and the Williams River Catchment Management Committee (CMC). The latter organisation is a subcommittee of the Hunter Catchment Management Trust and has the role of overseeing and co-ordinating activities in the catchment that involve natural resource management, including Landcare and River-Care activities. The Williams River CMC has a Remnant Vegetation Working Group, which has representatives from the aforementioned Landcare and River-Care groups, Port Stephens Council, Dungog Shire Council, and the Department of Land and Water Conservation. This Working Group would be an appropriate forum in which to discuss means of linking the outcomes of this CKPoM into the Landcare network of the Williams River catchment. Hence, it is recommended that the Working Group be briefed on the outcomes of the CKPoM, particularly those recommendations which relate to this catchment.

There is also value in linking the proposed habitat restoration projects with any activities carried out under the auspices of the “Farming for the Future” or similar programs.

Education

Education of land holders in this KMU should be an extension of the already existing River-Care/Landcare network in this KMU. Members of the Williams River-Care Association and the Clarencetown Landcare Group, along with individual land holders that are protecting remnant vegetation and/or are undertaking revegetation works should be briefed on how to tailor their activities to further contribute to the conservation of koala habitat. This would include information on what trees to plant (the preferred koala food trees *E. tereticornis* and *E. robusta* are obvious candidates for flood plain planting), how to protect and enhance existing koala habitat and how best to link these patches to form an interconnecting network of koala habitat. The Williams River Catchment Management Committee should be approached to facilitate contact with these organisations and individuals and to integrate the activities in the Balickera KMU with those elsewhere in the Williams River catchment.

Threats

Habitat Clearance

Much of the land along the Williams River flood plain was cleared by the late 1800’s, which led to localised extinction of koala populations within 50 years (Knott *et al.* 1998). While it is likely that there has been relatively little clearance of koala habitat in this area since, it must be recognised that this past clearing still poses a threat to the small number of koalas that still exist in the Balickera KMU. The current situation of small, highly fragmented patches of koala habitat along the Williams River effectively precludes the re-establishment of stable koala populations in this area. Furthermore, the fragmented nature of the remaining koala habitat threatens its long term future, due to the likely detrimental impact of edge effects on such remnants. In fact, many of these remnants are degraded and there is often little natural regeneration. Thus, it is likely that, in the absence of appropriate management, the existing trees will die and will not be replaced by younger trees.

In general, there is not a high likelihood of future clearance of koala habitat in the Balickera KMU. This is due to the fact that most of the land in this KMU is currently zoned Rural 1a or Rural 1g, zones which in general do not permit rural residential subdivision. There is some potential for clearing of koala habitat for agricultural activities, although this can be regulated, for instance as part of the development assessment process (a DA would be required under Council’s Tree preservation Order) and, for clearing of greater than 2ha, under the *Native Vegetation Conservation Act 1997*. It should also be noted that parts of the Balickera KMU are currently being investigated for rural residential release as part of PSC’s Beyond 2000 Settlement Strategy. However, it is intended that there will be extensive consultation between the PSC staff preparing the Beyond 2000 strategy and the staff preparing the CKPoM (including the AKF Field Biologist) to incorporate the principles of the latter into the outcomes of the former.

While there is little potential for future clearance of koala habitat in the Balickera KMU, the widespread clearance of koala habitat in the past continues to pose a threat to the future viability of such habitat and the small numbers of koalas it may support. Until such time as the existing koala habitat has been enhanced and previously cleared habitat restored (see Opportunities- Habitat restoration) this will continue to be the case.

Motor Vehicles

During the period from 1/1/94 to 26/3/98, the NATF record three koalas (all of which died) were hit by motor vehicles on the Pacific Highway on the eastern boundary of this KMU. Two were hit where Balickera Canal runs under the highway and another at the intersection with Italia Road. There is a large patch of Preferred Koala Habitat to the north of Grahamstown Dam in the nearby Karuah-Ferrodale KMU, which abuts the Pacific Highway in the vicinity of Balickera Canal. This, coupled with the large volume of high speed traffic on the Pacific Highway, potentially explains the above fatalities at Balickera Canal.

However, there were no collisions between koalas and motor vehicles elsewhere in the Balickera KMU that reported to the Native Animal Trust Fund during the same period. This is probably due in part to the fact that there are likely to be few koalas in this KMU and so they are less likely to be encountered. Traffic volumes are also likely to be lower on most roads in this KMU than that of the Pacific Highway. However, a recent sighting in this KMU (July 1998) was of a koala moving alongside East Seaham Road near the James Scott Bridge, just east of Seaham (koala sighting reported to S. Wilson, PSC).

The Pacific Highway is the road that carries the most traffic in this KMU. It is currently being widened and upgraded from a two lane single carriageway to a four lane dual carriageway between Raymond Terrace and Karuah. As part of this upgrade, measures aimed at ameliorating the impact of vehicles using this road on native fauna (including koalas) are being employed.

East Seaham Road and Italia Road are the other two main roads in this KMU. As both pass through or adjacent to koala habitat there is the possibility of a collision between motor vehicles and koalas along these roads. This possibility will increase in the future if habitat restoration works are successful and the number of koalas in the KMU increase. To help ameliorate any future impact of traffic on koalas in this KMU, care should be taken to plan habitat restoration projects to reduce the likelihood of koalas being attracted to either East Seaham Road or Italia Road. However, in some areas, for instance where East Seaham Road runs close to the Williams River and adjacent to Preferred Koala Habitat in the north of the KMU, there may be little scope for flexibility in planning restoration activities. In such cases there will probably be a need for other measures that reduce the likelihood of koalas being hit (e.g. slowing vehicle speeds).

In any case, should the past trend of decline in koala populations in this KMU be reversed, there will be a need to implement measures to effectively abate the threat posed to koalas by motor vehicles.

Domestic/ Feral Dogs

According to NATF records, there were no reported dog attacks on koalas in the Balickera KMU between 1/1/94 and 26/3/98. However, as there are domestic dogs (including working farm dogs) in this KMU, there is the potential for attacks on koalas. This should be addressed as part of a Shire-wide education program promoting responsible dog ownership, which informs dog owners of their responsibilities as well as providing relevant information on how they can help reduce the likelihood of their dog attacking a koala. This will be much more important in the future, should the past decline in koala populations be reversed.

Shooting for the fur trade

While this is no longer a threat to koalas in the Port Stephens LGA, nor elsewhere in Australia, as the last open season on koalas was in 1927 (Phillips 1990), it is mentioned here because of its contribution to the localised extinction and reduction of koala populations in the west of the LGA (Knott *et al.* 1998). Hunting of koalas for the fur trade was common in the LGA during the 1800's and early 1900's, when their numbers were plentiful (Knott *et al.* 1998). The consequences of this, in conjunction with the widespread destruction of habitat, are still evident in the low numbers of koalas found in this KMU today.

SWOT Analysis #3: Tomaree Peninsula Koala Management Unit

Description

The Tomaree Peninsula Koala Management Unit (KMU) covers most of the Tomaree Peninsula (Figure A.5). It includes the urban areas of Anna Bay, Boat Harbour, Fingal Bay, Shoal Bay, Nelson Bay, Corlette, Salamander Bay and Soldiers Point. It is bounded by Port Stephens to the north and north-west, by the Pacific Ocean to the east and south, and by the Fullerton Cove/Stockton Bight KMU to the west.

The major land use zones of the KMU are: agriculture (30% of the KMU; see Table A.9), water catchment areas (18%), residential (12%), coastal lands protection (11%), public recreation (10%) and wetlands (4%). Tomaree National Park (3300ha or 43% of the KMU) represents the major land use in this KMU, although this includes the majority of the land zoned Environmental Protection 7c Water Catchment Areas and Environmental Protection 7f1 Coastal Lands Protection.

Table A.9. Area (in hectares) and proportion of total area of the management unit for each of the land use zones for the Tomaree Peninsula Koala Management Unit.

Land Use Zone	Area (ha)	Proportion (% of total area of management unit)
Rural 1a	2266	30
Rural 1c3 Small Holdings	42	1
Rural 1c4 Small Holdings	68	1
Rural 1c5 Small Holdings	1	<1
Residential 2a	679	9
Residential 2b Medium Density	47	1
Residential 2c1 Medium Density	23	<1
Residential 2c2 Medium Density	10	<1
Residential 2d Future Residential	171	2
Business 3a General Business	35	<1
Business 3b Waterfront Business	5	<1
Business 3d Tourist Business	16	<1
Industrial 4b Light Industrial	38	1
Industrial 4c Waterfront Industrial	2	<1
Special Uses 5a	165	2
Special Uses 5c Arterial Roads	7	<1
Recreation 6a Public Recreation	764	10
Recreation 6c Private Recreation	217	3
Environmental Protection 7a Wetlands	294	4
Environmental Protection 7c Water Catchment Areas	1391	18
Environmental Protection 7f1 Coastal Lands Protection	839	11
Environmental Protection 7f3 Small Holdings	108	1
Residual (not tagged – N/T)	419	6
TOTAL	7606	

Table A.10 shows the area of land within the Tomaree Peninsula Koala Management Unit covered by each koala habitat category, as well as the percentage of the total area of the KMU each of these categories comprise.

Table A.10. . Area (in hectares) and proportion of total area of each of the categories of koala habitat for the Tomaree Peninsula Koala Management Unit. Also given is the proportion of the total area of Habitat Linking Areas constituted by each category of habitat linking area (e.g. Link over Other Vegetation). Note:

- Koala Habitat has been abbreviated to KH in the table.
- Quantitative figures can not be provided for Habitat Buffer areas as the width of these is determined on a case by case basis.

Habitat category	Area (ha)	Proportion (% of total area of KMU)		Habitat Linking Areas (% of area of all linking areas)
Preferred KH	1515	20		-
Supplementary KH	1600	21		-
Marginal KH	33	<1		-
Unknown KH Value	0	0		-
Mainly Cleared	1645	22		-
Other Vegetation	739	10		-
Link over Supplementary KH	360	5		41
Link over Marginal KH	10	<1		1
Link over Mainly Cleared Land	409	5		47
Link over Other Vegetation	92	1		11
Link over Unknown KH Value	0	0		0
Residual (not tagged-N/T)	27	<1		-
TOTAL	7606			

Table A.11. Overlap between each of the following koala habitat categories: Preferred and Supplementary Koala Habitat and all Habitat Linking Areas and each land use zone in the Tomaree Peninsula Koala Management Unit. Shown are the area (in hectares) of overlap between these koala habitat categories and land use zones as well as the percentage of the total area within each koala habitat category that each land use zone comprises. Refer to Table A.9 for an explanation of the land use zone codes. Note:

- Koala Habitat has been abbreviated to KH in the table.
- Quantitative figures can not be provided for Habitat Buffer areas as the width of these is determined on a case by case basis.

Land Use Zone	Koala Habitat Category							
	Preferred KH		Supplementary KH				Habitat Linking Areas	
	Area (ha)	% of hab. cat.	Area (ha)	% of hab. cat.			Area (ha)	% of hab. cat.
1a	775	51	284	18			210	24
1c3	14	1	1	<1			15	2
1c4	3	<1	30	2			8	1
1c5	<1	<1	0	0			0	0
2a	20	1	151	9			89	10
2b	1	<1	8	1			12	1
2c1	<1	<1	1	<1			2	<1
2c2	<1	<1	<1	<1			<1	<1
2d	10	1	24	1			28	3
3a	4	<1	<1	<1			10	1
3b	<1	<1	0	0			<1	<1
3d	2	<1	0	0			0	0
4b	10	1	0	0			4	<1
4c	<1	<1	0	0			1	<1
5a	12	1	46	3			53	6
Table A.11 cont.								

5c	0	0	3	<1			1	<1
6a	112	7	156	10			90	10
6c	58	4	21	1			24	3
7a	120	8	39	2			50	6
7c	251	17	640	40			146	17
7f1	42	3	147	9			45	5
7f3	34	2	3	<1			21	2
N/T	46	3	45	3			65	7
Total	1515		1600				872	

Table A.12. Overlap between each of four major land use zone groups: Rural Small Holdings 1c (1c1, 1c2, 1c3, 1c4 and 1c5), Residential 2 (2a, 2b, 2c1, 2c2, 2d, 2e), Business 3 (3a, 3b and 3d) and Industrial 4 (4a, 4b and 4c) which generally constitute the most intense land use zones, and Preferred Koala Habitat, Supplementary Koala Habitat and Habitat Linking Areas. Shown is the area (in hectares) of overlap as well as the percentage of the total area of the land use zones comprised by these categories of koala habitat (e.g. 32ha (or 3%) of the 928ha of land zoned Residential in this management unit overlaps with Preferred Koala Habitat). The total area of each land use zone is given at the top of the table. Note: Quantitative figures can not be provided in relation to overlap with Habitat Buffer areas as the width of these is determined on a case by case basis.

Koala Habitat Category	Land Use Zones							
	Rural Small Holdings 1c (111ha)		Residential 2 (928ha)		Business 3 (56ha)		Industrial 4 (41ha)	
	Area (ha)	% of zone	Area (ha)	% of zone	Area (ha)	% of zone	Area (ha)	% of zone
Preferred KH	18	16	32	3	6	10	10	24
Supplementary KH	30	28	184	20	<1	<1	0	0
Habitat Linking Areas	23	20	131	14	10	18	5	12
TOTAL	71	64	346	37	16	29	14	35

Strengths

Existing Koala Habitat

Preferred Koala Habitat

- Preferred Koala Habitat comprises 20% of the total area of the Tomaree Peninsula KMU.
- There are large, generally contiguous (they are dissected in parts by Nelson Bay Road and Port Stephens Drive) patches of Preferred Koala Habitat extending from just to the north of Anna Bay and Boat Harbour north to Salamander Bay and Taylors Beach.
- There are patches of Preferred Koala Habitat in a matrix of Supplementary Koala Habitat on the series of volcanic hills in the vicinity of Nelson Bay and Shoal Bay and within Tomaree National Park.

Supplementary Koala Habitat

- Supplementary Koala Habitat comprises 21% of the total area of the Tomaree Peninsula KMU.
- There is a large, generally contiguous (it is dissected by Nelson Bay Road and Gan Gan Road) patch of Supplementary Koala Habitat extending from Corlette to Fingal Bay and north east to Shoal Bay. The majority of this patch is within Tomaree National Park.

- There is a patch of Supplementary Koala Habitat to the west of Anna Bay which is contiguous with the large patch of Supplementary Koala Habitat that extends along the sand dunes inland from Stockton Bight.
- There are smaller patches of Supplementary Koala Habitat in the vicinity of Anna bay, Boat Harbour, Shoal Bay and Salamander Bay.

Habitat Buffers

- Ecological criteria have been established to determine the appropriate width of Habitat Buffers on a case by case basis. Where these Habitat Buffers in the Tomaree Peninsula KMU overlap with Supplementary Koala Habitat they are likely to both protect patches of Preferred Koala Habitat from the detrimental impacts of edge effects and provide for the extension of koala activity beyond the boundary of Preferred Koala Habitat.

Habitat Linking Areas

- Approximately 41% of the Habitat Linking Areas in this KMU overlap with Supplementary Koala Habitat. These Habitat Linking Areas are likely to contribute to the successful movement of koalas between patches of Preferred Koala Habitat.

Existing Land Use Zonings

Figure A.2 shows the overlap between the koala habitat categories (boundaries shown by black line) and the land use zones in the Tomaree Peninsula KMU.

Overlap with Environmental Protection Zones

- There is substantial overlap of Preferred Koala Habitat with land zoned Environmental Protection in the Tomaree Peninsula KMU (30%; see Table A.11), the majority of which is zoned Environmental Protection 7c Water catchment Areas. However, this includes some land (2% of Preferred Koala Habitat) which is zoned Environmental Protection 7f3 Small Holdings, which permits rural residential subdivision. This includes Preferred Koala Habitat on the volcanic hills in the vicinity of Nelson Bay and Shoal Bay and within Tomaree National Park, around Mambo Swamp at Salamander Bay and between Gan Gan Road and Nelson Bay Road to the north of Frost Road.
- The majority of Supplementary Koala Habitat in the Tomaree Peninsula KMU overlaps with land zoned Environmental Protection (51%; see Table A.11), mostly land zoned Environmental Protection 7c Water catchment Areas. This includes most of the large patch of Supplementary Koala Habitat that extends between Corlette and Fingal Bay and north east to Shoal Bay.

Overlap with other zones that are compatible with habitat conservation

- Land zoned Public Recreation 6a overlaps with Preferred Koala Habitat (7% of this habitat category; see Table A.11), Supplementary Koala Habitat (10%), and Habitat Linking Areas (10%). Quantitative figures can not be provided in relation to overlap with Habitat Buffer areas as the width of these buffers is determined on a case by case basis. While this zoning aims to ensure that land is developed for open space recreation, and permits a range of development with the consent of council, it is still likely to afford greater protection to koala habitat than, for instance, land zoned Residential;
- The majority of Preferred Koala Habitat in this KMU overlaps with land zoned Rural 1a (51%; Table A.11). This includes most of the large patches of Preferred Koala Habitat that occur between Anna Bay and Salamander Bay. There is also substantial overlap between this land use zone and Supplementary Koala Habitat (18%), and Habitat Linking

Areas (24%). Quantitative figures can not be provided in relation to overlap with Habitat Buffer areas as the width of these buffers is determined on a case by case basis. This zoning could afford some protection to koala habitat inasmuch as it generally precludes subdivision to small lot sizes, for example for rural residential subdivision (cf. land zoned Rural Small Holdings; especially 1c3, 1c4 or 1c5).

