Eton Range Realignment Project

ATTACHMENT 2 to EPBC Ref: 2015/7552 Preliminary Documentation Residual Impact Assessment and Offset Proposal

December 2015

Queensland Government

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Glossary

Term	Description
CQU	Central Queensland University
DAF	Department of Agriculture and Fisheries
DEHP	Department of Environment and Heritage Protection
DERM (former)	Department of Environment and Resource Management
DNRM	Department of Natural Resources and Mines
DoE	Department of the Environment
EMP(C)	Environment Management Plan (Construction)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
FMP	Fauna Management Plan (Koala)
FRW	Fauna Rescue Whitsunday
KSAT	Koala Spot Assessment Technique
MNES	Matters of National Environmental Significance
NC Act	*Nature Conservation Act 1992*
NRM	Department of Natural Resources and Mines
QPWS	Queensland Parks and Wildlife Service
RE	Regional Ecosystem
REF	Review of Environmental Factors
RFI	Request for Additional Information
SPRAT	Species Profile and Threats Database
TMR	Department of Transport and Main Roads
VMA	*Vegetation Management Act 1999*

1. Introduction

1.1 Purpose

This Residual Impact Assessment and Offset Proposal for the Koala has been prepared to respond to the request for additional information (RFI) issued by the Department of the Environment (DoE) for *Environmental Protection and Biodiversity Act 1999* (EPBC Act) referral 2015/7552. The residual impact assessment is based on the impact to the Koala following the implementation of mitigation measures included in the FMP. The offset proposal described in this report is proposed to counterbalance the residual impacts that remain after avoidance and mitigation measures. The proposal aims to provide conservation benefit and environmental value for the Koala, placing a particular focus on the regional context of the population of Koalas.

The 'Project area' in this Report is defined as the area within the resumption boundary that is required to accommodate the construction of two dual lane carriageways, split carriageways, and general road construction for 3.756 km of the 'Eton Range crossing' on the Peak Downs Highway between Mackay and Nebo.

1.2 Objectives

This Report:

- Identifies the anticipated residual impacts to Matters of National Environmental Significance (MNES), specifically the Koala (*Phascolarctos cinereus*), resulting from the construction and operation of the Eton Range Realignment Project – 'the Project'.
- Outlines the Department of Transport and Main Road's (TMR) commitment to provide offsets in accordance with the EPBC Act and the *EPBC Act Environmental Offsets Policy 2012* (the 'EPBC Act Offsets Policy'), in response to the residual impact generated as a result of construction and operation of the Project.
- Is to be read in conjunction with the Preliminary Documentation Main Report and the Fauna Management Plan - Koala (FMP), included as Attachment 1 to the Preliminary Documentation, which document the mitigation and management measures included in the assessment of residual impacts.

The EPBC Act Offsets Policy and Offsets Assessment Guide have been used to determine the offset requirements for the Project.

Error! Reference source not found. provides a summary of the structure of the Offsets Proposal, identifying where specific aspects of Item 1.1, 4.1, 4.2, 4.3, 4.4 and 4.5 of the RFI are addressed.

Table 1: RFI Requirements Specific to the Offset Proposal

Item no	Item requirement	Reference in the Offsets Proposal	Demonstration of how the Offsets Proposal addresses the item requirements in the RFI
1.1	**The preliminary documentation must provide:**		
(i)	Updated maps detailing areas of disturbance overlaid with known populations and habitat for Koala, including known movement corridors within and in the vicinity of the site.	Section 2.3	This report identifies known Koala movement corridors along the Eton – Nebo stretch of the Peak Downs Highway.

Item no	Item requirement	Reference in the Offsets Proposal	Demonstration of how the Offsets Proposal addresses the item requirements in the RFI
4	**Proposed Offsets**		
4.1	The preliminary documentation must include an assessment of the likelihood of residual impacts occurring, after mitigation and management measures relating to the project have been applied. Based on information provided in the referral, the Department considers that residual significant impacts to Koalas are likely. In the light of this, please provide an offset management plan or proposal to be implemented to compensate for the residual significant impacts on Koalas.	Entire document	The offset proposals have been developed to compensate for the residual significant impact of the Project on the Koala. The preferred option is the option that has been deemed to provide a greater conservation gain for the species.
4.2	The offset management plan/proposal must comply with the Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy (October 2012) and accompanying Offsets assessment guide, accessible from: www .environment.qov.au/epbc/publications/environmental-offsets-policy.html	Section 4.2 and 5.8	Compliance of the two offset proposals with the Offsets Policy is tabulated.
4.3	If you wish to propose indirect offsets instead of direct offsets you must address requirements at section 4.2.1 of the Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy. Discussions about the benefits of the proposed indirect offsets must consider the conservation advice for the Koala. You must also compare the anticipated cost (financial and other) of delivering the indirect offset(s) against the anticipated cost of delivering direct offsets.	Section 4 and 6	The added conservation gain of the hybrid offsets package has been discussed, including consideration of the relevant Conservation Advice. Anticipated costs of each proposal has been estimated.
4.4	Offsets should compensate for an impact for the full duration of the impact.	Entire document	Both offset proposals compensate for the full duration of the impact
4.5	Offsets must directly contribute to the ongoing viability of the Koala and deliver an overall conservation outcome that improves or maintains the viability of habitat for the Koala, as compared to what is likely to have occurred under the status quo, i.e., if neither the action nor the offset had taken place.	Section 6	An analysis of each option's ability to provide a conservation outcome for the Koala has been provided.

2. Residual Impact Assessment

2.1 Impact Area

The FMP identified that a total of 30.867 ha of potential Koala habitat will be impacted as a result of the Project. This is slightly reduced from the 31.192 ha included in the original EPBC Referral documentation.

It should be re-noted that approximately 12.728 ha of vegetation was previously removed for the Project. This was undertaken to accommodate survey, geotechnical works, access, and trial embankment works undertaken in 2014 and 2015. This trial area was subject to significant previous disturbance from the installation of Telstra and Ergon infrastructure, geotechnical investigations and survey. A Significant Impact Assessment for the Koala was carried out in December 2013 (EcoSM, 2013) which identified that the Project was unlikely to have a significant impact on any Matters of National Environmental Significance (MNES). Due the publication of the 'EPBC Act referral guidelines for the Vulnerable Koala' in late 2014, an additional environment assessment was conducted by TMR, and the decision was made to refer the Project for consideration.

These previously cleared areas have been included within the Project area described within this document. Further information is provided in Attachment 1 Fauna Management Plan – Koala (FMP).

2.2 Description of the Project

The Project area is composed of four (4) mapped Regional Ecosystems (REs), and non-remnant vegetation. All vegetation in the area provides suitable habitat for the Koala, except for the vine thicket community represented by RE 8.12.3. Refer to the Preliminary Documentation Main Report and the FMP for further information regarding the Project

2.3 Significant Impact Assessment

The potential impacts of the Project to the Koala were identified in the FMP to be as follows:

- Habitat removal and degradation;
- Habitat fragmentation and loss of connectivity;
- Disease and pathogens;
- Vehicle strike; and
- Predation by wild dogs.

The potential impacts have been assessed against the Significant Impact Criteria for Vulnerable species in accordance with *the Significant Impact Guidelines 1.1 - Matters of National Environmental Significance* to determine whether the impacts on matters of national environmental significance are likely to be significant. The outcome of this assessment, with reference to the proposed mitigation and management measures contained within the FMP, is provided in Table 2.

Table 2: Significant Impact Assessment of the Project on the Koala

EPBC Significant Impact Assessment - Criteria	Impacts of the Project on the Koala	Residual Impact to be addressed?
Lead to a long-term decrease in the size of an important population of a species?	The Project will result in the maximum removal of 30.867 ha of suitable Koala habitat along a 3.756 km stretch. Fragmentation has been minimised by designing the new road adjacent to the existing Peak Downs Highway to utilise existing disturbed areas. Habitat removal has been identified as an impact, with indirect impacts also noted. With the implementation of mitigation measures including Koala fencing, a fauna crossing and sequential clearing, and noting the availability of suitable existing habitat on the Eton Range, and the wider Clarke-Connors Ranges bioregion, the Project is not expected to cause a long-term decrease in the size of the existing population.	No
Reduce the area of occupancy of an important population?	The Project will directly reduce the area of occupancy of the Koala by 30.867 ha. The vegetation communities removed to facilitate the Project are mapped as 'Least Concern' and occur extensively throughout the Clarke-Connors Ranges sub-bioregion. It should also be noted that this vegetation exists directly adjacent to the existing Peak Downs Highway, which is a known threat to Koalas. Although the removal of 30.867 ha of habitat will reduce the area of occupancy within a contiguous habitat landscape of more than 600,000 ha by a very small percentage, it will still 'reduce' the area of occupancy of the population. The provision of offsets will be required to mitigate this residual impact.	Yes
Fragment an existing important population into two or more populations?	Original construction of the Peak Downs Highway fragmented the Eton Range habitat and created a potential barrier to movement. Construction of a split carriageway will further fragment the habitat and, depending on the success of the fauna under passage, may provide a further impediment to localised Koala movement. A potential north-south movement corridor has been identified approximately 10 km south-west of the Project on the Peak Downs Highway from historic Department of Environment and Heritage Protection (DEHP) and Central Queensland University (CQU) Koala sighting records (Figure 1). It is however unknown why this location is utilised as a crossing point by the local population. The important crossing points within the Project area are expected to be in the flatter sections of the Highway at the top of the range (CH 49,800 – 51,200 m), where Koala activity levels were highest. A fauna crossing has been incorporated into the design at this location to maintain connectivity at this location. In a regional context, and with consideration of the extent of suitable habitat on the Eton Range and the wider Clarke-Connors Ranges, while the Project will potentially exacerbate the current movement obstruction, it is not expected to fragment the population of Koalas that resides in the wider area. The provision of offsets will be required to mitigate this possible residual impact.	Possibly
Adversely affect habitat critical to the survival of a species?	The Project area has been identified as containing habitat critical to the survival of the Koala, in accordance with DoE's Koala Habitat Assessment Tool included in the FMP. The project will directly impact 30.867 ha of critical Koala habitat. Surveys undertaken within the Project impact area and within surrounding habitat show moderate and high Koala activity along the flatter parts of the study area and low and no activity along the steep slopes. It is expected that this is not unique to the area surveyed, but typical of the broader Eton Range, and Clarke-Connors Ranges sub-bioregion. It should also be noted that this vegetation exists directly adjacent to the existing Peak Downs Highway, which is a known threat to Koalas.	Yes

EPBC Significant Impact Assessment - Criteria	Impacts of the Project on the Koala	Residual Impact to be addressed?
	The provision of offsets will be required to mitigate this residual impact.	
Disrupt the breeding cycle of an important population?	The Koala breeding season is generally between September and March, with females giving birth to a single young between October and May. As described in the FMP, the construction phase of the project will be carried out in a way that minimises direct impacts to individuals. During the breeding season, males actively seek female Koalas and Koala movement is more extensive. An unmitigated Project could lead to an increase risk of vehicle strike. Traffic volume, speed and visibility influence the Koala collision rate. Prevett et al. (1995) found that road kills occurred where vehicle speeds exceeded 80km/hr and where wider habitat corridors or linear forests occurred on both sides of the road. It is noted that a large majority of the proposed road (Ch. 50,900 – 53,000 m northbound, Ch. 51,500 – 53,000 m southbound) will be restricted to 60km/hr due to the steep and winding nature of the alignment. The Project location is not a known corridor for movement along the Range. Figure 1 identifies a potential north-south movement corridor approximately 10 km south-west of the Project, which is more likely to be used as a crossing point for the Koala. The expected crossing points with the Project are expected to be in the flatter sections of the highway at the top of the range, where Koala activity levels were highest on either side of the existing highway. The Project is not expected to disrupt the breeding cycle of the existing population. Impacts of habitat fragmentation will be mitigated through the construction of a fauna crossing and furniture, while stress impacts will be managed through best practice sequential clearing, as detailed in the FMP.	No
Modify, destroy, remove or isolate, or decrease the availability or quality of habitat to the extent that the species is likely to decline?	The project will directly impact 30.867 ha of Koala habitat adjacent to the existing Peak Downs Highway, which accounts for only a small area of suitable habitat in the broader landscape. Although clearing will cause minor additional fragmentation of habitat on the Eton Range and reduce the area of available habitat, the extent of linear habitat disturbance is not likely to decrease the availability or quality of habitat available to the local population to the extent that the species will decline.	No
Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species habitat?	Invasive species, including feral animals such as the fox (*Vulpes vulpes*) and wild dog are likely to occur throughout the Eton Range, and Clarke - Connors Range sub-bioregion, including within and adjacent to the Project area These types of predatory species are drawn to areas of disturbance to prey upon mammals and reptiles that are moving away from the disturbance area, therefore, predation by feral animals is a risk to this species during and immediately after clearing activities. Predatory species are also attracted to the prey opportunities presented by cleared linear corridors, although it is recognised that in this location, the linear corridor is already present in the form of the existing Peak Downs Highway. There is potential for the spread of invasive weeds, such as Lantana, to occur during construction, degrading the habitat of the Koala through the suppression of sapling growth. The implementation of weed management measures during the construction and maintenance phase will minimise impact of weed species on Koala habitat quality of adjoining habitat areas. The Project is considered unlikely to result in any new invasive species becoming established in habitat areas adjacent to the impact area, as these invasive and predatory species are already established throughout the wider	No