Other Land Uses

- As mentioned previously, large tracts of Supplementary Koala Habitat occur within Tomaree National Park. Patches of Preferred Koala Habitat are also found in this National Park, as are Habitat Linking Areas that overlap with Supplementary Koala Habitat.

Other protection conferred under the EP&A Act

SEPP 14 Wetlands

There are a number of SEPP 14 Wetlands that overlap with Preferred Koala Habitat in this KMU. This includes SEPP 14 Wetlands to the west of Port Stephens Drive, to the south of Salamander Bay, to the north of Frost Road, to the west of Shoal Bay, and to the east of Gan Gan Road north of the Frost Road intersection, as well as the SEPP 14 Wetland (Mambo Swamp) at Salamander Bay.

Known Koala Populations

- Koala sightings obtained from the community survey and from the databases of the Native Animal Trust Fund and Tomaree Eco-Watch Association confirm that there is an extant koala population in this KMU. Moreover, these sources, on the basis of sightings and other records of females koalas with young, confirm the existence of breeding females in the Tomaree Peninsula KMU.

Likely Community Support

There are several community groups that are actively involved in koala conservation in the Tomaree Peninsula KMU. These include the Eco-Network Port Stephens (which is a peak environmental group), the Tomaree Eco-Watch Association, the Native Animal Trust Fund, the Hunter Koala Preservation Society, and a number of Tidy Towns Associations. These groups are already involved in activities such as caring for injured koalas, community education, habitat conservation, habitat restoration, and monitoring (recording koala sightings and koalas killed or taken into care). The existence of such groups indicates that there is strong community support for koala conservation in this KMU.

Links to other KMUs

There are some limited habitat links with the adjacent Fullerton Cove/Stockton Bight KMU.

Weaknesses

Existing Koala Habitat

Preferred Koala Habitat

- Land to the north of Anna Bay has been drained and cleared for agriculture. It is likely that this resulted in the loss of Preferred Koala Habitat.
- Rapid urban expansion since the 1950's (Knott *et al.* 1998) has resulted in the removal of native vegetation on the Tomaree Peninsula. It is likely that this included some Preferred Koala Habitat.
- There are small, fragmented patches of Preferred Koala Habitat within the urban areas of Anna Bay, Shoal Bay, Nelson Bay, Corlette and Soldiers Point. Other patches of Preferred Koala Habitat occur adjacent to urban areas such as Salamander Bay and Fingal

Bay. Koalas using habitat in these areas are at risk of being attacked by dogs or hit by cars.

- The large patches of Preferred Koala Habitat between Anna Bay/Boat Harbour and Salamander Bay/Taylors Beach are dissected by several roads. This includes Gan Gan Road, Port Stephens Drive and Frost Road that are noted Conflict Areas (meaning koalas have been hit by vehicles on these roads, see the Traffic Chapter) and Nelson Bay Road, which carries large volumes of traffic.
- Preferred Koala Habitat has been largely cleared for rural residential development on land zoned Environmental Protection 7f3 Small Holdings to the north of Boat Harbour (at Eucalyptus Drive and nearby streets).

Supplementary Koala Habitat

- Patches of Supplementary Koala Habitat occur within or adjacent to all of the urban areas of the Tomaree Peninsula KMU. Koalas using this habitat are at risk of being attacked by dogs or hit by cars.
- Large patches of Supplementary Koala Habitat have recently been cleared as part of the Landcom subdivision at Bagnall's Beach, Corlette.
- The large patch of Supplementary Koala Habitat in the east of this KMU is dissected by both Nelson Bay Road and Gan Gan Road.
- Bushfires frequently occur in the Supplementary Koala Habitat along Stockton Bight. Such bushfires could spread into the Supplementary Koala Habitat to the west of Anna Bay, thus threatening any koalas using this habitat.

Habitat Buffers

- Ecological criteria have been established to determine the appropriate width of Habitat Buffers on a case by case basis. It is disadvantageous in this KMU where such Habitat Buffers overlap with Mainly Cleared Land. This is because although koalas may use scattered trees occurring across cleared land, this is not an optimal situation, particularly where there are no trees or the buffer overlaps with residential. As a consequence, koalas are likely to be more vulnerable to attack by dogs or collision with motor vehicles. Furthermore, Habitat Buffers over Mainly Cleared Land are less likely to effectively protect Preferred Koala Habitat from the detrimental impacts of edge effects.

Habitat Linking Areas

- Approximately 47% of the Habitat Linking Areas in this KMP overlap with Mainly Cleared Land. Although koalas may use scattered trees occurring across cleared land, this is not an optimal situation, particularly where there are no trees or the linking area overlaps with residential development (about 14% of the Habitat Linking Areas in this KMU overlap with land zoned Residential; Table A.11). As a consequence, koalas are likely to be more vulnerable to attack by dogs or collision with motor vehicles.

Existing Zonings

- The majority (51%) of Preferred Koala Habitat in this KMU overlaps with land zoned Rural 1a. While such a land use zoning is likely to afford more protection to koala habitat than zones such as Rural Small Holdings Zones (eg 1c3, 1c4, or 1c5) or Residential, it does not confer as much protection to koala habitat as an Environmental Protection zoning. In particular, mineral sand mining and sand extraction are permitted on land zoned Rural 1a, whereas under the proposed Draft LEP 1999, such activities will not be permitted in the Environmental Protection 7a zone. However, the majority of land that is

zoned Rural 1a and overlaps with Preferred Koala Habitat may not have a high development potential due to other potential constraints such as flood prone land and acid sulphate soils;

- Approximately 7% of Preferred Koala Habitat in this KMU overlaps with land zoned Public Recreation. Again, while such a land use zoning is likely to afford more protection to koala habitat than zones such as Rural Small Holdings Zones (eg 1c3, 1c4, or 1c5) or Residential, it does not confer as much protection to koala habitat as an Environmental Protection zoning;
- Approximately 12% of Supplementary Koala Habitat in this KMU overlaps with land zoned Residential. The long term conservation of such patches of koala habitat and the koalas they support is endangered because of this situation. The small lot sizes and subsequently high density of housing in Residential zones inhibits (but does not completely preclude) the retention of existing trees and the growth or replanting of new trees. Added to this is the high level threat to koalas that inhabit such areas posed by dogs and motor vehicles.
- Approximately 64% of the land in this KMU that is zoned Rural Small Holdings overlaps with either Preferred or Supplementary Koala Habitat, or Habitat Linking Areas (Table A.12). This occurs in the vicinity of Gan Gan Road between Anna Bay and Boat Harbour and either side of Frost Road. Almost half of the land in this KMU that is zoned either Residential (approximately 37%) or Business (approximately 29%) overlaps with these same koala habitat categories (Table A.12). This occurs in most of the urban areas on the Tomaree Peninsula . Approximately 35% of the land in this KMU that is zoned Industrial also overlaps with these koala habitat categories. All of the land zoned Industrial on Port Stephens Drive and small amounts of land zoned Industrial to the south and west of Soldiers Point overlaps with such habitat. The development standards and assessment criteria for rezoning proposals and development applications outlined in chapters 4 and 5 of this CKPoM will apply to such land.

Opportunities

Habitat Conservation

Development Standards and Assessment Criteria

These have been developed for the whole LGA and are presented in Chapters 4 and 5. It is essential that these standards be applied to protect koala habitat throughout the Tomaree Peninsula.

Incentives-based conservation measures

While the application of incentives-based conservation measures should be investigated in all instances where landholders are willing to consider setting land aside for the conservation of koala habitat, the following should be investigated in particular:

- Land between Anna Bay/Boat Harbour and Salamander Bay/Taylors Beach that contains Preferred Koala Habitat in particular, and/or Supplementary Koala Habitat, Habitat Buffers (as defined by the ecological criteria) or Habitat Linking Areas and which landholders are willing to either rezone to Environmental Protection (or place in a Voluntary Conservation Zone, should one be established) or set aside under a Voluntary Conservation Agreement; and
- The provision of Management Grants to landholders who are willing to undertake koala habitat restoration on priority areas identified below. This will obviously depend on the availability of funding, such as could be provided should PSC's recent NHT application be successful.

Land managed by State Government Agencies

In light of the importance of protecting koala habitat where it occurs on public land, the following actions are recommended:

- Rezone public lands not zoned 7c containing Preferred Koala Habitat, Supplementary Koala Habitat, Habitat Buffer Areas and Habitat Linking Areas to Environmental Protection 7a, and
- Seek the agreement of relevant public authorities to manage their land for conservation of koala habitat

Crown Land

There are several portions of Crown Land in the Tomaree Peninsula KMU. Crown Land is administered by the Department of Land and Water Conservation (DLWC). The procedure for undertaking land assessments (as per the Crown Lands Act 1989) on areas of Vacant or Reserved Crown Land that may be undertaken on the Tilligerry Peninsula that contains koala habitat should also be applied to such land on the Tomaree Peninsula. Pending the outcome of this assessment, Crown Land which contains significant koala habitat may be reserved for Environmental Protection/Conservation. Following such reservation, it is proposed that private reserve trusts be established to manage these areas.

National Parks Estate

The National Parks and Wildlife Service will continue to investigate the potential of Crown Land on the Tomaree Peninsula for acquisition for as National Parks estate.

Hunter Water Corporation

In managing public land on the Tomaree Peninsula for water catchment purposes, the Hunter Water Corporation should continue to give due consideration to the conservation of koala habitat.

Habitat restoration

Areas in the Tomaree Peninsula KMU that should be targeted for habitat restoration projects include:

- Land between Anna Bay/Boat Harbour and Salamander Bay/Taylors Beach that is identified by the ecological criteria as Habitat Buffer or Habitat Linking Area over Mainly Cleared Land. Given that there are large contiguous patches of Preferred Koala Habitat in this area, it should be of the highest priority for koala habitat restoration projects on the Tomaree Peninsula; and
- Other land in the Tomaree Peninsula KMU that is identified through the ecological criteria as Habitat Buffer or Habitat Linking Area over Mainly Cleared Land. This could include such areas located to the south of Soldiers Point and in the vicinity of Mambo Swamp and, pending due consideration of the threat to koalas posed by dogs and cars, such areas within or adjacent to the urban areas of the Tomaree Peninsula KMU.

Community commitment

As mentioned previously, several community groups (Eco-Network Port Stephens, the Tomaree Eco-Watch Association, the Hunter Koala Preservation Society, the Native Animal Trust Fund, and several Tidy Towns Associations) are actively involved in koala conservation in this KMU. Future community education, koala monitoring and habitat restoration projects on the Tomaree Peninsula could expand on the existing work being done by these organisations, and projects should be planned in conjunction with these groups.

These groups should be approached for support and assistance with the habitat restoration projects outlined above as well as participation in the monitoring program outlined in chapter 17 of the CKPoM Resource Document.

Education

Existing education programs, such as meetings and field days being run by Eco-Network Port Stephens, and brochures such as those prepared by the Tilligerry Habitat Association and the Hunter Koala Preservation Society for elsewhere in the LGA, should be used as a starting point for educating the community about koala conservation. Other organisations, such as Tidy Towns committees, precinct committees and the NSW Farmers Association should also be approached to participate in education programs.

Sites in the Tomaree Peninsula KMU where koala conservation strategies are being implemented should be used to assist with community education programs. This should include areas that currently exist, such as areas where the Tomaree Eco-Watch Association is currently monitoring koalas and other sites where koala habitat is being restored (for instance by Tidy Towns Associations), but should also be expanded to include the sites of other projects where such strategies are being implemented (e.g. future areas of reserved Crown Land that are managed for koala conservation). Visits to such sites should help demonstrate to members of the wider community how they can assist with koala conservation.

Ecotourism

Given the widespread appeal of the koala, the fact that koalas are often seen in the Tomaree Peninsula KMU, the overall natural beauty of the Tomaree Peninsula, and the popularity of the Tomaree Peninsula as a tourist destination there are opportunities for ecotourism activities in this KMU. Provided ecotourism ventures are properly managed to minimise their impact on the environment, they can contribute substantially to koala conservation by raising public awareness, assigning value to the koala in addition to its intrinsic worth, and potentially providing funds for the implementation of conservation initiatives.

Threats

Habitat Disturbance

Potential future development that could involve the clearing of koala habitat in this KMU includes:

-
- The proposed 99 lot residential subdivision at Kaninbla Drive, Salamander Bay. This subdivision is likely to involve the clearing of Habitat Buffer (as defined by the ecological criteria) over Supplementary Koala Habitat and Habitat Linking Area over Supplementary Koala Habitat; and

In addition to the above, there is likely to be a gradual loss of koala habitat that occurs within residential development as mature trees die or are removed and are not replaced by natural regeneration or replanted trees.

Motor vehicles

On the basis of information supplied by the Native Animal Trust Fund and the Hunter Koala Preservation Society, four conflict areas (stretches of road where koalas are known to be hit by cars periodically or sporadically) were identified in the Tomaree Peninsula KMU: Gan Gan Road, Port Stephens Drive, Frost Road and roads in the Anna Bay urban area. The Native Animal Trust Fund database records 12 koalas were hit by motor vehicles in this KMU for the period 1/1/94 to 26/3/98. Six of these koalas died as a result.

Feral/Domestic Dogs

Because there is Preferred Koala Habitat both within and adjacent to the urban areas of this KMU and koalas are known to occur within these urban areas (as demonstrated by the koala sightings reported by the community-based survey and by other monitoring carried out by the Tomaree Eco-Watch Association), domestic dogs are likely to pose a significant threat to koalas in the Tomaree Peninsula

KMU. Between 1/1/94 and 26/3/98 the Native Animal Trust Fund recorded 3 koalas attacked by dogs on the Tomaree Peninsula, all of which survived.

SWOT Analysis #4: Raymond Terrace Management Unit

Description

The Raymond Terrace Koala Management Unit (KMU) comprises the Raymond Terrace urban area, Heatherbrae, Motto Farm and some agricultural land to the south west of Raymond Terrace. It is bounded to the west by the Hunter and Williams Rivers, to the north by the Balickera KMU on the edge of the Raymond Terrace urban area

The main land uses in this KMU are: agriculture, along the bank of the Hunter River (40% of the total area of the KMU; see Table A.13); residential (25% of the KMU), public recreation (10%) and private recreation (5%). While it comprises only about 1% of the total area of this KMU, business is an important land use in this KMU, given the status of Raymond Terrace as a regional business centre.

Table A.13. Area (in hectares) and proportion of total area of the management unit for each of the land use zones for the Raymond Terrace Management Unit.

Land Use Zone	Area (ha)	Proportion (% of total area of management unit)
Rural 1a	184	12
Rural 1c4 Small Holdings	3	<1
Rural 1c5 Small Holdings	12	1
Rural 1g Flood Prone	447	28
Residential 2a	313	20
Residential 2b Medium Density	4	<1
Residential 2d Future Residential	85	5
Business 3a General Business	10	1
Industrial 4a General Industrial	<1	<1
Industrial 4b Light Industrial	2	<1
Special Uses 5a	60	4
Special Uses 5c Arterial Roads	45	3
Special Uses 5d Local Roads	<1	<1
Special Uses 5g Urban Flood Plain	14	1
Recreation 6a Public Recreation	156	10
Recreation 6c Private Recreation	76	5
Environmental Protection 7c Water Catchment Areas	1	<1
Residual (not tagged – N/T)	158	10
TOTAL	1570	

Table A.14 shows the area of land within the Raymond Terrace Management Unit covered by each koala habitat category, as well as the percentage of the total area of the locality each of these categories comprise.

Table A.14. . Area (in hectares) and proportion of total area of each of the categories of koala habitat for the Raymond Terrace Koala Management Unit. Also given is the proportion of the total area of Habitat Linking Areas constituted by each category of habitat linking area (e.g. Link over Other Vegetation). Note:

- Koala Habitat has been abbreviated to KH in the table.
- Quantitative figures can not be provided for Habitat Buffer areas as the width of these is determined on a case by case basis.

Habitat category	Area (ha)	Proportion (% of total area of locality)		Habitat Linking Areas (% of area of all linking areas)
Preferred KH	148	9		-
Supplementary KH	13	1		-
Marginal KH	5	<1		-
Unknown KH Value	-	-		-
Mainly Cleared	843	54		-
Other Vegetation	11	1		-
Link over Supplementary KH	1	<1		<1
Link over Marginal KH	3	<1		2
Link over Mainly Cleared Land	205	13		97
Link over Other Vegetation	1	<1		<1
Link over Unknown KH Value	-	-		-
Residual (not tagged-N/T)	1	<1		-
TOTAL	1570			

Table A.15. Overlap between each of the following koala habitat categories: Preferred and Supplementary Koala Habitat and all Habitat Linking Areas and each land use zone in the Raymond Terrace Koala Management Unit. Shown are the area (in hectares) of overlap between these koala habitat categories and land use zones as well as the percentage of the total area within each koala habitat category that each land use zone comprises. Refer to Table A.13 for an explanation of the land use zone codes. Note:

- Koala Habitat has been abbreviated to KH in the table.
- Quantitative figures can not be provided for Habitat Buffer areas as the width of these is determined on a case by case basis.

Land Use Zone	Koala Habitat Category							
	Preferred KH		Supplementary KH				Habitat Linking Areas	
	Area (ha)	% of hab. cat.	Area (ha)	% of hab. cat.			Area (ha)	% of hab. cat.
1a	28	19	4	26			38	18
1c4	-	-	-	-			2	1
1c5	-	-	-	-			1	<1
1g	60	40	-	-			113	54
2a	6	4	9	64			38	18
2b	<1	<1	<1	<1			<1	<1
2d	3	2	-	-			4	2
3a	<1	<1	-	-			<1	<1
4a	-	-	-	-			-	-
4b	<1	<1	-	-			<1	<1
5a	5	3	-	-			8	4
5c	7	5	1	9			5	2
5d	-	-	-	-			-	-
5g	<1	<1	-	-			1	<1
6a	27	18	-	-			-	-
6c	6	4	-	-			-	-

Table A.15 cont.

7c	-	-	-	-			-	-
Residual N/T	7	4	-	-			-	-
TOTAL	148		13				210	

Table A.16. Overlap between each of four major land use zone groups: Rural Small Holdings 1c (1c1, 1c2, 1c3, 1c4 and 1c5), Residential 2 (2a, 2b, 2c1, 2c2, 2d, 2e), Business 3 (3a, 3b and 3d) and Industrial 4 (4a, 4b and 4c) which generally constitute the most intense land use zones, and Preferred Koala Habitat, Supplementary Koala Habitat and Habitat Linking Areas. Shown is the area (in hectares) of overlap as well as the percentage of the total area of the land use zones comprised by these categories of koala habitat (e.g. 9ha (or 2%) of the 402ha of land zoned Residential in this management unit overlaps with Preferred Koala Habitat). The total area of each land use zone is given at the top of the table. Note: Quantitative figures can not be provided in relation to overlap with Habitat Buffer areas as the width of these is determined on a case by case basis.

Koala Habitat Category	Land Use Zones							
	Rural Small Holdings 1c (15ha)		Residential 2 (402ha)		Business 3 (10ha)		Industrial 4 (2ha)	
	Area (ha)	% of zone	Area (ha)	% of zone	Area (ha)	% of zone	Area (ha)	% of zone
Preferred KH	-	-	9	2	<1	<1	<1	2
Supplementary KH	-	-	9	2	-	-	-	-
Habitat Linking Areas	2	15	43	11	<1	2	<1	10
TOTAL	2	15	61	15	<1	3	<1	12

Strengths

Existing Koala Habitat

Preferred Koala Habitat

- There is approximately 148ha (Table A.13) of Preferred Koala Habitat within the Raymond Terrace Koala Management Unit, which represents approximately 9% of the total area of the management unit (approx. 1570ha);
- The largest patches of Preferred Koala Habitat in this KMU are located along the Hunter River flood plain and along the bank of Windeyers Creek. Patches of Preferred Koala Habitat along Windeyers Creek are potentially connected to extensive tracts of Preferred and Supplementary Koala Habitat on the Tomago Sandbeds via an underpass beneath the Raymond Terrace Bypass; and
- There are also small patches of Preferred Koala Habitat that occur within the eastern parts of Raymond Terrace or on the edge of the urban area to the south and north of Raymond Terrace. There are also thin strips of Preferred Koala Habitat in places along the Hunter River.

Supplementary Koala Habitat

- There is approximately 13ha of Supplementary Koala Habitat within the Raymond Terrace KMU, which represents approximately 1% of the total area of the KMU; and
- While the Supplementary Koala Habitat in this management unit generally occurs as small, fragmented patches, some of these patches are in close proximity to the large expanses of Supplementary and Preferred Koala Habitat to the east in the Tomago Sandbeds KMU, although they are separated by the Raymond Terrace Bypass of the Pacific Highway (and its koala-proof fences).

Marginal Koala Habitat

See Weaknesses

Mainly Cleared

See Weaknesses

Other Vegetation

- There is only 11ha (1% of the total area of the KMU) of Other Vegetation in this KMU. This consists of small plantations of introduced pine, predominantly in the eastern parts of the KMU.

Habitat Buffers

- Ecological criteria have been established to determine the appropriate width of Habitat Buffers on a case by case basis. Such Habitat Buffers in this KMU may provide for the extension of significant koala activity beyond the boundary of Preferred Koala Habitat, and may afford some protection to Preferred Koala Habitat from the detrimental impacts of edge effects.

Habitat Linking Areas

- A very small proportion of the Habitat Linking Areas in this management unit overlap with either Supplementary or Marginal Koala Habitat (1% and 2% respectively). Such areas may facilitate the movement of koalas between patches of Preferred Koala Habitat.

Existing Land Use Zonings*Overlap with Environmental Protection Zones*

- See Weaknesses.

Overlap with other zones that are compatible with habitat conservation

- There are considerable amounts of land zoned Public Recreation 6a in this management unit (156ha or 10% of the KMU; Table A.13). While this zoning does not confer as much protection as an Environmental Protection zoning, it does offer more scope for the retention of koala habitat than zonings such as Residential, Industrial and Rural Residential (i.e. rural small holdings). There is overlap between this zoning and Preferred Koala Habitat (representing 18% of all Preferred Koala Habitat in this KMU; Table A.15) along parts of the Hunter River, land to south of Raymond Terrace and on Muree Golf Course, Raymond Terrace. Quantitative figures can not be provided in relation to overlap with Habitat Buffer areas as the width of these is determined on a case by case basis.
- There are substantial amounts of land, predominantly along the Hunter River flood plain to the south of Raymond Terrace, that are zoned Rural 1a (184ha, 12% of the KMU) or Rural 1g (447ha, 28%). Again, while these zonings do not confer the same level of protection as an Environmental Protection zoning, they do afford some protection to koala habitat by virtue of the fact that these zones generally do not permit rural residential subdivisions. Land zoned Rural 1a or Rural 1g overlaps with patches of Preferred Koala Habitat (28ha, or 19% of Preferred Koala Habitat and 60ha, or 40% respectively) as well as Habitat Linking Areas (38ha, or 18% of all Habitat Linking Areas; and 113ha, or 54%, respectively). Approximately 26% (4ha) of Supplementary Koala Habitat overlaps with Rural 1a. Quantitative figures can not be provided in relation to overlap with Habitat Buffer areas as the width of these is determined on a case by case basis.

Known Koala Populations

- Records obtained from the community-based survey and from the database of the Native Animal Trust Fund, show that there have been high numbers of koala sightings, including females with young, in this KMU. However, as regards the records from the community-based survey it is important to note that the high number of sightings can be attributed, at least in part, to the high density of the human population at Raymond Terrace. The fact that there are high numbers of people in this area means that there is a greater likelihood of koalas being sighted. In any case, this information, in conjunction with historical records (Knott *et al.* 1998), demonstrates the long term existence of koalas in the Raymond Terrace management unit; and
- Ongoing radio-tracking of koalas in the Raymond Terrace area to monitor the impact of the Raymond Terrace Bypass, confirms the current existence of koalas in this KMU.

Likely community support

- Community groups, such as the Native Animal Trust Fund, the Australian Wildlife Hospital, the Hunter Koala Preservation Society, as well as Tidy Towns Associations, are actively involved in koala conservation in the Raymond Terrace area. These groups are already involved in activities such as caring for injured koalas, community education, habitat conservation, habitat restoration, and monitoring (recording koala sightings and koalas killed or taken into care). The existence of such groups indicates that there is strong community support for koala conservation in this KMU.

Links to other KMUs

There are some links to the nearby Tomago Sandbeds KMU, mainly from the eastern parts of the Raymond Terrace KMU.

Weaknesses

Existing Koala Habitat

Preferred Koala Habitat

- There has been extensive clearing of vegetation on the alluvial flats of the Hunter River. Most of this land had been cleared by the 1850's (Knott *et al.* 1998), and would have included large amounts of Preferred Koala Habitat;
- Only relatively small patches of Preferred Koala Habitat remain in the Raymond Terrace KMU and these occur as highly fragmented remnants in a matrix of predominantly cleared land. This situation not only compromises the safe movement of koalas between patches of Preferred Koala Habitat but also renders these patches vulnerable to the detrimental impacts of edge effects; and
- Many of these patches occur within or adjacent to the Raymond Terrace urban area. Koalas occupying such habitat are likely to be under threat of injury or death from attack by domestic dogs or collision with motor vehicles. Indeed, the former route of the Pacific Highway where it passed through Raymond Terrace was identified as a black spot for koala road deaths and koalas have been injured or killed as a result of collisions with motor vehicles on other roads within Raymond Terrace. There have also been numerous koalas reported attacked by dogs in the Raymond Terrace area.

Supplementary Koala Habitat

- There are only small patches of Supplementary Koala Habitat remaining in the Raymond Terrace management unit. These occur generally as small patches within a matrix of cleared land.

Marginal Koala Habitat

- The remaining Marginal Koala Habitat in this management unit consists of only a few small patches located within or on the edge of the Raymond Terrace urban area, i.e. on land that has been predominantly cleared and now consists of residential houses.

Habitat Buffers

Ecological criteria have been established to determine the appropriate width of Habitat Buffers on a case by case basis. It is sub-optimal where these Habitat Buffers occur over Mainly Cleared Land in this KMU, as they may fail to provide for the extension of koala activity beyond the Preferred Koala Habitat and will most likely not protect the Preferred Koala Habitat from the detrimental impacts of edge effects.

Habitat Linking Areas

- The vast majority (97%) of Habitat Linking Areas in this management unit also overlap with Mainly Cleared Land, which represents a sub-optimal situation as regards the safe and successful movement of koalas between patches of Preferred Koala Habitat.

Existing Zonings

- There is only a very small amount of land in this KMU zoned Environmental Protection (which is zoned 7a Water Catchment Areas), virtually all of which overlaps with Mainly Cleared Land
- Large parts of this management unit are zoned Residential (402ha or 26%, Industrial or Business. These land use zones generally permit smaller lot sizes and/or are often intensively developed, both of which limits the potential for retention of vegetation. Most of the land so zoned has already been cleared and developed.
- There are areas that are zoned Residential or Industrial that have yet to be developed and that have existing koala habitat. This includes land zoned Residential that overlaps with part of a patch of Preferred Koala Habitat in the north of this management unit as well as patches of Supplementary and Marginal Koala Habitat immediately east of the Raymond Terrace bypass.

High Level Threats

The koala population in the Raymond Terrace management unit has been subject to high levels of threatening processes over many years. These include: habitat clearance and fragmentation, attack by dogs, and collisions with motor vehicles. Each of these threats are discussed in detail in the section on **Threats** below. Effective abatement of these threats is necessary to ensure the long term (and perhaps even the short term) survival of koalas in this management unit.

Opportunities

Habitat Conservation

Development Standards and Assessment Criteria

These have been developed for the whole LGA and are presented in Chapters 4 and 5. It is essential that these standards be applied to protect koala habitat throughout the Raymond Terrace Koala Management Unit. Given the substantial historical loss of koala habitat, it is particularly important to recognise the potential significance of individual preferred koala food trees in this KMU.

Incentives-based conservation measures

There is little scope for incentives based-conservation measures in this KMU, due to the fact that much of the area has already been developed.

Habitat restoration

Habitat restoration activities in this KMU should be focused on areas within and around the urban area where koalas are currently known to occur, including: Lakeside, Muree Golf Course, the Raymond Terrace Cemetery, Boomerang Park, Irrawang Public School and Irrawang High School. There is a need to integrate such activities with measures aimed at reducing the impact of motor vehicles and dogs on koalas.

Community commitment

- Future community education, koala monitoring and habitat restoration projects in the Raymond Terrace KMU should be planned in consultation with the Native Animal Trust Fund, the Australian Wildlife Hospital, the Hunter Koala Preservation Society, the Tilligerry Habitat Association, and local Tidy Towns Associations.

Education

- Given the impact of motor vehicles and dogs on koalas in this KMU, there is a real need to educate the Raymond Terrace community on how they can help ameliorate such threats. This should build on existing education programs and brochures and involve the community groups listed above.

Threats

Habitat Clearance

As mentioned in the Weaknesses section under Existing Zonings, there is some potential for future development of koala habitat in this management unit. This includes land currently zoned Residential east of the Raymond Terrace bypass and in the north of the management unit as well as land zoned Industrial east of Heatherbrae. However, much of the habitat clearance in this locality has occurred by the 1850's (Knott *et al.* 1998).

Because of the extent to which it occurred in the past, habitat clearance still constitutes an existing threat to the koala population of this management unit. The current situation of small, isolated patches of koala habitat surrounded by either cleared farmland or cleared and substantially modified urban areas continues to threaten both this remaining habitat and the koalas that occupy it. The small patches of koala habitat are likely to be extremely vulnerable to the detrimental impacts of edge effects.

It is also likely that there is little or no natural regeneration of trees in some of these remnants, which would threaten their long term viability. The koalas that inhabit these patches have to cope with a food resource that has been substantially reduced since European settlement as well as the fragmented nature of their habitat, which would force them to move considerable distances between trees rendering them more vulnerable to injury or death caused by collisions with motor vehicles or attack by dogs (which is further exacerbated by the proximity of the Raymond Terrace urban area) or to nutritional stress (Hume 1990).

Thus, the habitat fragmentation, which was caused by extensive habitat clearance in the past, continues to constitute a significant threat to koalas and koala habitat in this management unit and must be addressed through well planned and effective habitat restoration activities.

Motor Vehicles

The former route of the Pacific Highway through Raymond Terrace has been identified as a koala black spot on the basis of records provided to the Native Animal Trust Fund from the period 1/1/94 to 26/3/98. During this period eight koalas were hit along this stretch of road, seven of which died as a result. Two koalas were killed near the Bi-Lo car park. Another black spot is the 2-3km stretch of the Pacific Highway in the vicinity of Heatherbrae, Motto Farm and Windeyers Bridge. Eight koalas, all of which were killed, were hit along this stretch. The Raymond Terrace Bypass of the Pacific Highway now diverts through traffic away from Windeyers Bridge, but the Highway and the high traffic volumes it carries still passes through Heatherbrae and Motto Farm.

The Raymond Terrace Bypass of the Pacific Highway was opened to traffic in December 1998. The Fauna Impact Statement prepared for the RTA acknowledged that this Bypass would impact on koalas and could result in their localised extinction from the Raymond Terrace urban area (RTA 1992). As a consequence, a series of fauna underpasses were installed beneath the Bypass along with exclusion fencing to prevent koalas from crossing the road and to direct them towards the underpasses. A number of koalas are currently being radio tracked in the vicinity of this Bypass to examine the effectiveness of these ameliorative measures.

Irrawang Street and Elizabeth Avenue and other streets in the vicinity of Boomerang Park, Muree Golf Course and Raymond Terrace Cemetery within Raymond Terrace have been identified as conflict areas.

Dogs

There were six dog attacks on koalas reported to the NATF in this KMU between 1/1/94 and 26/3/98. Three of these koalas died as a result. Due to the fact that much of the remaining koala habitat (particularly that currently occupied by koalas) in this KMU occurs within or adjacent to the Raymond Terrace urban area, dogs are likely to continue to constitute a significant threat to koalas in this KMU.

SWOT Analysis #5: Medowie Koala Management Unit

Description

The Medowie Koala Management Unit (KMU) occurs to the east of Grahamstown Dam through to Oyster Cove and includes the urban area of Medowie together with surrounding lands. This KMU is bounded by the Karuah/Ferrodale KMU to the north and by the Tomago Sandbeds KMU to the south. The boundary of this KMU is shown on the accompanying excerpt of the Koala Habitat Planning Map (see Figure A.9).

The major land use zonings in this KMU include: Rural Small Holdings 1c1-1c5 (41%), Special Uses 5a Defence Purposes (22%), Environmental Protection 7a Wetlands (9%), and Rural 1f Forestry (8%).

Table A.17. Area (in hectares) and proportion of total area of the KMU for each of the land use zones.

Land Use Zone	Area (ha)	Proportion (% of total area of management unit)
Rural 1a	243	6
Rural 1c1 Small Holdings	650	16
Rural 1c2 Small Holdings	107	3
Rural 1c3 Small Holdings	351	8
Rural 1c4 Small Holdings	498	12
Rural 1c5 Small Holdings	76	2
Rural 1d Future Urban	67	2
Rural 1f Forestry	326	8
Residential 2a	53	1
Residential 2d Future Residential	87	2
Business 3a General Business	3	< 1
Industrial 4b Light Industrial	8	< 1
Special Uses 5a	918	22
Special Uses 5c Arterial Roads	7	< 1
Recreation 6a Public Recreation	152	4
Environmental Protection 7a Wetlands	390	9
Environmental Protection 7c Water Catchment Areas	33	< 1
Residual (not tagged – N/T)	192	5
TOTAL	4161	

Table A.18 shows the area of land within the Medowie KMU covered by each koala habitat category, as well as the percentage of the total area of the KMU that each of these categories comprise.