EPBC Significant Impact Assessment - Criteria	Impacts of the Project on the Koala	Residual Impact to be addressed?
	landscape. There is evidence of wild dogs on the Eton Range, however given the location, no data regarding dog attacks is available.	
Introduce disease that may cause the species to decline?	Vegetation clearing and resultant stress have the potential to increase the expression of chlamydia in koalas, however the implementation of mitigation measures such as sequential clearing will reduce the risk of disease. The Project is not anticipated to introduce disease that may cause the species to decline.	No
Interfere substantially with the recovery of the species?	The implementation of a fauna crossing structure and Koala fencing, in addition to offsets, will remove the potential for the Project to interfere with the recovery of the Koala.	No

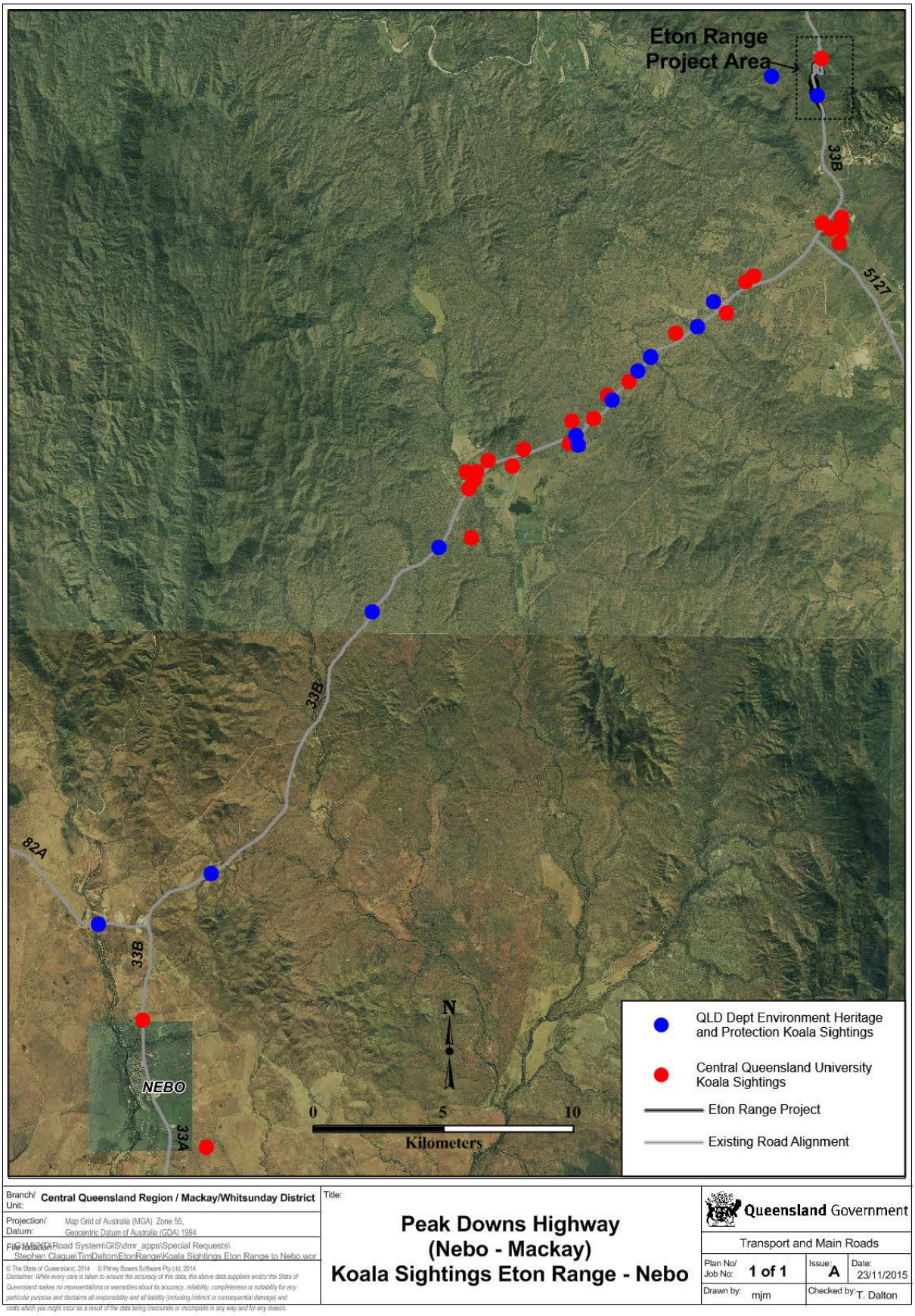


Figure 1: CQU/DEHP Koala Sightings along the Peak Downs Highway from Eton to Nebo (up to September 2015)

The FMP identified **habitat removal** and the potential of **further habitat fragmentation and a decrease in connectivity** as the residual risks of the Project. Table 2 identified the following residual impacts associated with the Project:

- Reducing the area of occupancy of an important population;
- Adversely affecting habitat critical to the survival of a species; and
- Further decreasing connectivity of habitat, potentially causing additional fragmentation of the existing Koala population.

As this impact cannot be completely mitigated through the measures defined in the FMP, offsets are proposed in accordance with the EPBC Act Offsets Policy.

3. Determining Offset Options

3.1 Development of Options

In determining the most suitable offset proposal for the Project, TMR has taken consideration of the residual impacts identified in Section 2 as well as a number of additional aspects, including the following:

- Availability of suitable data with regard to the existing habitat and population dynamics of the Koala within the Project impact area and immediate surrounding areas.
- Availability of suitable data with regard to existing threats to the Koala within the Project and immediate surrounding areas.
- The characteristics of the Project and immediate surrounding areas and its suitability for providing offsets for the ongoing protection of the Koala with respect to suitable habitat, existing land uses and tenure, and presence of existing linear road infrastructure.

Consideration of these aspects identified a number of factors to be considered in the development of the offsets proposal. These are outlined in Table 3 below.

Table 3: Aspects considered in development of the Project Offset Proposal Options

Aspect	Comments
Availability of suitable data with regard to the existing habitat and population dynamics of the Koala within and immediately adjacent to the Project.	• Data on the Koala within the vicinity of the Project impact area is limited to historic DEHP and CQU sighting/roadkill records (Figure 1) as well as the Project field investigation results. • The Clarke – Connors range population has been little studied apart from some preliminary audits near St Lawrence, Nebo and Collinsville. • There is no known data relating to the dynamics of the population. • There is very little known data relating to the size of the population. • Desktop and field verification of suitable habitat for the Koala was completed for the Project area. • The occurrence of Koalas within the vicinity of the Project area was initially identified during a Fauna Assessment undertaken in December 2013 (EcoSM, 2013). Direct visual sightings of the Koala were noted during the survey. • A subsequent Commonwealth listed threatened fauna species assessment was undertaken in July 2015 as per the newly introduced EPBC Act referral guidelines for the vulnerable Koala (SMEC, 2015). The study indicated low Koala activity levels along the steep slopes within the northern end of the project and medium – high activity levels at the southern lower grade end of the impact area.
Availability of suitable data with regard to existing threats to the Koala within the Project and immediate surrounding areas.	• There have been historical increases in mining traffic along the Peak Downs Highway due to the development of the Bowen Basin. • It is expected that the development of the Galilee Basin will result in significant future increases in mining traffic along the Peak Downs Highway. • Government agencies, local community groups and scientific bodies concur that roadkill along the Peak Downs Highway is a major threatening process to the continued existence of the Koala in the region. Considerable community sentiment now exists in the region around the issue. • Data on existing threats to the Koala within the vicinity of the Project area is limited to historic DEHP and CQU roadkill records along the Peak Downs Highway (Figure 1). These records identify that the majority of Koala sightings are further south along the Peak Downs Highway. • EcoSM (2013) identified the presence of wild dogs in the Project area. • SMEC (2015) identified that the presence of Lantana in and adjacent to the Project area has the potential to inhibit Koala access to the base of a tree.

Aspect	Comments
The characteristics of the Project and immediate surrounding areas and its suitability for providing offsets for the ongoing protection of the Koala with respect to suitable habitat, existing land uses and tenure, and presence of existing linear road infrastructure.	• Land use immediately adjacent to the Project is restricted to limited to cattle grazing and nature conservation. • The terrain and geology of the Clarke-Connors Range has largely precluded clearing for agriculture. • A substantial portion of the range lies within protected areas, including the adjacent Spencer's Gap State Forest and the nearby Ben Mohr State Forest. • The Clarke-Connors Range encompasses a huge area of approximately 631,980 hectares, most of which is remnant vegetation.

3.2 Offset Proposal Options

On the basis of the aspects outlined above, two offset options have been developed

- **Option 1** – A hybrid offset package comprising the following:
  - Part a – Funding a study by Koala Research CQ entitled 'Managing the Clarke Connors Range Koala Population' (refer to Appendix A).
  - Part b – A commitment towards funding the implementation of fauna sensitive design along the Peak Downs Highway as recommended by the study.
- **Option 2** – Implementation of a direct land offset.

Details of both options are provided in Sections 4 and 5 respectively.

4. Option 1 – Hybrid Offset Package

4.1 Details of Proposal

4.1.1 Part 1a – Study entitled 'Managing the Clarke Connors Range Koala Population'

As previously noted, the Clarke Connors Range encompasses a huge area of approximately 631,980 hectares, most of which is remnant vegetation. The dominant land use of the range is nature conservation and cattle grazing (DEHP, 2015b). A substantial part of the Clarke Connors Range lies within protected areas, State Forests or Leased Land. Notably these include Eungella and Homevale National Parks, and Spencer's Gap and Ben Mohr State Forests which are in close proximity to the Project. In addition, a number of smaller areas of freehold land have been gazetted as Nature Refuges via voluntary conservation agreements (Reef Catchments, 2015). The terrain and geology of the range has also largely precluded clearing for agriculture.

Following the Koala's recent listing of 'Vulnerable' in the entirety of the Queensland State, it is of the utmost importance for data to exist on the population within the Clarke Connors Range. The study proposes to determine population dynamics of the Clarke Connors Range Koala population through a number of discrete projects.

Although as not prevalent in the Project location, it is known that a significant number of Koalas fatalities occur further south along the Peak Downs Highway (Figure 1). This is an issue that has been heightened with the historic increases in mining traffic along the road and has led to considerable community interest. Understanding of local Koala movements on the stretch of the Peak Downs Highway between Eton and Nebo is low. The proposal will aim to provide valuable data for informed future investment in fauna sensitive road infrastructure along the Peak Downs Highway. It will also provide assistance in justifying any future funding allocations for this investment.

Specifically, the proposal seeks to increase knowledge of the Clarke-Connors Range Koala population, and facilitate improved conservation management for the species along the Peak Downs Highway, between Eton and Nebo. This will include:

1.0 Defining koala population management units across the Clarke-Connors Range;
2.0 Understanding koala habitat use, and diet, as well as ranging behaviour in the vicinity of the Eton to Nebo stretch of the Peak Downs Highway;
3.0 Habitat analysis and modelling to predict future koala-road kill hotspots on the Eton to Nebo stretch of the Peak Downs Highway; and
4.0 Investment planning for installation of wildlife barriers and underpasses on the Peak Downs Highway between Eton and Nebo.

The entire proposal can be viewed in Appendix A. TMR proposes to provide **$287,442** towards this section of the package.