Table A.18. . Area (in hectares) and proportion of total area of each of the categories of koala habitat for the Medowie Koala Management Unit. Also given is the proportion of the total area of Habitat Linking Areas constituted by each category of habitat linking area (e.g. Link over Other Vegetation). Note:

- Koala Habitat has been abbreviated to KH in the table.
- Quantitative figures can not be provided for Habitat Buffer areas as the width of these is determined on a case by case basis.

Habitat Category	Area (ha)	Proportion (% of total area of locality)		Habitat Linking Areas (% of area of all linking areas)
Preferred KH	686	16		-
Supplementary KH	116	3		-
Marginal KH	1446	35		-
Unknown KH Value	-	-		-
Mainly Cleared	322	8		-
Other Vegetation	437	11		-
Link over Supplementary KH	50	1		11
Link over Marginal KH	105	3		23
Link over Mainly Cleared Land	295	7		64
Link over Other Vegetation	4	< 1		< 1
Link over Unknown KH Value	8	< 1		2
Residual (not tagged-N/T)	-	-		-
TOTAL	4161			

Table A.19. Overlap between each of the following koala habitat categories: Preferred and Supplementary Koala Habitat and all Habitat Linking Areas and each land use zone in the Medowie Koala Management Unit. Shown are the area (in hectares) of overlap between these koala habitat categories and land use zones as well as the percentage of the total area within each koala habitat category that each land use zone comprises. Refer to Table A.17 for an explanation of the land use zone codes. Note:

- Koala Habitat has been abbreviated to KH in the table.
- Quantitative figures can not be provided for Habitat Buffer areas as the width of these is determined on a case by case basis.

Land Use Zone	Koala Habitat Category							
	Preferred KH		Supplementary KH				Habitat Linking Areas	
	Area (ha)	% of hab. cat.	Area (ha)	% of hab. cat.			Area (ha)	% of hab. cat.
1a	0	0	0	0			0	0
1c1	284	41	0	0			77	17
1c2	17	3	2	2			22	5
1c3	112	16	< 1	< 1			67	14
1c4	86	13	0	0			111	24
1c5	< 1	< 1	0	0			6	1
1d	12	2	0	0			20	4
1f	4	< 1	0	0			2	< 1
2a	< 1	< 1	0	0			26	6
2d	14	2	0	0			6	1
3a	0	0	0	0			3	< 1
4b	5	< 1	0	0			< 1	< 1
5a	63	9	7	6			6	1
5c	1	< 1	0	0			3	< 1
6a	16	2	0	0			12	3
7a	58	8	95	81			67	15
7c	< 1	< 1	12	10			< 1	< 1

Table A.19 cont.

Residual N/T	12	2	0	0			33	7
TOTAL	686		116				462	

Table A.20. Overlap between each of four major land use zone groups: Rural Small Holdings 1c (1c1, 1c2, 1c3, 1c4 and 1c5), Residential 2 (2a, 2b, 2c1, 2c2, 2d, 2e), Business 3 (3a, 3b and 3d) and Industrial 4 (4a, 4b and 4c) which generally constitute the most intense land use zones, and Preferred Koala Habitat, Supplementary Koala Habitat and Habitat Linking Areas. Shown is the area (in hectares) of overlap as well as the percentage of the total area of the land use zones comprised by these categories of koala habitat (e.g. 14ha (or 10%) of the 140ha of land zoned Residential in this management unit overlaps with Preferred Koala Habitat). The total area of each land use zone is given at the top of the table. Note: Quantitative figures can not be provided in relation to overlap with Habitat Buffer areas as the width of these is determined on a case by case basis.

Koala Habitat Category	Land Use Zones							
	Rural Small Holdings 1c (1682ha)		Residential 2 (140ha)		Business 3 (3ha)		Industrial 4 (8ha)	
	Area (ha)	% of zones	Area (ha)	% of zones	Area (ha)	% of zones	Area (ha)	% of zones
Preferred KH	501	30	14	10	0	0	5	61
Supplementary KH	3	< 1	0	0	0	0	3	38
Habitat Linking Areas	283	17	32	23	3	94	< 1	1
TOTAL	787		46		3		8	

Strengths

Existing Koala Habitat

Preferred Koala Habitat

- Approximately 16% of the total area of the Medowie KMU comprises Preferred Koala Habitat (PKH).
- There are patches of PKH throughout much of the Medowie urban area including some substantial patches in the south of the KMU.

Supplementary Koala Habitat

- Approximately 3% of the KMU comprises Supplementary Koala Habitat, predominantly in the Moffats Swamp area.

Marginal Koala Habitat

- Approximately 35% of the KMU comprises Marginal Koala Habitat, predominantly in the north.

Existing Land Use Zonings

Overlap with Environmental Protection Zones

- There is some overlap of Preferred Koala Habitat with land already zoned Environmental Protection in the Medowie KMU (8% of PKH), predominantly in the Moffats Swamp area.
- There is some overlap of Environmental Protection zones with land identified as Habitat Linking Areas (15% of Habitat Linking Areas), again predominantly in the Moffats Swamp area.
- The majority of the Supplementary Koala Habitat within the KMU is already zoned Environmental Protection 7a Wetlands (81% of Supplementary Koala Habitat), which includes Moffats Swamp Nature Reserve. An additional 10% of the Supplementary Koala Habitat occurs within land zoned Environmental Protection 7c Water Catchment Areas, in the south west corner of the KMU.

Overlap with other zones that are compatible with habitat conservation

- There is some overlap of Recreation zoned land within the Medowie KMU with Preferred Koala Habitat (2% of PKH). Most notably, this occurs in the central south of the KMU adjacent to the tail of Moffats Swamp. Several of the smaller areas zoned for Recreation amongst Rural Small Holdings and Residential zoned areas of the KMU overlap with Habitat Linking Areas.
- Special Uses 5a (Defence Purposes) zoned land overlaps with PKH in the eastern part of the KMU (9% of PKH).

Known Koala Populations

- Koala sightings including records of females with young, obtained from the community-based koala survey and from the databases of the Native Animal Trust Fund and Hunter Koala Preservation Society confirm the presence of an extant koala population within the Medowie KMU. This is particularly the case for western and southern parts of the KMU.

Links to Habitat in Adjacent KMUs

- The koala population within this KMU is potentially linked to both the Tomago Sandbeds KMU to the south and the Tilligerry Peninsula KMU to the east. Habitat fragmentation and roads impose increased risks and limitations on the potential for successful interaction of koalas between these units.

Weaknesses

Existing Koala Habitat

Preferred Koala Habitat

- It is presumed that a substantial amount of PKH has already been removed or degraded from this KMU in association with urban development.
- The patches of PKH located within the Medowie urban area generally abut Rural Small Holdings zones, which infer likely ongoing disturbance to remaining habitat and increased potential threat of koala mortality from traffic and domestic dogs in particular.

- Occupation by koalas of Preferred Koala Habitat in the southern part of the KMU would potentially be impacted significantly by road mortality associated with an identified koala “black spot” on Richardson Road in the Campvale area.

Habitat Buffers

- Ecological criteria have been established to determine the appropriate width of Habitat Buffers on a case by case basis. Where such buffers overlap with mainly cleared land they can provide an important buffering role, particularly where restoration is appropriate, however, they will generally be less effective in terms of habitat buffering than buffers that overlap with forested land.

Habitat Links

- The majority of the Habitat Linking Areas within the KMU overlap with Mainly Cleared Land (64% of Habitat Linking Areas).

Existing Zonings

- Substantial areas of Preferred Koala Habitat within the Medowie KMU overlap with Rural Small Holdings zones 1c1-1c5 (73% of PKH; 30% of these zones).
- Areas of Preferred Koala Habitat within the KMU are zoned Residential 2 (2% of PKH; 10% of this zone).
- An area of Preferred Koala Habitat within the KMU is zoned Light Industrial Zone 4b (4% of PKH; 61% of this zone).

Opportunities

Habitat Conservation

Investigation for Voluntary Conservation Agreements (VCAs), voluntary rezonings to Environmental Protection, or voluntary management agreements in conjunction with incentive-based measures to protect koala habitat:

- Land that has been identified as PKH and Habitat Buffer (as defined by the ecological criteria) in the central and south of the KMU, particularly the two largest patches to the south of Ferodale Road and west of Medowie Road that are currently zoned Rural Small Holdings (1c1; 1c3) and the area adjacent to the tail of Moffats Swamp; and
- Land that has been identified as PKH and Habitat Buffer (as defined by the ecological criteria) to the north of Ferodale Road that is currently zoned Rural Small Holdings, particularly the patch to the west of the land already zoned Environmental Protection 7a.

Development standards and Assessment Criteria

These have been developed for the whole LGA and presented in chapters 4 and 5.

Land managed by State Government Agencies

In light of the importance of protecting koala habitat where it occurs on public land, the following actions are recommended:

- Rezone public lands not zoned 7c containing Preferred Koala Habitat, Supplementary Koala Habitat, Habitat Buffer Areas and Habitat Linking Areas to Environmental Protection 7a, and

- Seek the agreement of relevant public authorities to manage their land for conservation of koala habitat

NPWS Estate

Within the Medowie KMU the National Parks and Wildlife Service is responsible for management of Moffats Swamp Nature Reserve.

State Forests

State Forests of NSW is responsible for management of Medowie State Forests, which includes some areas in the north of the Medowie KMU.

Habitat Restoration

Areas in the Medowie KMU that should be investigated for potential habitat restoration projects include:

- Degraded areas fringing Preferred and Supplementary Koala Habitat associated with Moffats Swamp including Habitat Buffer (as defined by the ecological criteria) over Marginal Koala Habitat and Mainly Cleared Land. This would potentially include areas to the east of Moffats Swamp that have been subject to sand mining operations;
- Habitat Buffer (as defined by the ecological criteria) over Mainly Cleared Land and Habitat Linking Areas over Mainly Cleared Land/Marginal Koala Habitat throughout the Medowie KMU, pending the effective abatement of the threat posed by dogs and traffic.

Links to Habitat in Adjacent KMUs

Identification and prioritisation of projects for habitat restoration within the Medowie KMU should consider any potential to restore and or enhance habitat links between this KMU and the Tomago Sandbeds KMU in particular.

Community Commitment

As already mentioned, the Native Animal Trust Fund and the Hunter Koala Preservation Society are actively involved in koala rescue and rehabilitation within the Port Stephens LGA. Future community education, koala monitoring and habitat restoration projects in the Medowie KMU should be planned in consultation with these groups.

Education

Existing brochures such as those prepared by the Tilligerry Habitat Association and the Hunter Koala Preservation Society should be used as a basis for educating the community about koala conservation issues.

Council's Health and Environment Newsletter could also encourage responsible dog ownership and careful driving in areas containing koala habitat, as well as providing information regarding the implementation of the CKPoM.

Threats

Habitat Disturbance

Potential future development within the Medowie KMU that may involve clearing of koala habitat principally includes:

- Development on lands currently zoned Rural Small Holdings or Residential where these lands contain Preferred or Supplementary Koala Habitat, Habitat Buffers (as defined by the ecological criteria) or Habitat Linking Areas.

Motor Vehicles

Several koala conflict areas have been identified on roads within the Medowie KMU on the basis of data recorded by the Native Animal Trust Fund for the period 1/1/94 to 26/3/98, during which time seven koalas died as a result of collision with cars and one was hit but survived. The identified conflict areas include parts of Medowie Road, Ferodale Road and Blocklesby Road, Main Road and Silverwattle Drive in particular.

Domestic Dogs

Patches of PKH together with Habitat Buffers (as defined by the ecological criteria) and Habitat Linking Areas occur within and adjacent to the Medowie urban and rural residential area. Koalas are known to occur within this area (as was demonstrated by the high number of koala sightings reported for the area in the community-based koala survey). Domestic dogs are therefore likely to pose a significant threat to koalas in the Medowie KMU. Between 1/1/94 and 26/3/98 the Native Animal Trust Fund recorded three koalas attacked by dogs within the KMU.

Feral Dogs

The Port Stephens Vertebrate Pest Animal Management Committee should address the issue of feral dogs within the Medowie KMU, particularly with regard to the need for effective control on lands administered by the Department of Defence, National Parks and Wildlife Service and State Forests of NSW (see Feral Animal Management chapter of this CKPoM).

Bushfire

Bushfire poses a significant potential threat to koalas occupying habitat within the Medowie KMU. This is particularly the case in the east and far north, which predominantly includes land administered by the Department of Defence, National Parks and Wildlife Service and State Forests of NSW. Koala issues should be taken into account as a component of fire management planning with respect to these areas (see Bushfires chapter of this CKPoM).

SWOT Analysis #6: Tomago Sandbeds Koala Management Unit

Description

The Tomago Sandbeds Koala Management Unit (KMU) occurs in the central southern part of the Port Stephens LGA. It is bounded to the north by Grahamstown Dam, the Medowie KMU and the Tilligerry Peninsula KMU, to the west by the Pacific Highway and the Raymond Terrace KMU and to the south by the Fullerton Cove KMU (see Figure A.11).

Environmental Protection 7c Water Catchment Areas (55%) and Rural 1a (24%) are the principal land uses within the Tomago Sandbeds KMU.

Table A.21. Area (in hectares) and proportion of total area of the KMU for each of the land use zones.

Land Use Zone	Area (ha)	Proportion (% of total area of management unit)
Rural 1a	2582	24
Rural 1c1 Small Holdings	220	2
Rural 1c2 Small Holdings	< 1	< 1
Rural 1g Flood Prone	3	< 1
Residential 2d Future Residential	16	< 1
Industrial 4a General Industrial	790	7
Industrial 4b Light Industrial	51	< 1
Special Uses 5a	743	7
Special Uses 5c Arterial Roads	3	< 1
Special Uses 5d Local Roads	< 1	< 1
Recreation 6a Public Recreation	128	1
Recreation 6c Private Recreation	41	< 1
Environmental Protection 7c Water Catchment Areas	5949	55
Environmental Protection 7k Flora and Fauna Conservation	29	< 1
Residual (not tagged – N/T)	209	2
TOTAL	10765	

Table A.22 shows the area of land within the Tomago Sandbeds KMU covered by each koala habitat category, as well as the percentage of the total area of the KMU that each of these categories comprise.

Table A.22. . Area (in hectares) and proportion of total area of each of the categories of koala habitat for the Tomago Koala Management Unit. Also given is the proportion of the total area of Habitat Linking Areas constituted by each category of habitat linking area (e.g. Link over Other Vegetation). Note:

- Koala Habitat has been abbreviated to KH in the table.
- Quantitative figures can not be provided for Habitat Buffer areas as the width of these is determined on a case by case basis.

Habitat category	Area (ha)	Proportion (% of total area of locality)		Habitat Linking Areas (% of area of all linking areas)
Preferred KH	2321	22		-
Supplementary KH	1613	15		-
Marginal KH	26	< 1		-
Unknown KH Value	0	0		-
Mainly Cleared	2223	21		-
Other Vegetation	1691	16		-
Link over Supplementary KH	544	5		45
Link over Marginal KH	3	< 1		< 1
Link over Mainly Cleared Land	493	5		41
Link over Other Vegetation	161	1		13
Link over Unknown KH Value	0	0		0
Residual (not tagged-N/T)	15	< 1		-
TOTAL	10765			

Table A.23. Overlap between each of the following koala habitat categories: Preferred and Supplementary Koala Habitat and all Habitat Linking Areas and each land use zone in the Tomago Koala Management Unit. Shown are the area (in hectares) of overlap between these koala habitat categories and land use zones as well as the percentage of the total area within each koala habitat category that each land use zone comprises. Refer to Table A.21 for an explanation of the land use zone codes. Note:

- Koala Habitat has been abbreviated to KH in the table.
- Quantitative figures can not be provided for Habitat Buffer areas as the width of these is determined on a case by case basis.

Land Use Zone	Koala Habitat Category							
	Preferred KH		Supplementary KH				Habitat Linking Areas	
	Area (ha)	% of hab. cat.	Area (ha)	% of hab. cat.			Area (ha)	% of hab. cat.
1a	456	20	246	15			363	30
1c1	120	5	5	< 1			24	2
1c2	< 1	< 1	0	0			0	0
1g	0	0	0	0			0	0
2d	0	0	0	0			< 1	< 1
4a	18	< 1	254	16			6	< 1
4b	0	0	12	< 1			0	0
5a	58	3	38	2			101	8
5c	< 1	0	< 1	< 1			< 1	< 1
5d	0	0	0	0			0	0
6a	11	< 1	< 1	< 1			3	< 1
6c	5	< 1	3	< 1			4	< 1
7c	1616	70	1042	65			681	57
7k	22	< 1	0	0			< 1	< 1

Table A.23 cont.

Residual N/T	14	< 1	11	< 1			17	1
TOTAL	2321		1613				1201	

Table A.24. Overlap between each of four major land use zone groups: Rural Small Holdings 1c (1c1, 1c2, 1c3, 1c4 and 1c5), Residential 2 (2a, 2b, 2c1, 2c2, 2d, 2e), Business 3 (3a, 3b and 3d) and Industrial 4 (4a, 4b and 4c) which generally constitute the most intense land use zones, and Preferred Koala Habitat, Supplementary Koala Habitat and Habitat Linking Areas. Shown is the area (in hectares) of overlap as well as the percentage of the total area of the land use zones comprised by these categories of koala habitat (e.g. 8ha (or 2%) of the 841ha of land zoned Industrial overlaps with Preferred Koala Habitat). The total area of each land use zone is given at the top of the table. Note: Quantitative figures can not be provided in relation to overlap with Habitat Buffer areas as the width of these is determined on a case by case basis.

Koala Habitat Category	Land Use Zones							
	Rural Small Holdings 1c (220ha)		Residential 2 (16ha)		Business 3 (0ha)		Industrial 4 (841ha)	
	Area (ha)	% of zone	Area (ha)	% of zone	Area (ha)	% of zone	Area (ha)	% of zone
Preferred KH	120	55	0	0	-	-	18	2
Supplementary KH	5	2	0	0	-	-	266	32
Habitat Linking Areas	24	11	< 1	3	-	-	6	< 1
TOTAL	150		< 1		-	-	291	

Strengths

Existing Koala Habitat

Preferred Koala Habitat (PKH)

- Preferred Koala Habitat (PKH) covers 22% of the KMU including several substantial areas as well as numerous smaller patches.
- Substantial areas of PKH occur to the south and east of Lakeside Village; from Cabbage Tree Road through to Campvale, and fringing the southern tail of Moffats Swamp.
- Numerous areas of PKH and Supplementary Koala Habitat occur throughout the Tomago Sandbeds and the majority of the KMU.

Supplementary Koala Habitat

- Supplementary Koala Habitat covers 15% of the KMU.

Marginal Koala Habitat

- Marginal Koala Habitat covers < 1% of the KMU.

Habitat Linking Areas

- 45% of the Habitat Linking Areas overlap with Supplementary Koala Habitat, while 13% overlap with Other Vegetation.

Existing Land Use Zonings

Overlap with Environmental Protection Zones

- 55% of the KMU is zoned Environmental Protection 7c Water Catchment Areas. This zoning overlaps with a substantial amount of PKH, , Supplementary Koala Habitat and Habitat Linking Areas.
- < 1% of the KMU is zoned Environmental Protection 7k Flora and Fauna Conservation, predominantly in coastal and estuarine areas to the southwest of Karuah, to the west of Swan Bay.

Overlap with other zones that are compatible with habitat conservation

- 7% of the KMU is zoned Special Uses 5a Defence Purposes, which overlaps with several relatively small patches of PKH in the Williamstown area.
- Between 1% and 2% of the KMU is zoned Recreation.
- 24% of the KMU is zoned Rural 1a.

Known Koala Populations

The community-based survey recorded a significant number of koala sightings in this KMU (Figure 1, Chapter 2), including numerous sightings of females with young (Figure 2, Chapter 2). The highest density of koala records within this KMU tended to be in the north. The koala records together with results of the field surveys (Phillips *et al.* 1996) indicated that this KMU supports some of the most significant koala habitat within the Port Stephens LGA. The number of koalas within this KMU is likely to be highest of all the KMUs.

Weaknesses

Existing Koala Habitat

Preferred Koala Habitat

- Clearing associated with sand mining activity (in particular) in the KMU has resulted in a high degree of fragmentation and (undoubtedly) the removal of a substantial amount of Preferred and Supplementary Koala Habitat.

Habitat Linking Areas

- 41% of the Habitat Linking Areas in the KMU occur over Mainly Cleared Land.

Existing Land Use Zonings

- 20% of the PKH is zoned Rural 1a. As mentioned previously, this zoning confers some protection to koala habitat, but not to the same level as an Environmental Protection zoning.
- 16% of Supplementary Koala Habitat within the KMU is zoned General Industrial 4a.

Opportunities

Habitat Conservation

Development Standards and Assessment Criteria

These have been developed for the whole LGA and presented in chapters 4 and 5.

Land managed by Government Agencies

In light of the importance of protecting koala habitat where it occurs on public land, the following actions are recommended:

- Rezone public lands not zoned 7c containing Preferred Koala Habitat, Supplementary Koala Habitat, Habitat Buffer Areas and Habitat Linking Areas to Environmental Protection 7a, and
- Seek the agreement of relevant public authorities to manage their land for conservation of koala habitat

Incentives-based Conservation Measures

The application of incentives-based conservation measures should be investigated in all instances where landholders are willing to consider setting land aside for the conservation of koala habitat. In the case of this KMU emphasis should focus upon the areas of PKH, Habitat Buffer (as defined by the ecological criteria), Habitat Linking Areas and Supplementary Koala Habitat in the Salt Ash area; areas of PKH and Supplementary Koala Habitat to the north of Masonite Road (near Heatherbrae); and areas of PKH and Supplementary Koala Habitat to the north of Nelson Bay Road.

Habitat Restoration

Habitat restoration should be promoted for all areas within the KMU where Habitat Buffers (as defined by the ecological criteria) or Habitat Linking Areas occur over Mainly Cleared Land. This should involve planting *E. robusta*, *E. parramattensis* and *E. tereticornis* as appropriate, as well as fencing to exclude livestock where necessary.

Extensive areas of habitat restoration are underway at various stages, following RZM sand mining operations on the Tomago Sandbeds.

Traffic Management

Appropriate speed mediation, driver warning and education measures are required with respect to each of the identified Black Spots and Conflict Areas within the KMU. The potential implementation of speed advisory signs or speed zones that apply at specific times of the day and year should be investigated for Richardson Road, Lemon Tree Passage Road and Medowie Road in particular. It is recommended that speed advisory signs or speed zones should be applied in conjunction with a marketing program to promote and encourage adherence to the speed limits.

Feral Dogs

Feral dog management within the KMU is being addressed in conjunction with the Port Stephens Vertebrate Pest Animal Management Committee.

Threats

Habitat Clearance

No new sand mining operations have currently been approved for the Tomago Sandbeds.

Any clearing of koala habitat on Rural 1a land in conjunction with agricultural activities would be regulated as part of the development assessment process (a DA would be required under Council's Tree preservation Order) and, for clearing of greater than 2ha, under the *Native Vegetation Conservation Act 1997*.

Motor Vehicles

Koala Black Spots have been identified in a several areas along Richardson Road including near Finnan Park-Grahamstown Dam; Campvale and the stretch of road between Medowie Road and Salt Ash.

Lemon Tree Passage Road to the east of Salt Ash is also a recorded Koala Black Spot (see the Traffic Management chapter).

Domestic/Feral Dogs

According to NATF records, several koalas were killed by domestic dogs within the KMU between 1/1/94 and 26/3/98. A number of these attacks occurred in the Salt Ash area. The potential for domestic dog attacks on koalas within the KMU should be addressed as part of a LGA-wide education program promoting responsible dog ownership (see the Dog Management chapter).

The post January 1994 bush fires radio-tracking study of rehabilitated koalas conducted by NPWS in conjunction with the NATF documented a high incidence of predation by feral dogs and/or roaming domestic dogs in the Tomago Sandbeds area (see the Feral Animal Management chapter).

SWOT Analysis #7: Karuah/Ferodale Koala Management Unit

Description

The Karuah/Ferodale Koala Management Unit (KMU) occurs in the central northern part of the Port Stephens LGA. It is bounded to the north by the Great Lakes LGA, to the south by Grahamstown Dam and the Medowie KMU, the Pacific Highway and the Balickera KMU in the west and Port Stephens coastline in the east (see Figure A.13).

Forestry and agriculture are the principal land uses in this KMU (40% of the total area is zoned Rural 1f Forestry; 37% is zoned Rural 1a; Table A.25). Some land within the KMU is zoned Environmental Protection 7c Water Catchment Areas (12%) and Environmental Protection 7a Wetlands (4%). Special Uses 5a Defence Purposes zoned land occupies 3% of the KMU.

Table A.25. Area (in hectares) and proportion of total area of the KMU for each of the land use zones.

Land Use Zone	Area (ha)	Proportion (% of total area of management unit)
Rural 1a	5560	37
Rural 1c1 Small Holdings	0	0
Rural 1c4 Small Holdings	< 1	0
Rural 1f Forestry	5979	40
Residential 2a	46	< 1
Residential 2d Future Residential	18	< 1
Residential 2e Village	11	< 1
Business 3a General Business	4	< 1
Industrial 4c Waterfront Industrial	10	< 1
Special Uses 5a Defence Purposes	476	3
Special Uses 5c Arterial Roads	8	< 1
Recreation 6a Public Recreation	138	< 1
Environmental Protection 7a Wetlands	549	4
Environmental Protection 7c Water Catchment Areas	1799	12
Residual (not tagged – N/T)	496	3
TOTAL	15093	

Table A.26 shows the area of land within the Karuah/Ferodale Koala Management Unit covered by each koala habitat category, as well as the percentage of the total area of the KMU that each of these categories comprise.

Table A.26. . Area (in hectares) and proportion of total area of each of the categories of koala habitat for the Karuah / Ferodale Koala Management Unit. Also given is the proportion of the total area of Habitat Linking Areas constituted by each category of habitat linking area (e.g. Link over Other Vegetation). Note:

- Koala Habitat has been abbreviated to KH in the table.
- Quantitative figures can not be provided for Habitat Buffer areas as the width of these is determined on a case by case basis.

Habitat Category	Area (ha)	Proportion (% of total area of locality)		Habitat Linking Areas (% of area of all linking areas)
Preferred KH	792	5		-
Supplementary KH	10	< 1		-
Marginal KH	9660	64		-
Unknown KH Value	49	< 1		-
Mainly Cleared Land	2053	14		-
Other Vegetation	1217	8		-
Link over Supplementary KH	25	< 1		5
Link over Marginal KH	218	1		48
Link over Mainly Cleared Land	167	1		37
Link over Other Vegetation	42	< 1		9
Link over Unknown KH Value	0	0		0
Residual (not tagged-N/T)	65	< 1		-
TOTAL	15093			

Table A.27. Overlap between each of the following koala habitat categories: Preferred and Supplementary Koala Habitat and all Habitat Linking Areas and each land use zone in the Karuah / Ferodale Koala Management Unit. Shown are the area (in hectares) of overlap between these koala habitat categories and land use zones as well as the percentage of the total area within each koala habitat category that each land use zone comprises. Refer to Table A.25 for an explanation of the land use zone codes. Note:

- Koala Habitat has been abbreviated to KH in the table.
- Quantitative figures can not be provided for Habitat Buffer areas as the width of these is determined on a case by case basis.

Land Use Zone	Koala Habitat Category							
	Preferred KH		Supplementary KH				Habitat Linking Areas	
	Area (ha)	% of hab. cat.	Area (ha)	% of hab. cat.			Area (ha)	% of hab. cat.
1a	241	31	7	68			152	34
1c1	0	0	0	0			0	0
1c4	0	0	0	0			0	0
1f	146	18	0	0			62	14
2a	6	< 1	0	0			< 1	< 1
2d	0	0	0	0			0	0
2e	0	0	0	0			< 1	< 1
3a	0	0	0	0			0	0
4c	0	0	0	0			< 1	< 1
5a	0	0	0	0			< 1	< 1
5c	< 1	< 1	0	0			1	< 1
6a	23	3	0	0			15	3
7a	5	< 1	0	0			16	3
7c	351	44	3	28			185	41
Residual N/T	19	2	< 1	4			19	4
TOTAL	792		10				451	

Table A.28. Overlap between each of four major land use zone groups: Rural Small Holdings 1c (1c1, 1c2, 1c3, 1c4 and 1c5), Residential 2 (2a, 2b, 2c1, 2c2, 2d, 2e), Business 3 (3a, 3b and 3d) and Industrial 4 (4a, 4b and 4c) which generally constitute the most intense land use zones, and Preferred Koala Habitat, Supplementary Koala Habitat and Habitat Linking Areas. Shown is the area (in hectares) of overlap as well as the percentage of the total area of the land use zones comprised by these categories of koala habitat (e.g. 6ha (or 8%) of the 75ha of land zoned Residential 2 in this KMU overlaps with Preferred Koala Habitat). The total area of each land use zone is given at the top of the table. Note: Quantitative figures can not be provided in relation to overlap with Habitat Buffer areas as the width of these is determined on a case by case basis.

Koala Habitat Category	Land Use Zones							
	Rural Small Holdings 1c (< 1ha)		Residential 2 (74ha)		Business 3 (4ha)		Industrial 4 (10ha)	
	Area (ha)	% of zone	Area (ha)	% of zone	Area (ha)	% of zone	Area (ha)	% of zone
Preferred KH	0	0	6	8	0	0	0	0
Supplementary KH	0	0	0	0	0	0	0	0
Habitat Linking Areas	0	0	< 1	< 1	0	0	< 1	8
TOTAL	0	0	7	7	0	0	< 1	8

Strengths

Existing Koala Habitat

Preferred Koala Habitat (PKH)

- Preferred Koala Habitat (PKH) covers 5% of the KMU. One of the largest areas of PKH within the KMU is located between the northern extent of Grahamstown Dam and the Pacific Highway in the area of Balickera Canal.
- Other substantial areas of PKH occur to the west and south of Swan Bay; to the south of Karuah; east and north of Karuah; and to the north west of Karuah.
- A number of relatively small areas of PKH also occur within the KMU, mainly within or adjacent to Marginal Koala Habitat.

Supplementary Koala Habitat

- Supplementary Koala Habitat covers < 1% of the KMU, most of which occurs in conjunction with PKH to the west and south of Swan Bay.

Marginal Koala Habitat

- Marginal Koala Habitat covers 64% of the KMU in mainly contiguous areas which are predominantly zoned either Rural 1a or Rural 1f Forestry.

Unknown Koala Habitat

- Unknown Koala Habitat covers < 1% of the KMU (in a strip approximately 3km in length along either side of Twelve Mile Creek east from the Pacific Highway).

Habitat Linking Areas

- The majority of the Habitat Linking Areas overlap with Marginal Koala Habitat (48%), as opposed to 37% overlap with Mainly Cleared Land. The remainder of the Habitat Linking Areas occur over Supplementary Koala Habitat (5%) and Other Vegetation (9%).

Existing Land Use Zonings

Overlap with Environmental Protection Zones

- 12% of the KMU is zoned Environmental Protection 7c (Water Catchment Areas). This zoning overlaps with a substantial amount of PKH, and Habitat Linking Areas to the immediate north of Grahamstown Dam.
- 4% of the KMU is zoned Environmental Protection 7a (Wetlands), predominantly in coastal and estuarine areas to the southwest of Karuah, west of Swan Bay.

Overlap with other zones that are compatible with habitat conservation

- Several areas in the east of the KMU are zoned Recreation 6a Public Recreation. Two of these areas contain PKH, one to the immediate north of Karuah and the other to the west of Swan Bay.
- The vast majority of the KMU is zoned either Rural 1f (Forestry) or Rural 1a. While these zonings do not confer the level of protection of an Environmental Protection zoning, they do provide greater protection than Rural Small Holding Zones (especially 1c2, 1c3, 1c4 and 1c5) and Residential Zones.
- Approximately 500ha of land in the Little Swan Bay and Big Swan Bay area (currently zoned either Environmental Protection or Public Recreation) in the east of the KMU was gazetted in February 1999 as Worimi Nature Reserve. In terms of koala habitat, this area is mapped as mostly Other Vegetation, with a few hectares of PKH at Evens Point.
- Approximately 2300ha of land to the north of Karuah (currently zoned Rural 1f Forestry and formerly part of Karuah State Forest and Worimi State Forest), was gazetted in February 1999 as Karuah Nature Reserve. Only part of this area occurs within the Port Stephens LGA, in the far north of the Karuah/Ferodale KMU. In terms of koala habitat, the portion of Karuah Nature Reserve within the Port Stephens LGA is mapped as mostly containing Marginal Koala Habitat and Preferred Koala Habitat. The PKH occurs notably in Wallaroo Swamp and in an area near the Karuah River.

Other protection conferred under the EP&A Act

SEPP 14 Wetlands

Several SEPP 14 coastal wetlands have been designated within the Karuah/Ferodale KMU including wetlands in the following areas: Lizzies Creek in the far north (mostly mapped as Other Vegetation with one patch of PKH); north of Little Swan Bay (mostly mapped as Other Vegetation); Reedy Creek (mostly mapped as Other Vegetation but contains parts of two patches of PKH); Swan Bay (mostly mapped as Other Vegetation); and Twelve Mile Creek and Saltwater Creek (mapped as PKH, Supplementary Koala Habitat, Marginal Koala Habitat and Other Vegetation).