4.1.2 Part 1b – Investment towards the implementation of Koala sensitive infrastructure along the Peak Downs Highway

While TMR considers that identifying areas where the Peak Downs Highway abuts Koala activity is essential for addressing knowledge gaps in the area, it also acknowledges the importance of timely implementation of the study's recommendations. Currently, wildlife signage has been installed along the stretch of Peak Down Highway between Eton and Nebo. It is expected that the study will provide recommendations for investment in the following additional wildlife protection and/or diversion infrastructure at identified Koala crossing points:

- Additional Koala road signage;
- Koala exclusion fencing; and
- Retrofitting of existing drainage structures with Koala underpasses.

This monetary commitment will ensure that a pool of funding (provided through the Project) is immediately available for the implementation of the study's recommendations. TMR proposes to provide **$200,000** towards this element of the package.

4.2 Compliance with EPBC Act Offsets Policy

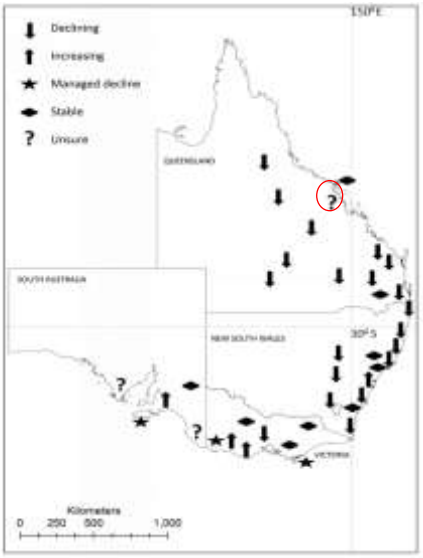
Section 4.2.1 of the EPBC Act Offsets Policy outlines that deviation from the 90% direct offset requirements will only be considered where:

- It can be demonstrated that a greater benefit to the protected matter is likely to be achieved through increasing the proportion of other compensatory measures in an offsets package, or
- Scientific uncertainty is so high that it isn't possible to determine a direct offset that is likely to benefit the protected matter.

Furthermore the study is required to comply with the criteria outlined in Appendix A of the EPBC Act Environmental Offsets Policy. Compliance with these criteria have been documented in Table 4 below.

Table 4: Compliance with Section 2.4.1 and Appendix A of the Environmental Offsets Policy

EPBC Offset Guideline Reference	Criteria	Details
Section 4.2.1	*It can be demonstrated that a greater benefit to the protected matter is likely to be achieved through increasing the proportion of other compensatory measures in an offsets package*	It was determined in the residual impact assessment that the residual threats posed to the Koala as a result of the Project are a reduction in the area of occupancy of an important population, effecting habitat critical to the survival of the species, and a decrease in connectivity of habitat potentially fragmenting the existing Koala population. The Clarke Connors Range encompasses a huge area of approximately 631,980 hectares, most of which is remnant vegetation. As previously described, most of this is in relatively secure land tenure and is not immediately threated by land clearing. It is therefore considered unlikely that the implementation of a small direct land offset will significantly benefit the local population of Koalas. Roadkill and reduced connectivity along the Peak Downs Highway is known to be a majority threatening process to viability of this population of Koalas. Fauna Rescue Whitsundays identified that of the 26 Koalas in their recent database, 11 (42%) were injured along the Peak Downs Highway (FRW, 2015). This confirms the impact that the existing highway has on the viability of the local Koala population. Considering the wider intact landscape of the Clarke – Connors Range, the hybrid package mentioned above is considered an appropriate approach to offset a significant threat to the local Koala population.
	Scientific uncertainty is so high that it isn't possible to determine a direct offset that is likely to benefit the protected matter. For example, this can be the case in some poorly understood ecosystems in the Commonwealth marine environment	As previously described, there are critical knowledge gaps around the density, dynamics, health, and conservation biology of the Koala population in the Clarke-Connors Range. This regional population has been little studied apart from some preliminary audits near St Lawrence and further west at Nebo and Collinsville. It is therefore difficult to provide an effective direct land offset when it is not known (a) the nature of the population, (b) the home range/movements of the population, and (c) the successfulness of Koalas crossings in the region. As identified by the Department of Environment on the Koala Species Profile and Threats database, the population range of Koalas in the Central Mackay Coast is relatively unknown and confidence in the 10,000 population estimate is low (DoE, 2015b). This is further demonstrated by McAlpine et al (2015) in Figure 2.

EPBC Offset Guideline Reference	Criteria	Details
		 **Figure 2: Estimated status of Australian Koala populations** (McAlpine et al, 2015)
Appendix A	(1) *The research program will improve the viability of the impacted protected matter*	As described in the 'Managing the Clarke Connors Range Koala Population' proposal (Appendix A), the data would help assist in firstly confirming the viability of the Clarke-Connors Range population, and will also provide scientifically robust data to inform decisions on future investment on fauna sensitive design on the Peak Downs Highway. Koala fatalities along the Highway not only cause disproportionate effects on the population, but also lead to community concern and distress. The commitment towards investment in Koala sensitive infrastructure in the identified high risk areas along the Peak Downs Highway will directly improve the viability of the population by helping to reduce a significant threat.
	(2) *The research program will be targeted toward key research education activities as identified in the relevant Commonwealth approved recovery plan, threat abatement plan, conservation advice, ecological character description, management plan or listing document.*	The EPBC 'Approved Conservation Advice for *Phascolarctos cinereus*' identifies a number of research priorities that the Commonwealth considers to contribute to effective management of the species. The following priorities included in the 'Approved Listing Advice (DoE, 2015b)' have been considered in the development of the study: • *Development and implementation of an integrated program of Koala population monitoring and abundance estimates across the Koala's range, **with particular focus on those regions for which population size and trends are currently least known**. Targeting regions where there were previous surveys but where there are no recent estimates will enable trends to be determined over a broader range of the species;* • *Develop landscape-scale population models, to provide a framework for the assessment of relative threat risk and management intervention cost-effectiveness.* • *Develop understanding of gene flow and landscape connectivity* • *Identify and delineate key populations; and* • *Maintain or enhance research programs directed at the assessment of the incidence and consequences to populations of Koala mortality or injury due to dogs and traffic, and of mechanisms to reduce the impacts of these threatening factors (DOE, 2015b).* The Koala was officially listed as Vulnerable under Queensland legislation in August 2015. It is likely the new listing of the Koala will eventuate in the development in a number of Recovery Plans and Management Strategies for State-wide introduction. Outputs of this study have the potential to assist in the development of such documentation.
	(3) *The research program will be undertaken in a transparent, scientifically robust and timely manner*	The study's methodology undertaken is described in 'Managing the Clarke Connors Range koala Population' (Appendix A). The methodology has been prepared to ensure the data sets produce robust scientific

EPBC Offset Guideline Reference	Criteria	Details
		conclusions. It is proposed that the study will be approximately two years in duration.
	(4) *The research program will be undertaken by a suitably qualified individual or organisation in a manner approved by the department*	The study will be led by Dr Alistair Melzer (PhD UQ, BSc (Hons), CBLT) who works for Koala Research - CQ. Alistair's project team is described in 'Managing the Clarke Connors Range Koala Population' (Appendix A). Koala Research – CQ is a community funded research program hosted by CQ University. The research will be completed in accordance with the university procedures and as described in Appendix A. All papers resulting from the research will undergo peer review prior to publication. The work will be made publically available once finalised. CV's of expected key team members of the study are included in Appendix C.
	(5) *The research program will consider best practice research approaches.*	Alistair Melzer has been researching Koalas and their habitat since 1988 and has provided expert advice to the Commonwealth and state agencies. He leads the research program at the Koala Research Centre of Central Queensland and is an executive member of the National Koala Research Network. All papers resulting from the research will be required to undergo peer review prior to publication. All specific research approaches are described in detail in Appendix A

5. Option 2 – Direct Land Offset Proposal

5.1 Introduction

A direct land-based offset prepared in accordance with the EPBC Act Offsets Policy has been proposed as Option 2. TMR has identified a parcel of land that will be legally secured as a direct offset for the maximum loss of 30.867 ha of Koala habitat as a result of the Project. A range of other areas were assessed but were not considered in the offset proposal as they provided limited conservation gain to the species.

5.2 Assessment of Potential Direct Offset Areas

5.2.1 Desktop Assessment

A desktop assessment and gap analysis was undertaken to identify potential offset sites for the Project. This included a review of local, state and federal government planning instruments and databases to assist in determining the ecological attributes of both impact areas and offset sites. The review included the following databases, maps and reports:

- Aerial photography;
- DEHP Regional Ecosystem and Essential Habitat Mapping, under the *Vegetation Management Act 1999* and Regional Ecosystem Description Database;
- DEHP Wildlife Online Database;
- Atlas of Living Australia;
- Department of the Environment's Protected Matters Search Tool ; and
- CQU Koala Record Database.

The results of the desktop assessment of the offset site are in Appendix E.

5.2.2 Site Assessments and Surveys Undertaken

A number of field surveys/assessments have been completed for the Project area and potential offset areas. The specific documents utilised in the offset proposal are identified below:

- Fauna/flora surveys of the impact area conducted by EcoSM in 2009, 2011, and 2013 to support the preparation of the Environmental Assessment Report; and
- A survey undertaken by SMEC in 2015 targeting Commonwealth listed threatened species (specifically the Koala) at the impact area.

Each of these surveys are summarised in Section 2.2.2 of the Preliminary Documentation Main Report. Collected data that has been utilised in this Offset Proposal to determine the Koala habitat quality of the Project area (Figure 3 and Figure 4).

In addition, a desktop determination was undertaken of the Project area in October 2015 by Koala Research – CQ. Koala Research – CQ was able to assign a Koala habitat ranking for each regional ecosystem within the Project area. These rankings are based on the publication 'Ranking koala habitat using Queensland mapped regional ecosystems' (Melzer, 2014). The results of the desktop assessment indicated that, apart from the vine thicket community (RE 8.12.3a), the three RE's ranked as high value Koala habitat.

An ecological survey undertaken by Kleinfelder (2015) focussed on a TMR owned property approximately 10km south of the Project. The site was identified as a potential direct offset location. The survey is included in Appendix D and has been summarised in Section 5.5.

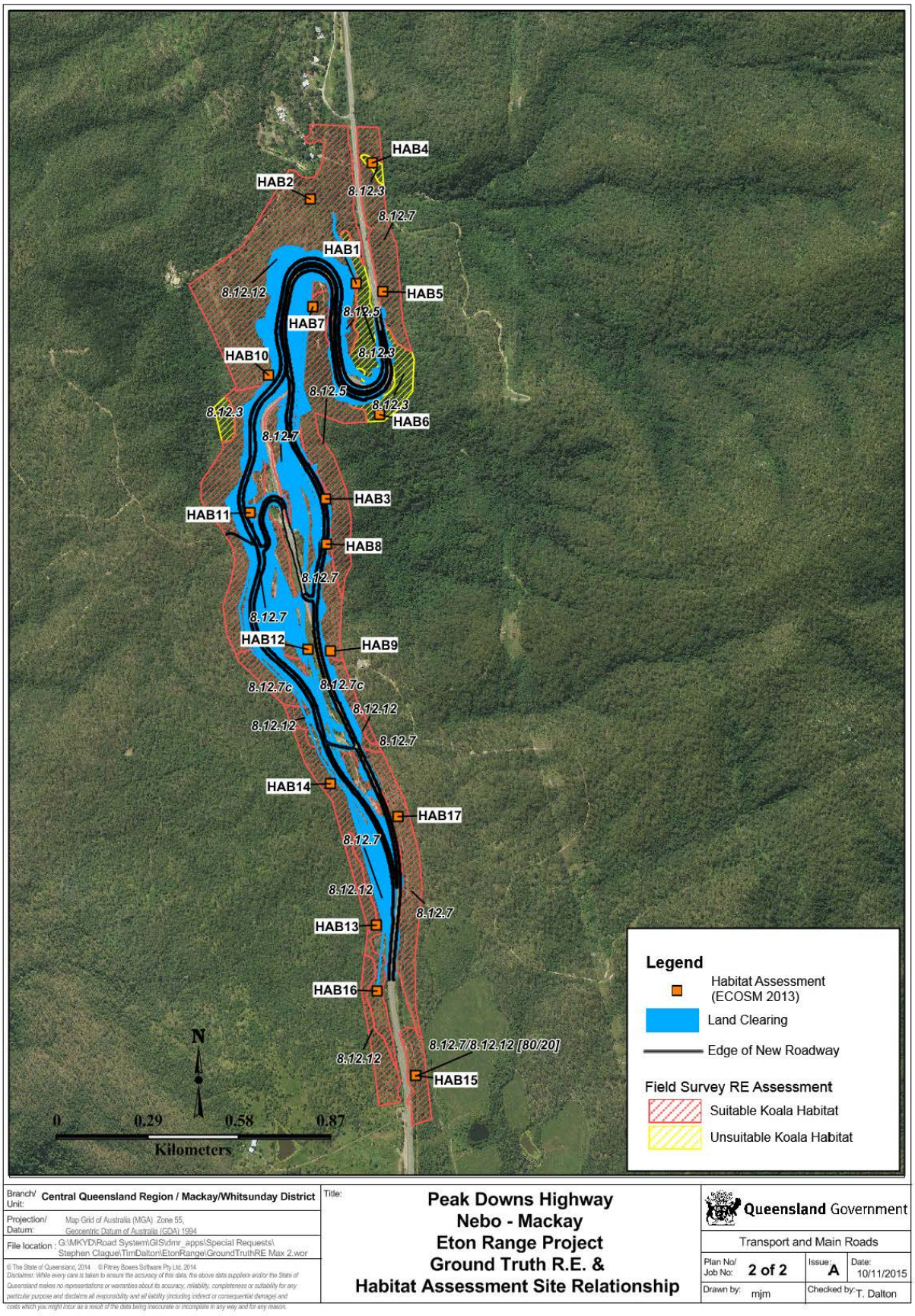


Figure 3: Relationship between field verified Regional Ecosystems and Habitat Assessment Sites at the Project Area

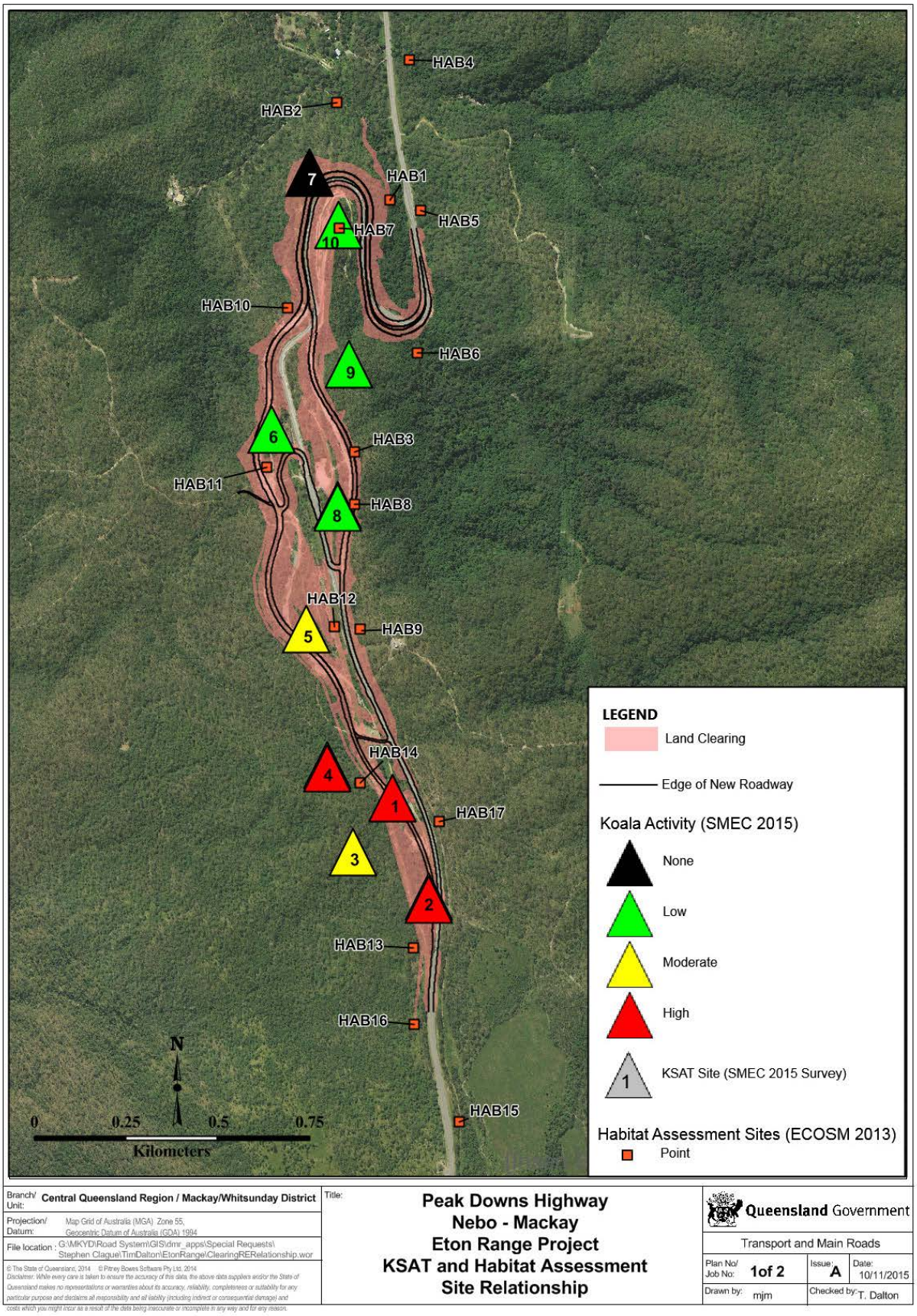


Figure 4: Relationship between Habitat Assessment Sites and KSAT Sites at the Project area

5.3 Offsets Assessment Guide Criteria

The Offsets Assessment Guide requires the proponent to establish criteria to assess the habitat quality of the impact and proposed offset site, including site condition, site context and species stocking rate distribution. Due to the varying quality of Koala habitat within both the Project area and proposed offset site, an approach has been developed that averages the quality in each case.

As shown in Figure 3 and Figure 4, individual habitat assessment sites were utilised in EcoSM's (2013) assessment of the Project area. For consistency purposes, Kleinfelder (2015) utilised a similar approach in the assessment of the offset site. Results from these habitat assessment sites were then used to assist in determining the overall Koala habitat quality of the sites in line with the approach described below.

5.3.1 Site Condition

The Offsets Assessment Guide identifies the need to consider three characteristics when determining site condition in relation to the Koala:

- What is the structure and condition of the vegetation on the site?
- What is the diversity of relevant habitat species present (including both endemic and non-endemic)?
- What relevant habitat features are on the site?

An assessment of each of these characteristics can be determined using a matrix that considers both Koala Research – CQ's (2015) Koala Habitat Rankings and Modified BioCondition scores for both the Project area (EcoSM, 2013) and offset site (Kleinfelder, 2015). Table 5 has been developed as the Project specific tool to determine the site condition score out of ten.

Table 5: Site Condition Scoring Matrix

Assessment Criteria	Assessment Score
Koala Habitat Rank score of 0, Modified BioCondition Score of 1-4	1
Koala Habitat Rank score of 1, Modified BioCondition Score of 1-4	2
Koala Habitat Rank score of 2, Modified BioCondition Score of 3-4	3
Koala Habitat Rank score of 2, Modified BioCondition Score of 1-2	4
Koala Habitat Rank score of 3, Modified BioCondition Score of 3-4	5
Koala Habitat Rank score of 3, Modified BioCondition Score of 1-2	6
Koala Habitat Rank score of 4, Modified BioCondition Score of 3-4	7
Koala Habitat Quality score of 4, Modified BioCondition Score of 1-2	8
Koala Habitat Quality score of 5, Modified BioCondition Score of 3-4	9
Koala Habitat Quality score of 5, Modified BioCondition Score of 1-2	10

5.3.2 Site Context

The Offsets Assessment Guide identifies the need to consider three characteristics when determining site context in relation to the Koala:

- What is the connectivity with other suitable/known habitat or remnants?
- What is the importance of the site in relation to the overall species population or the occurrence of the community?
- What threats occur on or near site?

It should be noted that a determination of the importance of site in relation to the overall population is difficult to ascertain due to the lack of scientific data on the Clarke-Connors Range Koala population.

As per the Queensland BioCondition Assessment Manual (2015), landscape attributes for the assessment site's patch size, connectivity, and context have been scored in EcoSM's (2013) and Kleinfelder's (2015) reports utilising GIS mapping.

Existing threats to the Koala at the impact and offset sites need to also be considered to determine an accurate site context score. The EPBC Koala Conservation Advice (DoE, 2015b) identifies four main threats to the continued survival of the Koala.

- fragmentation of habitat;
- vehicle strike;
- disease; and
- predation by dogs.

These components need to be considered when determining the 'threat' component of each assessment site's context score.

A specific equation to determine the total context score out of ten for each habitat assessment site has been developed considering each of the site context components.

$$\textbf{Assessment Site Context Score} = \frac{(\textbf{Size of Patch}+\textbf{Connectivity}+\textbf{Context}+\textbf{Lack of Threats})_{\textbf{measured}}}{(\textbf{Size of Patch}+\textbf{Connectivity}+\textbf{Context}+\textbf{Lack of Threats})_{\textbf{max}}} \times \mathbf{10}$$

5.3.3 Species Stocking Rate Distribution

The Offsets Assessment Guide identifies the need to consider three characteristics when determining species stocking rate in relation to the Koala:

- What is the presence of the species on the site? (i.e. confirmed / modelled).
- What is the density of species known to utilise the site?
- What is the role of the site population in regards to the overall species population?

The application of the metrics from the KSAT Methodology was applied to score for the Koala's species stocking rate. The east coast (med - high) activity category from Phillips and Callaghan (2011) was applied to the Koala population to provide an appropriate score from a regional perspective. The scoring matrix for the species stocking rate is provided in Table 6. The maximum species stocking rate score is ten

Table 6: Species Stocking Rate Scoring Matrix

Assessment Criteria (KSAT Results)	Assessment Score
No Scats Recorded	1
East coast med - high (low use) less than 10%	2
East coast med - high (low use) 10% or greater but less than 22.52%	3
East coast med - high (medium use) 22.52% or greater but less than 25%	4
East coast med - high (medium use) 25% or greater but lower than 28%	5
East coast med - high (medium use) 28% or greater but less than 30.5%	6
East coast med - high (medium use) 30.5% or greater but less than 32.84%	7
East coast med - high (high use) greater than 32.84% but less than or equal to 38%	8
East coast med - high (high use) greater than 38% but less than or equal to 45%	9
East coast med - high (high use) greater than 45%	10

5.4 Koala Habitat Quality of Project area

The Koala habitat quality of the Project area was determined utilising EcoSM (2013), SMEC (2015), and Koala Research – CQ's (2015) raw data.

The habitat quality scores for each habitat assessment site within the Project area is outlined in Table 7. It should be noted that a number of EcoSM's (2013) habitat assessment sites have since been disturbed as a result of the trial embankment activities previously described in Section 2.1. The habitat quality assessment calculation considers the original quality of the Koala habitat prior to these disturbances.

It should also be noted that habitat assessment sites 2, 4, 5, 6 and 15 have been omitted from the calculation as they are not located within or immediately adjacent to the finalised Project area (refer to Figure 3).

The habitat quality for the Project area, calculated as a combined score of all the habitat assessment sites, is 7. As expected, the Koala habitat quality increases towards the southern extents of the Project area.

Table 7: Koala Habitat Scoring Criteria for Project area

Habitat Site Assessment Unit	Site Condition	Site Context	Species Stocking Rate	Total Habitat Quality Score
HAB1	10	7.33	1	6.11
HAB3	8	7.33	3	6.11
HAB7	8	7.33	3	6.11
HAB8	8	7.33	3	6.11
HAB9	8	7.33	4	6.44
HAB10	9	7.33	3	6.44
HAB11	8	7.33	1	5.44
HAB12	8	7.33	4	6.44
HAB13	7	7.33	8	7.44
HAB14	7	7.33	9	7.78
HAB16	7	6.67	8	7.22
HAB17	8	7.33	10	8.44

Habitat Site Assessment Unit	Site Condition	Site Context	Species Stocking Rate	Total Habitat Quality Score
			Average	**6.68**
			Total Averaged Habitat Quality Score	**7**

5.5 Potential Direct Offset Site

5.5.1 Desktop Assessment

Based on the results of the desktop and field investigations, a proposed offset site (herein referred to as 'the Site') has been identified approximately 10km to the south of the Project. The Site lies on the western side of the Clarke-Connors Range approximately 350 meters west of the unpaved Blue Mountain Road. Current connectivity of remnant vegetation between the Project and the Site is relatively high. The Site also connects to Epsom State Forest 1 on its southern edge (refer to Figure 5). The Site is located on TMR owned land formally described as Lot 1 on RL5001.