Known Koala Populations

The community-based survey recorded a significant number of koala sightings in this KMU (Figure 1, Chapter 2), including four sightings of a female with young (Figure 2, Chapter 2). The highest density of koala records within this KMU tended to be in the north. The koala records together with results of the field surveys (Phillips *et al.* 1996) indicated that the overall number of koalas in the KMU is likely to be quite low, with localised populations in a number of areas, particularly in association with patches of PKH.

Weaknesses

Existing Koala Habitat

Preferred Koala Habitat

- Only 5% of the total area of the KMU is Preferred Koala Habitat. Many of the areas of PKH are relatively small and geographically separated, often beyond the scope of identifying Habitat Linking Areas;

Supplementary Koala Habitat

- Less than 1% of Supplementary Koala Habitat occurs within the KMU.

Habitat Buffers

Ecological criteria have been established to determine the appropriate width of Habitat Buffers on a case by case basis. The potential effectiveness of such buffers may be limited where they are determined to overlap with Mainly Cleared Land.

Habitat Linking Areas

- 37% of Habitat Linking Areas in the KMU fall over Mainly Cleared Land.

Existing Land Use Zonings

- 31% of PKH within the KMU is zoned Rural 1a, while 18% of the PKH is zoned Rural 1f Forestry. As mentioned previously, such zonings confer some protection to koala habitat, but not to the same level as an Environmental Protection zoning.

Koala Population Status

- As mentioned previously, the evidence indicates that remaining koala populations within the KMU are localised and low density.

Opportunities

Habitat Conservation

Development standards and Assessment Criteria

These have been developed for the whole LGA and presented in chapters 4 and 5.

Land managed by Government Agencies

In light of the importance of protecting koala habitat where it occurs on public land, the following actions are recommended:

- Rezone public lands not zoned 7c containing Preferred Koala Habitat, Supplementary Koala Habitat, Habitat Buffer Areas and Habitat Linking Areas to Environmental Protection 7a, and
- Seek the agreement of relevant public authorities to manage their land for conservation of koala habitat

Investigation for Voluntary Conservation Agreements (VCAs), voluntary rezonings to Environmental Protection, or voluntary management agreements in conjunction with incentive-based measures to protect koala habitat:

The application of incentives-based conservation measures should be investigated in all instances where private landholders are willing to consider setting land aside for the conservation of koala habitat. In the case of this KMU emphasis should focus upon any PKH, Habitat Buffers (as defined by the ecological criteria) or Habitat Linking Areas not included within an Environmental Protection zoning. One area recommended for this approach includes the land east of the Pacific Highway, north east of Ringwood Road and north of Old Swan Bay Road where PKH, and Habitat Linking Areas have been identified over Rural 1a lands.

Habitat Restoration

Habitat restoration should be promoted for all areas within the KMU where Habitat Buffers (as defined by the ecological criteria) or Habitat Linking Areas occur over Mainly Cleared Land. This should involve planting *E. tereticornis*, *E. robusta*, *E. microcorys* and *E. propinqua* as appropriate, as well as fencing to exclude livestock.

Traffic Management

Undertake appropriate speed mediation, driver warning and education measures on the southern section of the Bucketts Way, the western section of Ringwood Road (approaching the intersection with the Pacific Highway) and Richardson Road near Finnan Park. Input should also be sort into ameliorative measures proposed in conjunction with upgrading of the Pacific Highway.

Domestic/Feral Dogs

Feral dog management on State Forests of NSW and National Parks and Wildlife Service lands within the KMU should be addressed in conjunction with the Port Stephens Vertebrate Pest Animal Management Committee.

Threats

Habitat Clearance

A substantial area of PKH to the immediate north of Grahamstown Dam is planned for inundation in conjunction with the proposed Grahamstown Dam augmentation project.

There is some potential for clearing of koala habitat for agricultural activities, although this can be regulated, for instance as part of the development assessment process (a DA would be required under Council's Tree preservation Order) and, for clearing of greater than 2ha, under the *Native Vegetation Conservation Act 1997*.

Rural 1f Forestry zoned land within the KMU may be subject to timber harvesting operations, mostly within lands managed by State Forests of NSW. The majority of these lands have been identified as Marginal Koala Habitat, although several relatively small patches of PKH and a few substantial patches of PKH do occur within State Forests.

Motor Vehicles

During the period from 1/1/94 to 26/3/98, the NATF record three koalas (all of which died) hit by motor vehicles on the Pacific Highway on the western boundary of this KMU. Two were hit where Balickera Canal runs under the highway and another at the intersection with Italia Road. This is discussed further in the SWOT for the adjoining Balickera KMU, together with ameliorative measures that have been proposed in conjunction with upgrading of the Highway.

The NATF records for the same period include three koalas killed on the Pacific Highway within 5km either side of Karuah, one at Swan Bay and a further three on Richardson Road, opposite Finnan Park.

The community-based koala survey recorded the following additional koala roadkills within the KMU: three koalas on the Pacific Highway opposite Grahamstown Dam; three in the area of the intersection of the Pacific Highway and Ringwood Road; one on the Pacific Highway midway between the Ringwood

Road turnoff and the Bucketts Way turnoff; two along the southern section of the Bucketts Way; a further two on the Pacific Highway between the Bucketts Way turnoff and Karuah; and two on the highway at Karuah.

Domestic/Feral Dogs

According to NATF records, there was one reported dog kill of a koala (1995) on the Grahamstown HWC land between 1/1/94 and 26/3/98. The potential for domestic dog attacks on koalas within the KMU should be addressed as part of an LGA-wide education program promoting responsible dog ownership.

SWOT Analysis #8: Fullerton Cove/Stockton Bight Koala Management Unit

Description

The Fullerton Cove/Stockton Bight Koala Management Unit (KMU) is located in the south of the Port Stephens LGA. It extends from the Hunter River just south of Heatherbrae to the Tomaree Peninsula (Figure A.15). It is bounded to the west by the Hunter River, to the south by the Hunter River, Fullerton Cove and the Pacific Ocean (along Stockton Bight), to the east by the Tomaree Peninsula KMU, and to the north by the Tomago Sandbeds KMU (delineated by Tomago and Cabbage Tree Roads and Nelson Bay Road between Williamtown and Salt Ash) and Tilligerry Creek and Port Stephens. It includes the urban area of Fern Bay, parts of the urban area of Tomago and the rural residential settlements of Bobs Farm, Williamtown (in part) and Salt Ash (in part).

Land use zoning in this KMU includes: agriculture (62% of the KMU; see Table A.29), water catchment areas (20%), public recreation (8%), coastal lands protection (2%) and future residential at Fern Bay (25%). Sand extraction is carried out on parts of the Stockton Bight sand dunes.

Table A.29. Area (in hectares) and proportion of total area of the management unit for each of the land use zones for the Fullerton Cove/Stockton Bight Koala Management Unit.

Land Use Zone	Area (ha)	Proportion (% of total area of management unit)
Rural 1a	4925	40
Rural 1g Flood Prone	2694	22
Residential 2a	14	<1
Residential 2d Future Residential	224	2
Industrial 4a General Industrial	85	1
Special Uses 5a	180	1
Special Uses 5c Arterial Roads	131	1
Recreation 6a Public Recreation	944	8
Recreation 6c Private Recreation	78	1
Environmental Protection 7a Wetlands	17	<1
Environmental Protection 7c Water Catchment Areas	2417	20
Environmental Protection 7f1 Coastal Lands Protection	244	2
Environmental Protection 7k Flora and Fauna Conservation	37	<1
Residual (not tagged – N/T)	353	3
TOTAL	12342	

Table A.30 shows the area of land within the Fullerton Cove/Stockton Bight Koala Management Unit covered by each koala habitat category, as well as the percentage of the total area of the KMU each of these categories comprise.

Table A.30. . Area (in hectares) and proportion of total area of each of the categories of koala habitat for the Fullerton Cove / Stockton Koala Management Unit. Also given is the proportion of the total area of Habitat Linking Areas constituted by each category of habitat linking area (e.g. Link over Other Vegetation). Note:

- Koala Habitat has been abbreviated to KH in the table.
- Quantitative figures can not be provided for Habitat Buffer areas as the width of these is determined on a case by case basis.

Habitat category	Area (ha)	Proportion (% of total area of KMU)		Habitat Linking Areas (% of area of all linking areas)
Preferred KH	282	2		-
Supplementary KH	3941	32		-
Marginal KH	0	0		-
Unknown KH Value	18	<1		-
Mainly Cleared	5871	48		-
Other Vegetation	1350	11		-
Link over Supplementary KH	25	<1		8
Link over Marginal KH	0	0		0
Link over Mainly Cleared Land	258	2		85
Link over Other Vegetation	22	<1		7
Link over Unknown KH Value	0	0		0
Residual (not tagged-N/T)	11	<1		-
TOTAL	12342			

Table A.31. Overlap between each of the following koala habitat categories: Preferred and Supplementary Koala Habitat and all Habitat Linking Areas and each land use zone in the Fullerton Cove / Stockton Koala Management Unit. Shown are the area (in hectares) of overlap between these koala habitat categories and land use zones as well as the percentage of the total area within each koala habitat category that each land use zone comprises. Refer to Table A.29 for an explanation of the land use zone codes. Note:

- Koala Habitat has been abbreviated to KH in the table.
- Quantitative figures can not be provided for Habitat Buffer areas as the width of these is determined on a case by case basis.

Land Use Zone	Koala Habitat Category							
	Preferred KH		Supplementary KH				Habitat Linking Areas	
	Area (ha)	% of hab. cat.	Area (ha)	% of hab. cat.			Area (ha)	% of hab. cat.
1a	207	74	1766	45			212	69
1g	17	6	141	4			40	13
2a	<1	<1	0	0			2	1
2d	<1	<1	205	5			10	3
4a	<1	<1	5	<1			10	3
5a	0	0	72	2			1	<1
5c	0	0	81	2			0	0
6a	17	6	5	<1			12	4
6c	32	12	0	0			4	1
7a	0	0	17	<1			0	0
7c	<1	<1	1540	39			1	<1
7f1	0	0	0	0			0	0
7k	<1	<1	30	1			2	1
N/T	7	3	77	2			13	4
Total	282		3941				305	

Table A.32. Overlap between each of four major land use zone groups: Rural Small Holdings 1c (1c1, 1c2, 1c3, 1c4 and 1c5), Residential 2 (2a, 2b, 2c1, 2c2, 2d, 2e), Business 3 (3a, 3b and 3d) and Industrial 4 (4a, 4b and 4c) which generally constitute the most intense land use zones, and Preferred Koala Habitat, Supplementary Koala Habitat and Habitat Linking Areas. Shown is the area (in hectares) of overlap as well as the percentage of the total area of the land use zones comprised by these categories of koala habitat (e.g. 1ha (or 1%) of the 237ha of land zoned Residential in this KMU overlaps with Preferred Koala Habitat). The total area of each land use zone is given at the top of the table. Note: Quantitative figures can not be provided in relation to overlap with Habitat Buffer areas as the width of these is determined on a case by case basis.

Koala Habitat Category	Land Use Zones							
	Rural Small Holdings 1c (0ha)		Residential 2 (237ha)		Business 3 (0ha)		Industrial 4 (85ha)	
	Area (ha)	% of zone	Area (ha)	% of zone	Area (ha)	% of zone	Area (ha)	% of zone
Preferred KH	-	-	1	<1	-	-	<1	<1
Supplementary KH	-	-	205	86	-	-	5	6
Habitat Linking Areas	-	-	11	5	-	-	10	12
TOTAL	-	-	217	91	-	-	15	17

Strengths

Existing Koala Habitat

Preferred Koala Habitat

- Preferred Koala Habitat (282ha in total) comprises 2% of the total area of the Fullerton Cove/Stockton Bight KMU.
- The largest patches of Preferred Koala Habitat in this KMU occurs in the east to the north of Bobs Farm.
- There are patches of Preferred Koala Habitat on the Newcastle Golf Course at Fern Bay, in the vicinity of Nelson Bay Road to the west of Fullerton Cove and to the west of Salt Ash.

Supplementary Koala Habitat

- Supplementary Koala Habitat (3941ha in total) comprises 32% of the total area of the Fullerton Cove/Stockton Bight KMU.
- There is a very large, contiguous patch of Supplementary Koala Habitat that extends along the Stockton Bight sand dunes from the Tomaree Peninsula west to a point to the east of Williamtown. Another large, contiguous patch of Supplementary Koala Habitat extends from this point south to Fern Bay.
- There is a patch of Supplementary Koala Habitat on Fenningham Island in the east of the KMU and scattered small patches of Supplementary Koala Habitat from Tomago to Bobs Farm.

Habitat Buffers

- Ecological criteria have been established to determine the appropriate width of Habitat Buffers on a case by case basis. Where such Habitat Buffers overlap with Supplementary Koala Habitat, they are likely to both protect patches of Preferred Koala Habitat from the detrimental impacts of edge effects and provide for the extension of koala activity beyond the boundary of Preferred Koala Habitat.
- Habitat Buffers aim to protect Preferred Koala Habitat from the detrimental impact of 'edge effects'. Where they are determined to overlap with Other Vegetation they could potentially fulfil this role.

Habitat Linking Areas

- About 8% of the Habitat Linking Areas in this KMU overlap with Supplementary Koala Habitat. This occurs particularly in the vicinity of Fern Bay and Salt Ash. Habitat Linking Areas that extend over such habitat are likely to facilitate the successful movement of koalas between patches of Preferred Koala Habitat.

Existing Land Use Zonings

Overlap with Environmental Protection Zones

- About 40% of the Supplementary Koala Habitat in this KMU overlaps with land zoned Environmental Protection. Almost all of this is Water Catchment Areas, which overlaps with large areas of the two large patches of Supplementary Koala Habitat that occur on the Stockton Bight sand dunes.

Overlap with other zones that are compatible with habitat conservation

- Land zoned Public Recreation 6a overlaps with Preferred Koala Habitat (6% of this habitat category; see Table A.31), and Habitat Linking Areas (4%). While this zoning aims to ensure that land is developed for open space recreation, and permits a range of development with the consent of council, it is still likely to afford greater protection to koala habitat than, for instance, land zoned Residential;
- Land zoned Private Recreation 6c (the Newcastle Golf Club at Fern Bay) overlaps with about 12% of the Preferred Koala Habitat in this KMU. While this land is in private ownership and aims to ensure land is developed for space recreation, and permits a range of development with the consent of council, it is still likely to afford greater protection to koala habitat than, for instance, land zoned Residential;
- About 80% of Preferred Koala Habitat, 49% of Supplementary Koala Habitat, and 82% of Habitat Linking Areas in this KMU overlaps with land zoned either Rural 1a or Rural 1g. These zonings could afford some protection to koala habitat inasmuch as they generally preclude subdivision to small lot sizes, for example for rural residential subdivision (cf. land zoned Rural Small Holdings; especially 1c3, 1c4 or 1c5).

Other protection conferred under the EP&A Act

SEPP 14 Wetlands

Some of the Preferred Koala Habitat in the east of this KMU overlaps with SEPP 14 Wetlands.

Known Koala Populations

Koala sightings obtained from the community survey and from the database of the Native Animal Trust Fund confirm that there is an extant koala population in this KMU. Moreover, these sources, on the basis of sightings and other records of females koalas with young, confirm the existence of breeding females in the Fullerton Cove/Stockton Bight KMU.

Likely Community Support

Community groups that are actively involved in koala conservation in the Fullerton Cove/Stockton Bight KMU include the Native Animal Trust Fund and the Hunter Koala Preservation Society. These groups are already involved in activities such as caring for injured koalas, community education, habitat conservation, habitat restoration, and monitoring (recording koala sightings and koalas killed or taken into care). The existence of such groups indicates that there is community support for koala conservation in this KMU.

Weaknesses

Existing Koala Habitat

Preferred Koala Habitat

- There has been substantial clearing of koala habitat in this KMU. Knott *et al.* (1998) report that much of the low lying land between Tomago and Tilligerry Creek had been drained and cleared by the start of the 1900's. It is likely that this resulted in the removal of large tracts of Preferred and Supplementary Koala Habitat.
- Many of the remaining patches of Preferred Koala Habitat in this KMU occur as small, generally isolated patches in a predominantly cleared land scape. This represents a sub-optimal situation for the safe movement of koalas between areas of Preferred Koala Habitat. Also, the small size and largely fragmented nature of these patches of Preferred Koala Habitat renders them vulnerable to edge effects.
- Some of the patches of Preferred Koala Habitat in this KMU occur adjacent or in close proximity to main roads such as Nelson Bay Road (which includes a noted koala black spot), Tomago Road and Cabbage Tree Road (both noted conflict areas).