The Site comprises of the southern section of Lot 1 RL5001 and is 75.17 hectares in area. It contains mostly remnant vegetation and field verified mapping indicates four field verified regional ecosystems – Least Concern RE's 11.12.3, 11.3.9, 11.3.25 and 11.3.4. Each of these are dominated by Koala food trees in the form of *Eucalyptus* spp and *Corymbia* spp. Currently the Site is grazed by cattle by means of a road license.

5.5.2 Field Assessment

An ecological assessment was undertaken by Kleinfelder in November 2015 to evaluate the Site and its suitability as an offset for the Project (refer to Appendix D). The assessment collected field data relating to the condition of the existing habitat, the importance of the Site within the landscape, and the current Koala activity levels. It should be noted that the Site is only a portion of the total study area assessed (refer to Figure 6 and Figure 7).

As identified in Appendix D, the survey found:

- Moderate to poor habitat as identified by an overall Modified BioCondition Class Score of 3;
- Good site context in relation to the landscape in which the site is situated;
- Medium to high levels of Koala activity; and
- Mild to moderate levels of external threats.

Photos of the Site are included in Plate 1 and Plate 2.

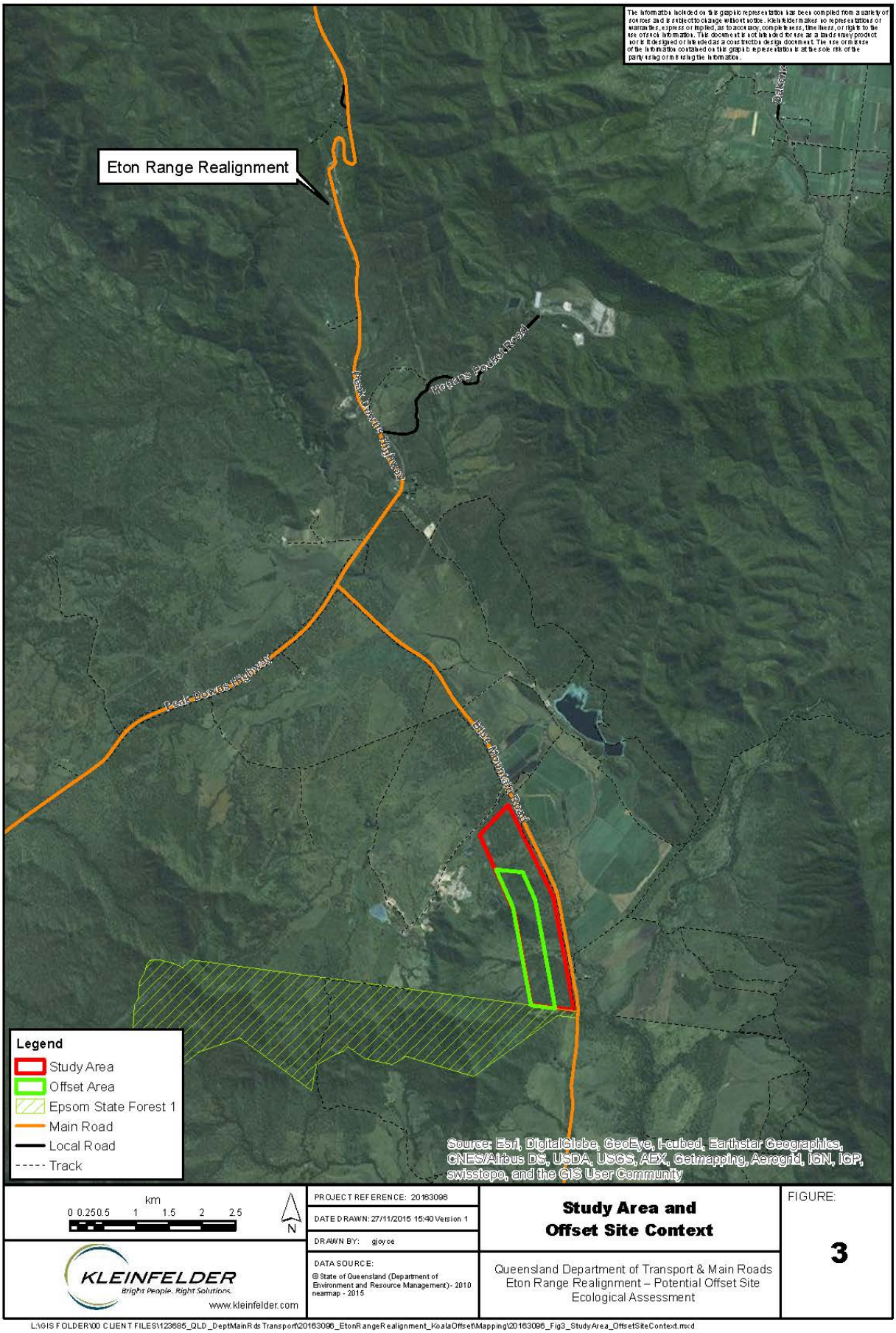


Figure 5 - Location of Site in relation to adjacent State Forest and the Project area

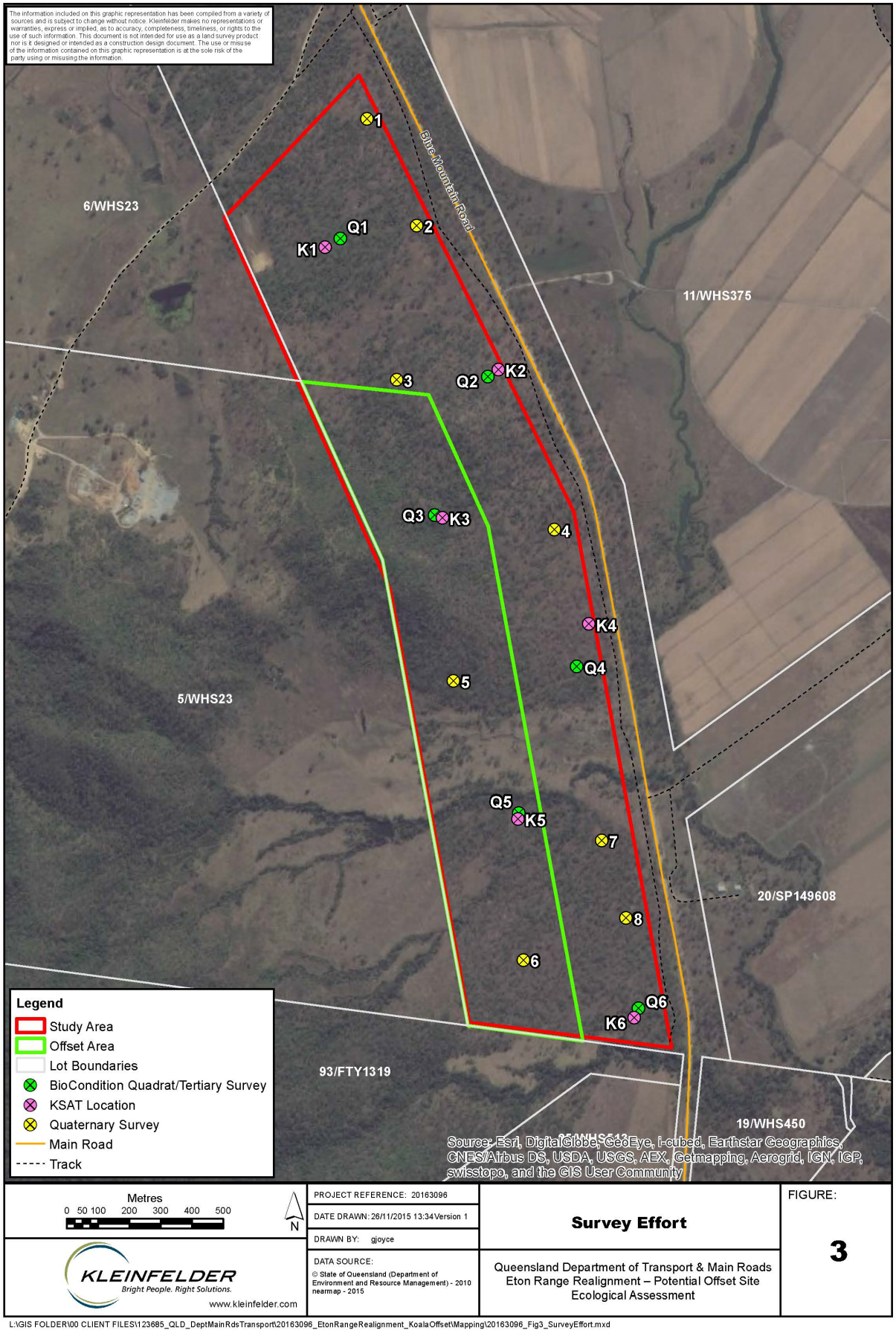


Figure 6: Survey Efforts conducted at the Site

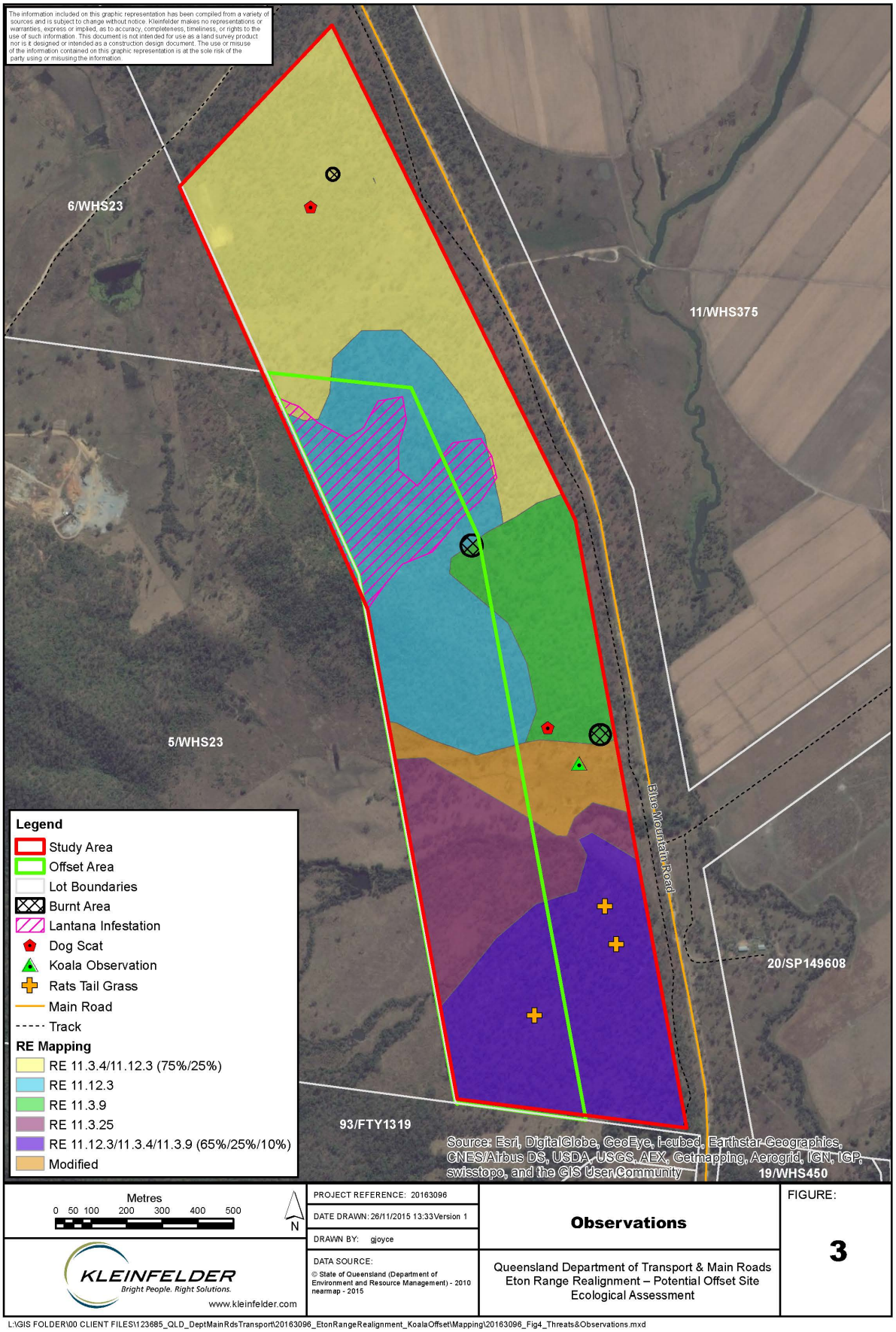


Figure 7: Field Verified Regional Ecosystems and Observations of the Site

Plate 1: Site photos from BioCondition quadrat 3

Plate 2: Site photos from BioCondition quadrat 6

The offset site has been assessed in accordance with the criteria outlined in Section 5.2 to determine the direct offset requirements for the Project (Table 8).

Table 8: Proposed Offset Site

Offset Site	Lot 1 RL5001 North of Epsom State Forest 1, Blue Mountain Road, Hazledean	
Total area of property	Lot 1 RL5001 is 166.2124 ha in size. In compliance with the outputs of the finalised EPBC Environmental Offsets Calculator, only the southern portion of the property is proposed as the Site.	166.2124 ha
Total area of Site	The southern portion of Lot 1 RL5001 is proposed as the Site.	75.17 ha
Habitat Quality[1]	*Condition*: Mapped as predominantly RE 11.12.3 and 11.3.25 which contain known Koala habitat. Moderate to Poor Modified BioCondition Class Scores.	8.25
	Context: Good site condition and is connected to Epsom State Forest 1 to the south. Mild – Moderate level of threats, including weed incursion, potential of bushfires and wild dogs.	7.67
	Species Stocking Rate: Medium to High levels of Koala activity identified from KSATs.	6.25
	Habitat Quality Score:	**7** (7.39)
Time over which loss is averted	A 20 year period has been applied as the Site will be legally secured.	20 years
Time until ecological benefit	A 0 year period has been applied as the habitat value is already present at the Site.	0 years
Risk of loss without offset	If the Site is not used as an offset it is at a moderate risk of being sold and potentially cleared for cattle grazing or mining, consistent with the surrounding land uses.	50%
Future quality without offset	Without protection and application the habitat quality is considered likely to reduce due to the existing threats of additional weed incursion and bushfires.	6
Risk of loss with offset	The Site will be legally secured.	0%
Future quality with offset	As the Site will be legally secured the habitat integrity will remain and will not be at risk of future clearing for agricultural/mining purposes. The management measures detailed below are expected to maintain the habitat quality of the Site.	7
Time over which loss is averted (max 20 years)	A 20 year period has been applied as the land will be legally secured.	20 years
Confidence in result	A high degree of confidence can be applied as the site is located adjacent to State Forest and contains existing Koala habitat	80%

[1] Quadrat sites 1 and 2 have been omitted from the calculation as they are located north of the Site and were undertaken within RE 11.3.4/11.12.3 (75/25) which is predominately located outside the Site (Figure 6 and Figure 7).

5.6 Results of Offsets Assessment Guide

The habitat scoring criteria developed for the Project has been based on the outcome of the site assessment of the Project area and offset Site (with summaries provided in Table 7 and Table 8 respectively). The full results are provided in Appendix I.

The results indicate that:

- The total impact area of the Project is 30.867 ha. The impact site has a Koala habitat quality score of 7.
- The Site is 75.17 ha with a current Koala habitat quality of 7. The expected future Koala habitat quality is also 7.
- Assuming that the Site was not legally secured the risk of averting the loss of the Site is 50% and the quality of the land will decrease to a habitat quality score of 6. The Site provides a 107.51% direct offset.

5.7 Management of Offset Site

An offsets area management plan (OAMP) will be prepared for this Site if DoE conditions this option, and will detail areas where management actions are to be implemented, with clear timeframes and performance objectives. This OAMP will be applied over a five year period.

In order to maintain the habitat quality of the proposed offset site at 7, a number of management measures are required, including the following:

- Moderating vehicle and machinery access;
- Removal of Lantana thickets, Giant Rats Tail Grass and other weeds over a five year period where required; and
- Management of fire risks.

There is also expected to be costs associated with ensuring that the potential site is legally secured, as well as ongoing monitoring of the site in line with the EPBC Approval.

The estimated total cost of these measures is approximately **$195,000**. This cost has been determined using best judgement, considering all the information available at the time of the valuation. It has been assumed that no land purchase is required for this offset site.

5.8 Compliance with the EPBC Act Offsets Policy

Option 2 has been developed in accordance with the principles and aims of the EPBC Act and EPBC Act Offsets Policy, as outlined in Table 9.

Table 9: Offset Proposal compliance with the EPBC Act Offsets Policy

Suitable offsets must:	Proposed offsets
(1) Deliver an overall conservation outcome that improves or maintains the viability of the aspect of the environment that is protected by national environment law and affected by the proposed action	This offset proposal provides a legally secured parcel of land with suitable habitat and connectivity for the koala.
(2) Be built around direct offsets but may include other compensatory measures	A 107.51% direct offset is identified in this offset proposal option.
(3) Be in proportion to the level of statutory protection that applies to the protected matter	The offset proposal has been defined based on the Offsets Assessment Guide, and therefore is considered consistent with the statutory protection afforded to the protected matters.
(4) Be of a size and scale proportionate to the residual impacts on the protected matter	The offset proposal has been defined based on the Offsets Assessment Guide, and therefore is considered consistent with the statutory protection afforded to the protected matters.

Suitable offsets must:	Proposed offsets
(5) Effectively account for and manage the risks of the offset not succeeding	The offset site is already owned by TMR and will be legally secured as part of this Offsets Proposal.
(6) Be additional to what is already required, determined by law or planning regulations or agreed to under other schemes or programs (this does not preclude the recognition of state or territory offsets that may be suitable as offsets under the EPBC Act for the same action, see section 7.6)	There are no Queensland State approvals for the Koala for the Project. There are no State Offsets required as works do not involve an activity prescribed under Section 9(c) of *Environmental Offsets Act 2014*.
(7) Be efficient, effective, timely, transparent, scientifically robust and reasonable	The offset proposal includes clearly documented frameworks with an appropriate level of scientific rigour applied, relevant to the level of risk posed to the protected matters.
(8) Have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced	The offset proposal includes the commitment to develop a detailed OAMP for the Project, by TMR to be applied for a five year period.

6. Offset Option Analysis

A comparison of estimated outcomes and costs of Option 1 and 2 is provided in Table 10.

Table 10: Comparison of Estimated Costs for Option 1 and 2

Aspect	Option 1 – Hybrid Offset Package	Option 2 – Direct Land Offset Proposal
Long-term conservation value for the Koala	An initial study will be undertaken to help determine the population dynamics and movement patterns of Koalas within the vicinity of the Peak Downs Highway (Eton - Nebo). Future investment on Koala sensitive infrastructure along the Peak Downs Highway will then focus on increasing connectivity between the large amount of intact Koala habitat between Eton and Nebo. This option will aim at increasing scientific knowledge of the local Koala population. It will also lead to increases in Koala connectivity and reduce Koala fatalities along the Highway.	A portion of land containing identified habitat for the Koala will be legally secured, and management measures will be employed to ensure that the existing Koala habitat is maintained at its current habitat value. It is unknown whether the area that will be offset will make a long-term contribution to regional conservation of the Koala. This is due to the vastness of existing intact Koala habitat within the Clarke-Connors Range, of which most occurs in relatively secure land tenure.
Koala Research – CQ Study	$287,442	N/A
Investment in Koala sensitive infrastructure along the Peak Downs Highway	$200,000	N/A
Direct land offset and management measures	N/A	$195,000
Estimated Funding value	**$487,442**	**$195,000**

6.1 Stakeholder Consultation

TMR have been actively engaging with a number of government and community organisations regarding the Project and the offset proposal. Initial consultation with DEHP was undertaken for the development of the proposals. Discussions have been ongoing between TMR and Fauna Rescue Whitsundays (FRW) – a not for profit volunteer organisation that cares for the region's wildlife and habitat. A meeting was held on the 25/11/15 between representatives from TMR, FRW, and Ipswich's Moggill Koala Hospital. Feedback was received from the groups and considered in the offset proposal and the FMP. A letter of support from FRW towards Option 1 of this proposal is included in Appendix B.

6.2 Preferred Option

TMR considers that by directly studying and managing a major known threat to the Koala in the region (the Peak Downs Highway between Eton and Nebo), considerable improvements can be made towards Koala conservation in the region. Currently it is not known how significant the impacts of the Peak Down Highway are to the conservation of the regional population, nor how significance the loss of north-south connectivity is. The study will not only address large knowledge gaps in relation to the regional Koala population, but will aid in eventually increasing connectivity and decreasing vehicle strike through strategic investment on the Peak Downs Highway. Furthermore, it is intended that the results of the research program will be used by TMR to assist in the future upgrading of linear infrastructure projects in the region.

Despite the capacity of the direct land offset (Option 2) to continue to support Koalas, the size of the required offset is relatively small when considering the home range of an individual Koala, as well as the vastness of intact Koala

habitat along the Clarke–Connors Range and adjacent lowlands (Reef Catchments, 2015). Although habitat removal is identified as a residual risk of the Project, it is not considered as major of a threatening process in the region.

By targeting known knowledge gaps of the population, and developing and implementing strategic future investment for Koala sensitive infrastructure on the Peak Downs Highway, measureable environmental outcomes can be achieved that will have a long-term conservation value for the species in the region. Option 1 has greater potential to also leave a lasting legacy that is likely to be well supported by the local media, community, and relevant stakeholders.

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Appendix A: Koala Research – CQ Proposed Study 'Managing the Clarke Connors Range Koala Population'

Koala Research – CQ
a community funded research program
hosted by CQUniversity

Proposal: Managing the Clarke-Connors Range koala population

This study aims to address critical knowledge gaps around conservation biology and population dynamics of koalas in Central Queensland's hinterland ranges. There is a particular focus on the Clarke-Connors Range as these hills and ranges are considered to support one of the most extensive contiguous koala populations in Queensland, and are also considered likely to be a major area of refuge under both expected climate changes and the nation's expanding human footprint.

A lack of regional knowledge is providing uncertainty around the application of suitable conservation management measures around current and future upgrading and modification of major road corridors along the Peak Downs Highway. Consequently, the study will directly address koala connectivity issues associated with the existing Peak Downs Highway between Nebo and Eton.

The study is expected to run over two years and involves a number of discrete projects. These are:

1.0 Defining koala population management units across the Clarke-Connors Range;
2.0 Understanding koala habitat use, and diet, as well as ranging behaviour in the vicinity of the Eton to Nebo stretch of the Peak Downs Highway;
3.0 Habitat analysis and modelling to predict future koala-road kill hotspots on the Eton to Nebo stretch of the Peak Downs Highway; and
4.0 Investment planning for installation of wildlife barriers and underpasses on the Peak Downs Highway between Eton and Nebo.

It is understood that monitoring of the Eton Range koala underpass and fauna exclusion fencing will be undertaken by TMR post construction. These results, if available and where relevant, will be included within the reporting aspect of the study.

Key research team members include:

Dr Alistair Melzer, CQUniversity, a terrestrial ecologist specialising in koalas and koala habitat;

Dr William Ellis, a koala zoologist with broad experience in koala genetic studies, koala social interactions and habitat use, as well as GPS radio tracking of koalas;

Dr Sean FitzGibbon, a zoologist experienced in koala capture and VHF and GPS koala tracking;

Dr Ben Bath, a field zoologist with particular expertise in koala capture and tracking;

Mr Rolf Schlagloth, CQUniversity, currently developing koala road-kill hotspot modelling for Victorian highways.

CQUniversity will provide GIS technicians and field assistants as required to assist the principal research team.

CV's for the key team members are provided separately.

The cost (excluding GST) associated with this study is $287,442, including:

1.0 Defining koala population management units across the Clarke-Connors Range $47,300

2.0 Habitat analysis and modelling to predict future koala-road kill hotspots $64,468

3.0 Understanding koala habitat use, and diet, as well as ranging behaviour in the vicinity of highways $138,014

4.0 Investment planning for installation of wildlife barriers and underpasses on the Peak Downs Highway between Nebo and Eton. $21,160

5.0 Integrated reporting, workshop and project management $16,500

Please note that this study has been developed as a research activity with the expectation that the principal researchers and associated institutions will be able to publish the findings in appropriate peer reviewed journals as well as use the work to facilitate student studies and teaching.

Contact:

Dr Alistair Melzer,

Koala Research - CQ

School of Medical and Applied Sciences (Conservation Biology)

Building 361 CQUniversity

Ibis Avenue, Rockhampton Q 4702

Mobile: 0458246600 (preferred)

Phone: 0749232297

a.melzer@cqu.edu.au; a.melzer@cqes.com.au (preferred)

Context: Queensland's coastal ranges – centred on the Clarke-Connors range, have been identified as significant refugia in the past (Smith 2013), and have been proposed as future koala climate refugia identified in modelling by Adam-Hoskings *et al*. (2011), and, more broadly, as a biodiversity refugia in modelling by NSCAFF (Reside *et al.* 2013).