Supplementary Koala Habitat

- The large patches of Supplementary Koala Habitat that occur along the Stockton Bight sand dunes are dissected by Nelson Bay Road, which carries large volumes of traffic.
- There are large transgressive sand dunes along the southern edges of the patches of Supplementary Koala Habitat on Stockton Bight. These dunes are moving slowly inland, burying vegetation (including Supplementary Koala Habitat) in their path. It was a blow out of this transgressive dune system that fragmented the Supplementary Koala Habitat along Stockton Bight.
- Areas of Supplementary Koala Habitat in the vicinity of the aforementioned blow out were mined by BHP Pty Ltd for mineral sands between 1985 and 1995. Revegetation works have been carried out on these mined areas.
- Substantial amounts of Supplementary Koala Habitat (potentially up to about 200ha) have already been (or are likely to be) cleared as part of a large residential subdivision to the north of Fern Bay. This subdivision, which was recently approved following an unsuccessful appeal to the Land and Environment Court, will comprise approximately ... lots over ... stages. Approximately 37ha of land (including some Preferred and Supplementary Koala Habitat) was zoned Environmental Protection 7k Flora and Fauna Conservation to compensate for this subdivision, although the majority of this land is located between the subdivision and Nelson Bay Road.

Mainly Cleared Land

- Almost half (approx. 48%) of this KMU is comprised of Mainly Cleared Land. While this includes extensive areas of beach and transgressive sand dunes along Stockton Bight, it also includes substantial areas between Tomago and Tilligerry Creek that probably constituted koala habitat and were cleared almost a century ago.

Habitat Buffers

- Ecological criteria have been established to determine the appropriate width of Habitat Buffers on a case by case basis. It is disadvantageous where these overlap with Mainly Cleared Land, for although koalas may use scattered trees occurring across cleared land, this is not an optimal situation, particularly where there are no trees. As a consequence, koalas are likely to be more vulnerable to attack by dogs or collision with motor vehicles. Furthermore, Habitat Buffers over Mainly Cleared Land are less likely to effectively protect Preferred Koala Habitat from the detrimental impacts of edge effects.

Habitat Linking Areas

- The vast majority (about 85%) of the Habitat Linking Areas in this KMU overlap with Mainly Cleared Land. Although koalas may use scattered trees occurring across cleared land, this is not an optimal situation, particularly where there are no trees. As a consequence, koalas are likely to be more vulnerable to attack by dogs or collision with motor vehicles.

Existing Zonings

- The vast majority (80%) of Preferred Koala Habitat in this KMU overlaps with land zoned Rural 1a or Rural 1g. While these land use zones are likely to afford more protection to koala habitat than zones such as Rural Small Holdings Zones (eg 1c3, 1c4, or 1c5) or Residential, they do not confer as much protection to koala habitat as an Environmental Protection zoning. In particular, mineral sand mining and sand extraction are permitted on land zoned Rural 1a and Rural 1g, whereas under the proposed Draft LEP 1999, such activities will not be permitted in the Environmental Protection 7a zone. However, the majority of land that is zoned Rural 1a or Rural 1g and overlaps with Preferred Koala Habitat may not have a high development potential due to other potential constraints such as flood prone land, SEPP 14 wetlands and acid sulphate soils;
- Approximately 6% of Preferred Koala Habitat in this KMU overlaps with land zoned Public Recreation and approximately 12% of Preferred Koala Habitat overlaps with Private Recreation. Again, while these land use zones are likely to afford more protection to koala habitat than zones such as Rural Small Holdings Zones (eg 1c3, 1c4, or 1c5) or Residential, they do not confer as much protection to koala habitat as an Environmental Protection zoning;
- Approximately 5% of Supplementary Koala Habitat in this KMU overlaps with land zoned Residential (the Fern Bay subdivision). The long term conservation of such patches of koala habitat and the koalas they support is endangered because of this situation. The small lot sizes and subsequently high density of housing in Residential zones inhibits (but does not completely preclude) the retention of existing trees and the growth or replanting of new trees. Added to this is the high level threat to koalas that inhabit such areas posed by dogs and motor vehicles.
- Almost half (49%) of the Supplementary Koala Habitat in this KMU overlaps with land zoned Rural 1a or Rural 1g. Mineral sand mining and sand extraction; activities which have in the past and, in the case of sand extraction, continue to impact on Supplementary Koala Habitat in this KMU, are permitted with Council consent under these land use zones.

- Almost all (about 91%) of the land in this KMU that is zoned Residential overlaps with either Preferred or Supplementary Koala Habitat, or Habitat Linking Areas (Table A.32). This applies mainly to the recently approved residential subdivision to the north of Fern Bay, which overlaps with about 205ha of Supplementary Koala Habitat. Approximately 17% of the land in this KMU that is zoned Industrial overlaps with either Preferred or Supplementary Koala Habitat, or Habitat Linking Areas (Table A.32). The development standards and assessment criteria for rezoning proposals and development applications outlined in chapters 4 and 5 of this CKPoM will apply to such land.

Opportunities

Habitat Conservation

Development Standards and Assessment Criteria

These have been developed for the whole LGA and are presented in Chapters 4 and 5. It is essential that these standards be applied to protect koala habitat throughout the this KMU.

Incentives-based conservation measures

While the application of incentives-based conservation measures should be investigated in all instances where landholders are willing to consider setting land aside for the conservation of koala habitat, the following should be investigated in particular:

- Preferred Koala Habitat and (subject to a commitment from landholders to undertake restoration of koala habitat) associated Habitat Buffers (as defined by the ecological criteria) and Habitat Linking Areas over Mainly Cleared Land to the north of Bobs Farm; and
- Land that comprises part of the two large patches of Supplementary Koala Habitat that extend along the Stockton Bight sand dunes.

Land managed by State Government Agencies

In light of the importance of protecting koala habitat where it occurs on public land, the following actions are recommended:

- Rezone public lands not zoned 7c containing Preferred Koala Habitat, Supplementary Koala Habitat, Habitat Buffer Areas and Habitat Linking Areas to Environmental Protection 7a, and
- Seek the agreement of relevant public authorities to manage their land for conservation of koala habitat

Crown Land

There are substantial areas of Crown Land located in this KMU. This includes much of the Supplementary Koala Habitat along Stockton Bight. Crown Land is administered by the Department of Land and Water Conservation (DLWC). The procedure that may be undertaken for land assessments (as per the Crown Lands Act 1989) on areas of Vacant or Reserved Crown Land on the Tilligerry Peninsula that contain koala habitat should also be applied to such land in the Fullerton Cove/Stockton Bight KMU. Pending the outcome of this assessment, Crown Land which contains significant koala habitat could be reserved for Environmental Protection/Conservation. Following such reservation, private reserve trusts could be established to manage these areas.

National Parks Estate

The National Parks and Wildlife Service will continue to investigate the potential of Crown Land in this KMU for acquisition for as National Parks estate. This should include the proposed Stockton Bight National Park.

Hunter Water Corporation

In managing public land on Stockton Bight for water catchment purposes, the Hunter Water Corporation should continue to give due consideration to the conservation of koala habitat.

Habitat restoration

Areas in the Fullerton Cove/Stockton Bight KMU that should be targeted for habitat restoration projects include:

- Land to the north of Bobs Farm that overlaps with Habitat Buffers (as defined by the ecological criteria) or Habitat Linking Areas over Mainly Cleared Land;
- Other land in this KMU that is identified through the ecological criteria as Habitat Buffer or Habitat Linking Area over Mainly Cleared Land. This could include such areas located to the south of Williamtown and in the vicinity of Fern Bay; and
- Areas of Mainly Cleared Land located adjacent to the large patches of Supplementary Koala Habitat along Stockton Bight.

Community commitment

Future community education, koala monitoring and habitat restoration projects in this KMU should expand on the existing work being done by organisations such as the Native Animal Trust Fund and Hunter Koala Preservation Society, and projects should be planned in conjunction with these groups.

These groups should be approached for support and assistance with the habitat restoration projects outlined above as well as participation in the monitoring program outlined in chapter 17 of the CKPoM Resource Document.

Education

Existing education programs, such as brochures prepared by the Tilligerry Habitat Association and the Hunter Koala Preservation Society for elsewhere in the LGA, should be used as a starting point for educating the community about koala conservation. Other organisations, such as Tidy Towns committees, precinct committees and the NSW Farmers Association should also be approached to participate in education programs.

The Oakvale Wildlife Farm at Salt Ash should be approached to assist with education programs, for instance, by giving talks on koala conservation to park visitors.

Threats

Habitat Disturbance

Potential future development that could involve the clearing of koala habitat in this KMU includes:

- The residential subdivision at Fern Bay. Supplementary Koala Habitat on this site has already been cleared to construct roads and further removal such habitat will occur.
- The proposed upgrading of Nelson Bay Road in the vicinity of Bobs Farm. This development is likely to result in the removal of some koala habitat along the existing route.

Motor vehicles

Two stretches of Nelson Bay Road that abut this KMU have been identified as koala black spots on the basis of records provided to the Native Animal Trust Fund for the period 1/1/94 to 26/3/98. Eight koalas (five of which died) were hit along Nelson Bay Road in the vicinity of Oakvale/Salt Ash during this period. The other black spot is Nelson Bay Road in the vicinity of Williamtown, where five koalas were hit, three of which died as a result. Tomago Road and Cabbage Tree Road, both of which are noted conflict areas where koalas have been reported hit by cars, comprise part of the northern boundary of the Fullerton Cove/Stockton Bight KMU.

Feral/Domestic Dogs

At least one koala was reported to the NATF as being attacked (and subsequently killed) by a dog in this KMU between 1/1/94 and 26/3/98. A substantial number of koalas were reported attacked by dogs in the vicinity of Tomago, Williamtown and Salt Ash. While it is not possible to confirm that these attacks occurred within the Fullerton Cove/Stockton Bight KMU it serves to indicate that dogs pose a significant threat to koalas in this KMU.

Bushfires

The Supplementary Koala Habitat along the sand dunes of Stockton Bight is a noted bushfire hazard, where there have been a number of extensive bushfires in recent years. Koalas occupying this habitat are therefore likely to be placed at risk.

SWOT Analysis #9: Western Koala Management Unit

Description

The Western Koala Management Unit (KMU) is found in the western part of the Port Stephens LGA. It is bounded in the east by the Williams River, in the north and west by the Dungog LGA (with the Patterson River representing the western boundary), and to the south by the City of Maitland. It contains the villages of Seaham, Hinton and Wallalong.

Agriculture is the main land use in this KMU (94% of the total area is zoned either Rural 1a or Rural 1g; Table A.33). Rural Small Holdings, Villages and Public Recreation each comprise approximately 1% of the KMU, and there are small areas used for forestry (Uffington State Forest in the north of the KMU) and, near Seaham, Environmental Protection.

Table A.33. Area (in hectares) and proportion of total area of the management unit for each of the land use zones for the Western Koala Management Unit.

Land Use Zone	Area (ha)	Proportion (% of total area of management unit)
Rural 1a	10961	61
Rural 1c2 Small Holdings	23	<1
Rural 1c3 Small Holdings	160	1
Rural 1f Forestry	80	<1
Rural 1g Flood Prone	5976	33
Residential 2e Village	143	1
Special Uses 5a	7	<1
Recreation 6a Public Recreation	107	1
Environmental Protection 7a Wetlands	15	<1
Environmental Protection 7c Water Catchment Areas	8	<1
Environmental Protection 7j Scientific Site	9	<1
Residual (not tagged – N/T)	608	3
TOTAL	18096	

Table A.34 shows the area of land within the Western Koala Management Unit covered by each koala habitat category, as well as the percentage of the total area of the KMU each of these categories comprise.

Table A.34. . Area (in hectares) and proportion of total area of each of the categories of koala habitat for the Western Koala Management Unit. Also given is the proportion of the total area of Habitat Linking Areas constituted by each category of habitat linking area (e.g. Link over Other Vegetation). Note:

- Koala Habitat has been abbreviated to KH in the table.
- Quantitative figures can not be provided for Habitat Buffer areas as the width of these is determined on a case by case basis.

Habitat category	Area (ha)	Proportion (% of total area of locality)		Habitat Linking Areas (% of area of all linking areas)
Preferred KH	559	3		-
Supplementary KH	0	0		-
Marginal KH	4745	26		-
Unknown KH Value	55	<1		-
Mainly Cleared	10235	57		-
Other Vegetation	77	<1		-
Link over Supplementary KH	0	0		0
Link over Marginal KH	336	2		37
Link over Mainly Cleared Land	570	3		63
Link over Other Vegetation	1	<1		<1
Link over Unknown KH Value	0	0		0
Residual (not tagged-N/T)	11	<1		-
TOTAL	18096			

Table A.35. Overlap between each of the following koala habitat categories: Preferred and Supplementary Koala Habitat and all Habitat Linking Areas and each land use zone in the Western Koala Management Unit. Shown are the area (in hectares) of overlap between these koala habitat categories and land use zones as well as the percentage of the total area within each koala habitat category that each land use zone comprises. Refer to Table A.33 for an explanation of the land use zone codes. Note:

- Koala Habitat has been abbreviated to KH in the table.
- Quantitative figures can not be provided for Habitat Buffer areas as the width of these is determined on a case by case basis.

Land Use Zone	Koala Habitat Category							
	<i>Preferred KH</i>		<i>Supplementary KH</i>				<i>Habitat Linking Areas</i>	
	Area (ha)	% of hab. cat.	Area (ha)	% of hab. cat.			Area (ha)	% of hab. cat.
1a	222	40	-	-			588	65
1c2	<1	<1	-	-			9	1
1c3	4	1	-	-			<1	<1
1f	4	1	-	-			12	1
1g	146	26	-	-			250	28
2e	2	<1	-	-			4	<1
5a	0	0	-	-			0	0
6a	30	5	-	-			6	1
7a	2	<1	-	-			2	<1
7c	4	1	-	-			<1	<1
7j	0	0	-	-			1	<1
N/T	145	26	-	-			36	4
TOTAL	559		0	0			907	

Table 4. Overlap between each of four major land use zone groups: Rural Small Holdings 1c (1c1, 1c2, 1c3, 1c4 and 1c5), Residential 2 (2a, 2b, 2c1, 2c2, 2 d, 2e), Business 3 (3a, 3b and 3d) and Industrial 4 (4a, 4b and 4c)

which generally constitute the most intense land use zones, and Preferred Koala Habitat, Supplementary Koala Habitat and Habitat Linking Areas. Shown is the area (in hectares) of overlap as well as the percentage of the total area of the land use zones comprised by these categories of koala habitat (e.g. 2ha (or 1%) of the 143ha of land zoned Residential in this KMU overlaps with Preferred Koala Habitat). The total area of each land use zone is given at the top of the table. Note: Quantitative figures can not be provided in relation to overlap with Habitat Buffer areas as the width of these is determined on a case by case basis.

Koala Habitat Category	Land Use Zones							
	Rural Small Holdings 1c (183ha)		Residential 2 (143ha)		Business 3 (0ha)		Industrial 4 (0ha)	
	Area (ha)	% of zone	Area (ha)	% of zone	Area (ha)	% of zone	Area (ha)	% of zone
Preferred KH	4	2	2	1	-	-	-	-
Supplementary KH								
Habitat Linking Areas	9	5	4	3	-	-	-	-
TOTAL	13	7	6	4	-	-	-	-

Strengths

Existing Koala Habitat

Preferred Koala Habitat

- The largest patches of Preferred Koala Habitat in this KMU are located to the south of Seaham and include patches that occur on low lying, swampy areas.
- There are small scattered patches of Preferred Koala Habitat along the Williams River floodplain. There is also a thin strip of Preferred Koala Habitat along the banks of the Williams, Hunter and Patterson Rivers and strips of Preferred Koala Habitat along the network of watercourses that run off of the hills in the central and northern parts of the KMU.

Marginal Koala Habitat

- Marginal Koala Habitat covers approximately 26% of the Western KMU.
- Very large contiguous areas of Marginal Koala Habitat are found on the hills in the northern and central parts of this KMU.
- Smaller patches of Marginal Koala Habitat, which are often surrounded by cleared land, occur on hills and ridges in the northern, central and western parts of the KMU.

Mainly Cleared

- While large tracts of Mainly Cleared land occur along the alluvial flats and associated low lying areas of the Williams, Hunter and Patterson Rivers, there has been less clearing of the vegetation on the hills in the northern and central parts of the KMU.

Habitat Linking Areas

- Approximately 37% of the total area of the Habitat Linking Areas in this KMU overlap with Marginal Koala Habitat. These also occur predominantly in the northern and central parts of the KMU. These Habitat Linking Areas are likely to adequately facilitate the movement of koalas between areas of Preferred Koala Habitat.