Recently, a contraction in the northern and western extent of the koala's range (Gordon *et al*. 2006, Seabrook *et al*. 2011) together with widespread declines in abundance across the central and northern parts of its range (McAlpine *et al*. 2015) have prompted national concern for the fate of the species (ECRC 2011), and the Commonwealth listing of the koala as *vulnerable* in New South Wales (NSW), Australian Capital Territory (ACT) and Queensland (Qld) (TSSC 2012). Range contractions are expected to continue with predicted increases in climate variability as well as increased frequency and intensity of extreme weather events impacting on koalas (Adam-Hoskings *et al*. 2011), and their habitat (Adam-Hoskings *et al*. 2012). These declines, and predicted climatic changes, have been associated with human-induced increases in greenhouse gasses – especially carbon dioxide, methane and nitrous oxide (IPCC 2013). There are expectations of an increase in maximum and minimum temperatures, increased frequency and duration of heat waves, as well as an increased severity and duration of droughts (Hughes and Steffen 2013, IPCC 2013). Consequently, there are widespread concerns about the continued survival of the koala.

Despite range contractions, koalas have persisted and maintain a widespread, but largely fragmented distribution across Queensland. We consider that current localities supporting koalas reflect refugia from the environmental challenges encountered over the last 25 years (Melzer *et al*. 2013). In broad terms these refugia are associated with the mountains, hills and scarps associated with the coastal ranges (including Kroombit Tops, Clarke-Connors Range), the precipice sandstones of the Carnarvon and associated ranges (including Blackdown Tableland), and the hills and ranges of the Einasleigh Uplands.

The coastal ranges from about Collinsville, south through the Clarke-Connors ranges, to the commencement of the Marlborough Hills (some 300 km), represents the most extensive regional koala population. Generally the koalas are located in the drier woodlands or open forests – mostly on the western aspect of these ranges, although populations still extend to the coast around St Lawrence and Clairview, as well as Sarina. In the latter case, however, these coastal populations are being fragmented as coastal development expands. This regional population has been little studied apart from some preliminary audits near St Lawrence (Melzer and Tucker 2011). This study estimated a population of some thousands of koalas in and around St Lawrence. A recent field inspection of properties near Nebo (Mt Spencer, adjacent to Mt Adder and Pinnacles) returned a moderate number of koala sightings, suggesting that the regional population there will also be quite high. Preliminary work at Sonoma State Forest, north of Collinsville, identified a low density population.

The terrain and geology of these coastal ranges has largely precluded their clearing for agriculture and their development for large-scale resource extraction. In addition, the dominant land uses of the ranges (nature conservation and intermittent cattle grazing) are largely able to coincide with the existing landscape without the need for modification.

However, there are some key threatening processes acting on this landscape. These include inappropriate land management (*e.g*. fire), increasing climate variability with impacts exacerbated by poor land management, development of the coastal lowlands, and ongoing road and rail kills associated with the Bruce Highway (Clairview/St Lawrence/Waverley Creek) and the Peak Downs Highway (Nebo to Eton), as well as the Nebo to Mackay rail link. Critically there is little known of the full extent, connectivity or ecology of this koala population or of the habitat upon which it is based. Consequently, it is difficult to make conclusions of the significance of any discrete impacts on either the local koala population or on the regional population.

Specifically, progressive upgrades of the Peak Downs Highway that cuts across this landscape results in small incremental losses of known koala habitat and connectivity, and have the potential to increase the road kill rate or the extent to which the highway provides an ecological barrier to koala dispersal. Potential further increases in mining traffic along the Highway resulting from development of the Galilee Basin will exacerbate this existing threat.

This proposal seeks to increase knowledge of the Clarke-Connors Range koala population, and facilitate improved conservation management for the species and its habitat. The project will include:

(a) A consideration of the effective koala-management units across the Clarke-Connors, and associated ranges;
(b) Habitat analysis and modelling to predict future koala-road kill hotspots on the Nebo – Eton stretch of the Peak Downs Highway; and
(c) Investment planning for installation of wildlife barriers and underpasses on the Peak Downs Highway between Nebo and Eton.

Basic studies of koala habitat use and movement patterns in the vicinity of the Nebo – Eton stretch of the Peak Downs Highway. The expected outputs are:

1. Increased knowledge of koala habitat use and diet, as well as the significance of the greater Clarke-Connors Range koala population, together with recommendations for future management.
2. A framework for predicting the occurrence of koala-hotspots on road corridors; and
3. Identification of koala-hotspots along the extent of the Nebo-Eton stretch of the Peak Downs Highway, together with recommendations on investment in wildlife barriers and associated mitigation works.

1.0 Effective management units across the Clarke-Connors and associated ranges

The aim of this project is to determine whether the koalas along the Clarke-Connors Range are a single management unit or form discrete management units. Understanding this will shed light on population connectedness (and hence the significance of any impacts in any one part of the range), and gene exchange across the area, and informs conservation management.

Methods: This project will examine the genetic relatedness of koalas across the extent of the ranges. Up to 30 tissue samples from at least two, and up to four widely distributed sites will be analysed. We currently hold samples archived from the DTMR St Lawrence/Waverley Creek study (Melzer and Tucker 2011). Further samples can be collected from road kills along the Peak Downs Highway in the ranges to the east of Nebo. (We understand that frozen bodies have been archived by local community members). Samples from two other sites (e.g. Collinsville, Lotus Creek - Collaroy district, or Croydon Road) will be collected from wild-caught koalas. Small tissue samples (approx. 5mm diameter) will be taken from each koala's ear and placed in 70% ethanol. Samples will be transported to the University of Queensland for analysis. *Note: Team members working on roadways will be provided with appropriate training and personal protective equipment, and will complete suitable risk assessment. Vehicles will be equipped with identification and flashing lights.*

Genetic analysis of these samples will rely on a 20 microsatellite panel developed at The University of Queensland, and based on previous markers identified by Houlden *et al*. (1999), and Cristescu *et al*. (2009), as well as unique markers identified by the University of Queensland research team (Ellis unpublished data). Single nucleotide polymorphic markers will not be used for this study as they are still under development. The 20 microsatellite panel will be sufficient to interpret the local and regional (as well as state wide and national) patterns of genetic connectivity amongst the study groups in this project. All DNA extraction and amplification will be undertaken in the laboratory at The University of Queensland.

Genetic diversity will be estimated separately for each group, or regional population, and compared to currently available datasets by locus – matching between studies where identical primers have been used. The mean number of alleles per locus, an unbiased estimate of heterozygosity (He) and observed heterozygosity (Ho) will be calculated using GENALEXversion 6.5 (Peakall and Smouse 2012). FSTAT (Goudet 2001) will be employed to calculate allelic richness, which uses rarefaction to correct the mean number of alleles/locus for sample size and FIS. We will test for deviations from Hardy Weinberg equilibrium using Markov chain analysis in Genepop on the Web (http://genepop.curtin.edu.au/; Raymond and Rousset1995).

It may also be possible to examine the stability of the population-based genetic diversity by comparing samples of different age, or from animals of different age. This will allow comment on the significance of variation in the genetic profile among local populations, hence informing management decisions. Over the course of our study, and with reference to archived samples, we would seek to detect temporal changes in expected heterozygosity and mean number of alleles per locus by combining koalas into groups according to age, and applying the Queller and Goodnight relatedness estimator as calculated in GENALEX version 6.5 (Peakall and Smouse 2012). We will use Wilcoxon signed rank test with GraphPad Prism version 6.0a for MacOSX GraphPad Software, La Jolla, California, USA, www.graphpad.com) to determine median relatedness values and significant departures from zero (unrelated).

Output: A technical report will be prepared describing the genetic diversity across the Clarke-Connors Range, drawing conclusions with regard to the regional relatedness and significance of the greater populations as well as providing management recommendations, where appropriate.

Costs: $47,300

2.0 Landscape analysis and modelling to predict future koala-road kill hotspots along the Eton – Nebo stretch of the Peak Downs Highway

Methods: This project extends research currently underway at CQUniversity. Currently, the koala team are analysing koala black-spots along a highway near Ballarat (Victoria). The aims are to understand what constitutes a black spot, understand what road conditions contribute to the likelihood of a koala strike, and develop a framework for predicting koala black spots more generally. This work is scheduled for completion in mid-2016 – although major conclusions should be available much earlier. Our intent is to apply the findings of this project to koala problem areas around the Peak Downs Highway between Eton and Nebo. The work will attempt to predict likely black spots. In broad terms the relationship between koala habitat attributes, topography and the pattern of road kills are analysed to identify associations with frequency of koala road deaths. Results will be tested against: (a) current DEHP and CQU records of koala road kills in this area; and (b) areas of known high value koala habitat. The project will produce a framework for predicting koala hotspots along the road, and provide input to decisions regarding investment in wildlife protection measures.

Effort: Desktop habitat quality – highway alignment analysis; ground-truthing and revision of analysis; predicting hotspots; field testing predictions on the Peak Downs Highway.

Output: ARC GIS compatible digital maps and hard copy maps will be prepared describing the koala-road-collision risk zones along the Eton to Nebo stretch of the Peak Downs Highway.

Costs: $64,468

3.0 Koala habitat use and movement patterns in the vicinity of the Eton – Nebo stretch of the Peak Downs Highway

Methods:

Koala ranging and habitat use: Ten koalas will be caught and fitted with GPS and VHF enabled collars. These animals will be caught in the ranges on the Nebo side of the range from habitat adjacent to the highway road reserve. The animals will be collared and tracked. Routine tracking using the VHF transmitters will be undertaken to develop a data base on tree use and animal behaviour during the breeding and non-breeding seasons. The project will run over two years. Every 3 to 4 months, the animals will be caught, and GPS data down loaded. At the end of the study all animals will be re-caught and collars removed. *Note: All collars are fitted with weak links. These perish over time. At that point the link breaks and the collars fall off. This ensures that no koala is left with a permanent collar.* Koala activity and habitat use will be mapped by relating GPS tracks and logged sighting coordinates to habitat maps and highway infrastructure maps.

Koalas will also be individually microchipped in order to successfully identify the animals if they are injured post study and taken in care. This is consistent with current practices by local wildlife carers when rehabilitated Koalas are released.

Roadkill: Carcasses will be logged, noting the species, location, and frequency of kill as well as date. The logging will utilise a geo-referenced, mobile devise deployed by local field assistants. The monitoring will extend the entire length of the highway from Eton to Nebo. Field workers will also stop (when safe to do so) and collect tissue samples for genetic analysis and also identify gender of the carcasses. Collected data will inform this project, and the modelling of koala hotspots. Data will be collected in four three-day campaigns, scheduled within the spring-summer months to coincide with the time of greatest koala activity. *Note: Surveyors will be provided with appropriate training and personal protective equipment and will complete suitable risk assessment. Vehicles will be equipped with identification and flashing lights.*

Diet: Although typical food species of the koala are broadly known (Melzer *et al*. 2014), local diet varies in association with plant leaf chemistry and landscape conditions (nutrients, moisture). To ascertain the regional importance of koala food tree species, koala diet will be determined through analysis of the content of fresh faecal pellets that will be collected from a range of habitat types. Traditionally, diet studies have relied on the manual identification and counting of known cuticle fragments in a large number of samples. Here, however, we intend to apply an analysis of eucalypt DNA within the faeces. The method has been used in other species, so suitable primers are available for a large number of organisms. We will use this method for analysing koala diets because it could provide a more efficient means to determine koala diets. The concept is straight forward: koala faeces are collected, DNA is extracted and a small fragment of DNA is amplified using suitable primers. Thereafter, Next generation sequencing is used to generate a large number of copies of each fragment, which are, in turn, used to determine number and proportion of each *Eucalyptus* species found in the sample.

Typical diet species for koalas across Queensland have been identified through previous work (Melzer *et al*., 2014), thus enabling us to generate a reference database of the key diet species for the region. Leaves from three trees of each prospective species will be collected and stored (silica gel) at ambient room temperature until DNA extraction.

As DNA fragments in faeces are typically small, target regions have to be short, variable and flanked by conserved genomic regions to allow solid primer design. This permits reliable amplification of a region where fixed, species-specific variations exist. Literature searches indicate that several possible chloroplast regions that have been used for species identification for diet analysis in herbivores, for example the trnL region (Valentini *et al*., 2009) can be used. This gene, which contains a small (36bp) P6 loop region, was found suitable for diet analysis in a number of small

herbivores (Soininen *et al*., 2009). However, the (generally) single-genus diet of koalas (*Eucalyptus*) has proved more challenging. Alignment of this region in publically available eucalypt chloroplast genomes indicated that this region was not variable enough to distinguish species for this genus. Based on this finding, a more *Eucalyptus*-focussed DNA-specific search was conducted.