Existing Land Use Zonings

Overlap with Environmental Protection Zones

- See Weaknesses

Overlap with other zones that are compatible with habitat conservation

- About 5% of the Preferred Koala Habitat in this KMU overlaps with land zoned Recreation 6a Public Recreation. This occurs mainly along the banks of the Williams and Hunter Rivers where there are strips of land zoned thus. This zoning aims to ensure that land is developed for open space recreation, and although it permits a range of development with the consent of council it is still likely to afford greater protection to koala habitat than for instance, residential zonings;
- The vast majority (94%) of the KMU is zoned Rural 1a or Rural 1g Flood Prone. About 40% of the Preferred Koala Habitat in this KMU overlaps with Rural 1a and another 26% overlaps with Rural 1g (Table A.35). While such a zoning does not confer as much protection as an Environmental Protection zoning, it does offer a higher level of protection than Rural Small Holding Zones (especially 1c2, 1c3, 1c4 and 1c5) and Residential zones. In particular, rural residential subdivision is generally not permitted within the Rural 1g zone. However, a limited amount of subdivision is permitted in the Rural 1a zone on land west of the Williams River. Clause 13 of the Port Stephens LEP 1987 permits the creation of one extra lot (of a minimum size of 0.4ha) for every 10ha of land in a given lot (which much be greater than 20ha in area). Any residual land (i.e. the land other than the small lots) must be consolidated into a single lot that cannot be subdivided further.

Other protection conferred under the EP&A Act

SEPP 14 Wetlands

State Environmental Planning Policy No. 14 - Coastal Wetlands aims “to ensure that the coastal wetlands are preserved and protected in the environmental and economic interests of the State”. This policy applies to land that has been mapped as coastal wetland for the purposes of this SEPP. In respect to such land, a person cannot: clear the land; construct a levee on that land; drain that land; or fill that land, except with the consent of council and the concurrence of the Director of Urban Affairs and Planning. Development proposed for such land is considered to be designated development, which requires an Environmental Impact Statement. In deciding whether to grant concurrence, the Director of Urban Affairs and Planning should consider, among other things: the effect of the proposed development on the growth of native plant communities, the survival of native wildlife populations, and the provision and quality of habitats for both indigenous and migratory species, as well as any representations made by the Director of National Parks and Wildlife. Hence, the potential impact of any proposed development on koalas or koala habitat in areas designated as coastal wetlands would need to be formally taken into account under SEPP 14.

SEPP 14 Wetlands overlap with some Preferred Koala Habitat along Seaham Road to the south of Seaham.

Known Koala Populations

The community-based survey recorded only a few scattered koala sightings in this KMU (Figure 2.1 of the CKPoM Resource Document), none of which were of a female with young (Figure 2.2). The fact

that there has only been intermittent sightings of koalas in this KMU suggests that there may be low numbers of koalas in this area. Such a conclusion is substantiated by the results of the field surveys conducted in this area (Phillips *et al.* 1996), as well as historical work which has indicated that the koala populations along the Hunter and Williams Rivers have been drastically reduced since European settlement (Knott *et al.* 1998).

However, based on interviews with long term residents and review of historical records, together with the reconstruction of the pre-European vegetation interpreted in the context of the known tree species preferences of koalas in the Port Stephens LGA, Knott *et al.* (1998) demonstrated the historical importance of the flood plains along the Hunter and Williams Rivers to koalas. These flood plains were once covered by a mosaic of vegetation communities, including Shrubby Tall Open Forest and Open Swamp Forest that would have contained preferred koala food trees, such as *Eucalyptus tereticornis* and *E. robusta*. Historical records and interviews note that koalas were plentiful in forests on the flood plains of the Hunter and Williams Rivers (Knott *et al.* 1998).

Hence, while existing koala habitat in the Western KMU may be largely unoccupied by koalas at present, it has the potential to again support stable koala populations, provided there is effective abatement of any threats (both past and present) to koalas. The most obvious of the threats that needs to be addressed is the habitat destruction and consequent habitat fragmentation that occurred by the late 1800's (Knott *et al.* 1998). Therefore, restoration of koala habitat along the Williams River and associated flood plains, along with effective management of traffic and dogs, may permit the re-establishment of koala populations in these formerly very important areas.

Likely Community Support

One organisation in the Balickera KMU that is undertaking projects compatible with koala conservation is the Williams River-Care Association. This organisation has undertaken revegetation projects in the riparian zone of the Williams River in the north of the KMU and has fenced off sections of the river bank to protect vegetation from livestock. Many of the local farmers in the area, including those on hobby farms, are also revegetating parts of their properties. The Clarencetown Landcare Group also undertakes projects in the northern parts of this KMU. Given that protection of existing koala habitat and restoration of previously cleared koala habitat are the two most important actions to be undertaken in this KMU, there is likely to be support from organisations and individuals already undertaking such actions.

Weaknesses

Existing Koala Habitat

Preferred Koala Habitat

- Only 3% of the total area of the Western KMU is Preferred Koala Habitat;
- There has been extensive clearing of vegetation on the alluvial flats of the Williams, Hunter and Patterson Rivers since European settlement in the area (Knott *et al.* 1998), which most likely included large areas of Preferred Koala Habitat. The Preferred Koala Habitat that remains in the Western KMU, particularly along the these river floodplains, is extremely fragmented;
- The fact that the Preferred Koala Habitat in this KMU generally occurs as fragments in a matrix of cleared land represents a sub-optimal situation for the safe movement of koalas between areas of Preferred Koala Habitat. Also, the small size and largely fragmented nature of these patches of Preferred Koala Habitat renders them vulnerable to edge effects.

Supplementary Koala Habitat

There is no Supplementary Koala Habitat within the Western KMU.

Mainly Cleared

- Mainly Cleared Land represents 57% of this KMU.
- The Mainly Cleared land occurs throughout this KMU, with the main exception being the hills in the north and centre of the KMU. Most of this land along the river floodplains has been cleared by the mid to late 1800s (Knott *et al.* 1998).
- The fact that the vegetation along the floodplains has been cleared to a far greater extent than the vegetation on the hills in the northern and central areas of this KMU, has meant that habitat of lesser value to koalas has been retained while much of the Preferred Koala Habitat has been lost.

Habitat Buffers

- Ecological criteria have been established to determine the appropriate width of Habitat Buffers on a case by case basis. Where such Habitat Buffers in the Western KMU fall over Mainly Cleared Land, they are less likely to fulfil their joint function of protecting the adjacent Preferred Koala Habitat from deleterious “edge effects” and providing for the likely extension of significant koala activity beyond the boundary of the Preferred Koala Habitat.

Habitat Linking Areas

- With the majority (63%) of the Habitat Linking Areas in this KMU falling over Mainly Cleared Land, the safe movement of koalas between patches of Preferred Koala Habitat is jeopardised, particular if there are few trees remaining in such areas. For although koalas can move considerable distances on the ground between trees, doing so makes them more vulnerable to injury from dogs or collision with motor vehicles and can deplete their reserves of energy, causing them nutrient stress (Hume 1990).

Existing Land Use Zonings

- The vast majority (94%) of the land in the Western KMU (including the majority (66%) of Preferred Koala Habitat) is currently zoned Rural 1a or Rural 1g (Table A.35). As mentioned previously, such zonings confer some protection to koala habitat (by generally precluding subdivision to smaller lot sizes, e.g. rural residential subdivisions – although some limited subdivisions is permitted in the Rural 1a zone west of the Williams River), but not to the same level as an Environmental Protection zoning. However, in addressing this as a weakness, consideration needs to be given to the need for the additional protection that an Environmental Protection zoning would confer. While it is difficult to predict the behaviour of individual land holders, it seems likely that there will be little future clearing of Preferred Koala Habitat in the Western KMU, particularly on the floodplains. Rather, the trend is for revegetation of previously cleared land. It will still be necessary however, to regulate development that could impact Preferred Koala Habitat, Habitat Buffers (as defined by the ecological criteria) or Habitat Linking Areas.

Koala Population Status

- As mentioned previously, there are very few koalas left in the Western KMU. While it will require considerable efforts over the long term to facilitate the re-establishment of stable koala populations in this area, given the past importance to koalas of the flood plains of the Williams, Hunter and Patterson Rivers, this is considered to be worth the effort. In particular, this will require a commitment by the local community to not only protect existing koala habitat over the long term, but also to undertake restoration of the large tracts of koala habitat cleared last century. If existing koala habitat is protected and cleared habitat effectively restored, and potential threats such as motor vehicles and dogs effectively abated, serious consideration should be given to investigating the potential for

active management to either augment existing or establish new koala populations in this area.

Opportunities

Habitat Conservation

Development standards and Assessment Criteria

These have been developed for the whole LGA and presented in chapters 4 and 5. They must be applied rigorously to land in the Western KMU, particularly in relation to proposals that seek to intensify land use over areas containing Preferred Koala Habitat, Habitat Buffers (as defined by the ecological criteria) and Habitat Linking Areas.

Incentives-based conservation measures

While the application of incentives-based conservation measures should be investigated in all instances where landholders are willing to consider setting land aside for the conservation of koala habitat, the following should be investigated in particular:

- The large patches of Preferred Koala Habitat to the south of Seaham;
- Patches of Preferred Koala Habitat and associated Habitat Buffers (as determined by the ecological criteria) and Habitat Linking Areas (including those over Mainly Cleared Land, provided there is a commitment from landholders to revegetate) along the Williams River floodplain; and
- Preferred Koala Habitat and associated Habitat Buffers (as defined by the ecological criteria) and Habitat Linking Areas to the west of Seaham.

Habitat restoration

Because large areas of koala habitat were removed in the past and the remaining koala habitat is highly fragmented, restoration of koala habitat is an essential component of the koala conservation strategy for the Western KMU. As mentioned elsewhere, it is appropriate that habitat restoration projects be linked into the existing Landcare and River-Care network. The following represents the priorities (from highest to lowest) for the restoration of koala habitat in the Western KMU:

1. Enhance existing Preferred Koala Habitat along the Williams River flood plain and adjacent low lying areas. This should include supplementary planting of preferred koala food trees, such as *E. tereticornis* and *E. robusta* where appropriate, as well as fencing to exclude livestock to protect such plantings and to facilitate natural regeneration. The objective is to increase the density of preferred koala food trees within remnant Preferred Koala Habitat and to ensure the long term existence of such species in these remnants;
2. Restore koala habitat on land identified through the ecological criteria as Habitat Buffer over Mainly Cleared Land or Habitat Linking Area over Mainly Cleared Land along the Williams River flood plain and adjacent low lying areas. Again this should involve planting *E. tereticornis* or *E. robusta* where appropriate, as well as fencing to exclude livestock;
3. Restore koala habitat on land identified through the ecological criteria as Buffer over Mainly Cleared Land or Linking Area over Mainly Cleared Land in the vicinity of the Preferred Koala Habitat along drainage lines in the hills in the north and centre of the KMU. This should include planting of *E. tereticornis* as well as appropriate mixes of species found in nearby forest;

4. Enhance existing Preferred Koala Habitat and restore koala habitat in the associated Habitat Buffers (as defined by the ecological criteria) and Habitat Linking Areas over Mainly Cleared land along the Hunter and Patterson River floodplains. This should also involve planting *E. tereticornis* or *E. robusta* where appropriate, as well as fencing to exclude livestock; and
5. Restore (as much as possible) koala habitat on land identified as Mainly Cleared along the Williams River flood plain and adjacent low lying areas, in the first instance, followed by similar areas along the Hunter and Patterson Rivers. Ultimately, this should be linked with the network of koala habitat restored in accordance with the priorities outlined above.

Community support

The existing River-Care/Landcare network should be used as the basis for enlisting community support in the Western KMU. This will involve co-operation with the Hunter Catchment Management Trust, the Williams River Catchment Management Committee (CMC), and the Williams River-Care Association. The Hunter Catchment Management Trust should be briefed on the outcomes of the CKPoM and approached to assist with the integration of these outcomes into natural resource management in the catchment. The Williams River CMC is a subcommittee of the Hunter Catchment Management Trust and has the role of overseeing and co-ordinating activities in the catchment that involve natural resource management, including Landcare and River-Care activities. The Williams River CMC has a Remnant Vegetation Working Group, which has representatives from Landcare and River-Care groups, Port Stephens Council, Dungog Shire Council, and the Department of Land and Water Conservation. This Working Group would be an appropriate forum in which to discuss means of linking the outcomes of this CKPoM into the Landcare network of the Williams River catchment. Hence, it is recommended that the Working Group be briefed on the outcomes of the CKPoM, particularly those recommendations which relate to this catchment.

There is also value in linking the proposed habitat restoration projects with any activities carried out under the auspices of the “Farming for the Future” or similar programs.

Education

Education of land holders in this KMU should be an extension of the already existing River-Care/Landcare network in this KMU. Members of River-Care Associations and Landcare Groups, along with individual land holders that are protecting remnant vegetation and/or are undertaking revegetation works should be briefed on how to tailor their activities to further contribute to the conservation of koala habitat. This would include information on what trees to plant (the preferred koala food trees *E. tereticornis* and *E. robusta* are obvious candidates for flood plain planting), how to protect and enhance existing koala habitat and how best to link these patches to form an interconnecting network of koala habitat. The Hunter Catchment Management Trust and Williams River Catchment Management Committee should be approached to facilitate contact with such organisations and individuals and to integrate the activities in the Western KMU with those elsewhere in the Hunter and Williams River catchments.

Threats

Habitat Clearance

Much of the land along the Hunter and Williams River flood plains was cleared by the late 1800's, which led to localised extinction of koala populations within 50 years (Knott *et al.* 1998). While it is likely that there has been relatively little clearance of koala habitat in this area since, it must be recognised that this past clearing still poses a threat to the small number of koalas that still exist in the Western KMU. The current situation of small, highly fragmented patches of koala habitat along the Hunter and Williams Rivers effectively precludes the re-establishment of stable koala populations in this area. Furthermore, the fragmented nature of the remaining koala habitat threatens its long term future, due to the likely detrimental impact of edge effects on such remnants. In fact, many of these remnants are degraded and there is often little natural regeneration. Thus, it is likely that, in the absence of appropriate management, the existing trees will die and will not be replaced by younger trees.

Given that there has been a number of rural residential subdivisions recently created in this KMU, it is possible that there may be clearing of Preferred Koala Habitat in the future. This should be addressed by the rigorous application of development standards and assessment criteria aimed at protecting koala habitat. There is also some potential for clearing of koala habitat for agricultural activities, although this can be regulated, for instance as part of the development assessment process (a DA would be required under Council's Tree preservation Order) and, for clearing of greater than 2ha, under the *Native Vegetation Conservation Act 1997*. It should also be noted that parts of the Western KMU are currently being investigated for rural residential release as part of PSC's Beyond 2000 Settlement Strategy. However, it is intended that there will be extensive consultation between the PSC staff preparing the Beyond 2000 strategy and the staff preparing the CKPoM (including the AKF Field Biologist) to incorporate the principles of the latter into the outcomes of the former.

The widespread clearance of koala habitat in the Western KMU in the past continues to pose a threat to the future viability of such habitat and the small numbers of koalas it may support. Until such time as the existing koala habitat has been enhanced and previously cleared habitat restored (see Opportunities-Habitat restoration) this will continue to be the case.

Motor Vehicles

During the period from 1/1/94 to 26/3/98, the NATF record three koalas (two of which died) were hit by motor vehicles on roads in the Western KMU. All these collisions occurred in the vicinity of Glen Oak in the north east of the KMU. The two fatalities were a female koala and her pouch young. That so few koalas have been reported hit by cars in this KMU is probably due in part to the fact that there are likely to be few koalas in this KMU and so they are less likely to be encountered.

Some roads in this KMU, such as Seaham Road and Nelson Plains Road abut patches of Preferred Koala Habitat. The possibility of a collision between motor vehicles and koalas along such roads will increase in the future if habitat restoration works are successful and the number of koalas in the KMU increase. To help ameliorate any future impact of traffic on koalas in this KMU, care should be taken to plan habitat restoration projects to reduce the likelihood of koalas being attracted to major roads such as Seaham Road and Nelson Plains Road. However, in some areas, for instance where Nelson Plains Road dissects Preferred Koala Habitat to the south of Seaham, there may be little scope for flexibility in planning restoration activities. In such cases there will probably be a need for other measures that reduce the likelihood of koalas being hit (e.g. slowing vehicle speeds).

In any case, should the past trend of decline in koala populations in this KMU be reversed, there will be a need to implement measures to effectively abate the threat posed to koalas by motor vehicles.

Domestic/ Feral Dogs

According to NATF records, there were no reported dog attacks on koalas in the Western KMU between 1/1/94 and 26/3/98. However, as there are domestic dogs (including working farm dogs) in this KMU, there is the potential for attacks on koalas. This should be addressed as part of a LGA-wide education program promoting responsible dog ownership, which informs dog owners of their responsibilities as well as providing relevant information on how they can help reduce the likelihood of their dog attacking a koala. This will be much more important in the future, should the past decline in koala populations be reversed.

Shooting for the fur trade

While this is no longer a threat to koalas in the Port Stephens LGA, nor elsewhere in Australia, as the last open season on koalas was in 1927 (Phillips 1990), it is mentioned here because of its contribution to the localised extinction and reduction of koala populations in the west of the LGA (Knott *et al.* in press). Hunting of koalas for the fur trade was common in the LGA during the 1800's and early 1900's, when their numbers were plentiful (Knott *et al.* in press). The consequences of this, in conjunction with

the widespread destruction of habitat, are still evident in the low numbers of koalas found in this KMU today.

APPENDIX 4

Education Brochures

APPENDIX 6

AKF Spot Assessment Technique