A thorough analysis of the chloroplast genome of Australian *Myrtacea* revealed several hypervariable regions, including the intragenic spacers between the rpl 2 – tRNA –His and psbA (Bayly *et al*., 2013). Based on this finding, sample sequences spanning this region, from *E. microcorys, E. calmadulensis, E. elata, E. grandis, E. microcorys, E. obliqua* and *E. umbra* were downloaded from the National Centre for Biotechnical Information webpage (www.**ncbi**.nlm.nih.gov) and aligned manually using BioEdit. Both intragenic regions were considered suitably variable for the purpose of species identification. A set of already published primers (Vaillancourt and Jackson, 2000) to amplify these two regions are available.

DNA extraction and amplification: Approximately 5mg of dry leaf will be placed in a 1.5 ml microfuge snap lock tube along with metal beads and placed in a bead beater for 5 minutes, or until ground to a fine powder. DNA will be extracted using the Qiagen DNEasy plant mini kit according to the manufacturer's instructions, resulting in good quality, 10-20 ng DNA/µl extractions. DNA quality and quantity will be verified on a 1% agarose gel.

A polymerase chain reaction (PRC) will be conducted using the trnH primer as forward primer and rpl2 or psbA as reverse primer. PCRs will be conducted in 20µ reactions.

Resulting sequences will be imported into BioEdit and aligned manually to show clusters of identifiable units. In our work to date, *Eucalyptus grandis, E. microcorys* and *Lophostemon confertus* can be identified to species level, while the two *Corymbia* species, the two ironbarks (*E. melanophloia* and *E. crebra*), and *E. major* and *E. tereticornis* form three distinct pairs, where the pair cannot be told apart from each other, but have a unique sequence compared to the other five units.

This method will be applied across the sites (estimate based on four sites) and will include:

- Sampling prospective species and generating specific target sequences;
- Collecting and analysing scats (Storage, DNA extraction, PCR, report).

The results will be related to the local floristics to decide dietary species where species groups cannot be separated. For example, although *E. major* and *E. tereticornis* cannot be distinguished through this method, *E. major* does not occur in the region.

Output: (1) A report on koala ranging behaviour, tree use and relationship to the highway and associated infrastructure; including a consideration of gender and seasonal influences as well as statistics on highway crossings. Digital GPS track logs relating koala activity to other relevant GIS layers.(2) An analysis of the distribution of koala and other wildlife road kills along the highway and in relation to habitat and infrastructure characteristics. Data will be available as GIS compatible digital files. (3) A report on local koala diet and a discussion in relation to observed tree use reported in output 1 above.

Costs: $138,014

4.0 Investment planning for installation of wildlife barriers and underpasses

This project will incorporate the distribution of contemporary and recorded DEHP and CQ University road kills, modelling of potential hotspots, as well as the results of the tracking relating to tree use and movements in relation to the Peak Downs Highway. The project will focus on the Eton to Nebo stretch of the Peak Downs Highway. Initially, mapped vegetation along the highway route will be ground truthed. At the same time, surveys of koala activity will be undertaken. The surveys will use

scat distribution and frequency of occurrence, as well as direct sightings of koalas and mapped recent historical records. The results will be used to identify areas where the highway abuts high koala activity. This work will be mapped against the known characteristics of likely koala black spots. The results of the koala ranging and associated habitat will be considered in interpreting the likelihood of koala road interactions.

Output: A report and associated mapping will be prepared that identifies likely high risk areas and provides recommendations for future investment in wildlife protection and/or diversion infrastructure. The output will be related to topographical and road design features to identify likely locations for installation of protective/diversion fences, new underpasses, and/or retrofitting existing bridges and culverts.

Costs: $21,160

5.0 Integrated reporting, and project management

Dr Alistair Melzer will oversee the separate project elements and manage logistical support and field coordination. CQUniversity will provide contract management and regulatory oversight.

An integrated report and associated workshop with DTMR and other key stakeholders will be held upon project commencement, annually, and within three months of the completion of all elements of the study. Stakeholder meetings to report progress will be held every 6 months.

Cost: $16,500

Note: *All activities are subject to: (a) risk assessment and job safety analyses as appropriate, (b) appropriate permits from the DEHP (c) CQUniversity animal ethics approvals, and (d) approval to access both private and public owned land. There will be an experienced first-aider present with each catch team. Only experienced persons are used in these catch teams. Teams working along highways will be provided with additional training and risk assessment. They will be required to wear reflective clothing, have vehicles fitted with flashing lights, and to apply a road protocol to ensure that traffic flows are not interrupted and that other drivers are not put at risk.*

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Appendix B: Correspondence with Fauna Rescue Whitsundays

Fauna Rescue Whitsundays Association Inc.
ABN: 60 931 156 282
PO Box 806 Cannonvale, QLD 4802
24/7 HOTLINE: (07) 4947 3389
Email: frwsecretary@gmail.com
Website : www.frw.org.au

26 November 2015

To: **Tim Dalton**
Environmental Officer | Mackay / Whitsunday District
Program Delivery And Operations | Department of Transport and Main Roads

Subject: Letter of Support for Eton Range EPBC Offset Research Proposal

Fauna Rescue Whitsundays would like to thank you for the opportunity to meet and comment on the Eton Range EPBC Offset Research Proposal.

As one of the local volunteer care providers for the regions wildlife, Fauna Rescue Whitsundays (FRW) has seen a dramatic increase in injured and orphaned koalas coming into care from the Peak Downs Highway in the last two years. FRW has been actively mapping koala sightings and rescues for the last 12mths and the data is showing we have a dramatic number of vehicle related injuries and deaths to koalas on the Peak Downs Highway between the Eton range and Nebo.

Fauna Rescue Whitsundays has been running community and industry awareness sessions about the plight of the local koala populations and we believe the EPBC offset research proposal including mapping and rehabilitation support, coupled with the addition of future wildlife crossings will have a positive effect in mitigating the number of vehicle related injuries and deaths we are documenting.

Yours sincerely,
Jan Gottke

Secretary

Fauna Rescue Whitsundays Association Inc

Appendix C: CVs (Koala Research – CQ)

Curriculum Vitae

Name: Alistair John Melzer

Contact details: 376 Coorooman Creek Road
Cawarral Qld 4072
0458246600 (Central Queensland Environmental Surveys)
0749 309944 (CQUniversity)

Date of birth: 29 March 1953
Citizenship: Australian
Marital status: married

Dr Alistair Melzer PhD Ecology (University of Queensland) has been working in the dry tropical environment of Queensland since 1989. Dr Melzer has worked with Queensland's industry, government and community since 1995 to resolve environmental problems associated with project development and subsequent management. These include:

- flora and fauna surveys associated with formal impact assessment,
- environmental management plans and associated ecosystem health monitoring,
- bush fire management strategies,
- weed management plans, and
- revegetation strategies and associated restoration success monitoring

in coastal, estuarine and inland Queensland.

Alistair Melzer also pursues applied research projects in partnership with state agencies, universities and the community. Currently these include:

- Koala conservation biology,
- Restoration of koala habitat under climate change, and
- Management of environmental weeds and the recovery of fire sensitive ecosystems.

He has provided impartial, expert advice to community, industry, state (New South Wales, South Australia and Queensland) federal agencies and local governments on a variety of environmental issues associated with conservation biology, biodiversity management, environmental risks associated with water management and coastal industrial development as well as environmental policy interpretation. He has been formally and informally involved in the recovery planning processes for the Bridled nailtail wallaby, Hairy-nosed wombat and the Yellow chat as well as conservation planning for the Koala and some ecosystems.

Dr Melzer was Director of the Centre for Environmental Management, CQUniversity, Rockhampton from 2001 to 31 December 2006 where he managed a multi disciplinary team of about 30 resource economists, marine, aquatic and terrestrial ecologists, ecotoxicologists and technical staff focused on industrial and resource management issues.

From March 2008, Dr Melzer has pursued an independent program of research, contract research and consulting through Central Queensland Environmental Surveys. He has authored or co-authored over 30 scientific papers and more than 60 technical reports. He also continues to supervise postgraduate students and international interns at CQUniversity.

Dr Melzer works on regional conservation biology and biodiversity management issues in protected, industrial and developing landscapes and considers the complex issues associated with achieving conservation outcomes within increasingly developed regional landscapes and

coastlines. He continues to publish scientific and ecological management papers. He is an Adjunct Research Fellow at CQUniversity.

Qualifications

Tertiary education

Doctorate of Philosophy – Botany, University of Queensland 1995.
Bachelor of Science (Honours) – Botany, University of Queensland 1988.
Bachelor of Science – Botany, University of Queensland 1986.
Certificate in Biological Laboratory Techniques - Queensland Institute of Technology (now Queensland University of Technology) 1976.

Secondary education

Senior Certificate - Nambour State High School 1970.
Junior Certificate - Nambour State High School 1968.

Training

Open water diving certificate - Professional Association of Diving Instructors 1979.
Senior first aid and cardiopulmonary resuscitation certificates.
Chainsaw operations (Level 1 and 2).

Memberships & affiliations

Member of Ecological Society of Australia.
Member of Royal Society of Queensland.
Member of Queensland Naturalists' Club Inc.
Member of the Koala Research Network.
Member of the Central Queensland Koala Volunteers.

Employment details

March 2008 to present	Principal, Central Queensland Environmental Surveys
January 2007 to March 2008	*Senior Research Fellow*
July 2001 to 31 December 2006	*Director*, Centre for Environmental Management (Formally Centre for Land and Water Resource Management).
Nov. 1999-July 2001	Interim Director, Centre for Environmental Management (Gladstone).
1996-1999	*Senior Research Officer*, Central Queensland University. Leader of the Industrial Land Management Programme within the Centre for Environmental Management in the Faculty of Arts, Health and Sciences.
1994-1996	*Research Fellow*, Central Queensland University, Rockhampton.
1984-94	Full time study through the Botany Department, University of Queensland.
1983	Travelled overseas for 12 months.
1975-82	*Technician* - Queensland Institute of Medical Research, Herston, Brisbane.
1972-74	*Cadet Technician* - Animal Research Institute, Yeerongpilly, Brisbane.

Post-graduate student supervision

Candidate: Mr Richard Knight
Degree: MSc
General topic: Rehabilitation success in Bowen Basin coal mines
Completed: 2002

Candidate: Ms Margaret Stanek
Degree: MSc
General topic: Habitat requirements for Bridled Nailtail Wallaby
Completed: 2000

Candidate: Ms Delma Clifton
Degree: part time PhD
General topic: Water turnover and field metabolic rate in koalas
Completed: 2008

Candidate: Ms Gail Tucker
Degree: Part time MSc
General topic: Habitat utilisation and survivorship of sub-adult koalas
Completed: 2010

Candidate: Ms Leonie Andersen
Degree: MSc
General topic: Eco toxicology and shell disease in mud crabs
Completed: 2003

Candidate: Ms Samantha Fox
Degree: Part time PhD
General topic: Conceptualisation of integrated environmental monitoring systems
Completed: 2009

Candidate: Mr John Clarke

Degree: Part time MSc
General topic: Ecology of the Kroombit Tinker Frog
Completed: 2007

Candidate: Ms Tina Ball
Degree: Part time MSc
General topic: Nature refuges as habitat for arboreal marsupials
Completed : 2008

Candidate: Mr Wayne Boyd
Degree: Full time PhD
General topic: Assessing rehabilitation success in Bowen Basin open cut coal mines
Completed: 2012

Candidate: Mrs Dixe Knott
Degree: Part time PhD
General topic: Influence of vegetation management on native flora and fauna
Completion expected: 2016

Candidate: Mr Rolf Schlagloth
Degree:PhD
General topic: Modelling koala road kill blackspots
Completion expected: 2016

Scientific Publications

1. McAlpine, C., Lunney, D., **Melzer, A**., Menkhorst, P., Phillips, S., Phalen, D., Ellis, W., Foley, W., Baxter, G., de Villers, D., Kavanagh, R., Adams-Hosking, C., Todd, C., Whisson, D., Molsher, R., Walter, M., Lawler, I. and Close, R. (in press 2015) Conserving Koalas in the 21st Century: Regional trends, challenges and prognoses.*Biological Conservation.*DX.DOI.ORG/10.1016/j.biocon.2015.09.020
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61. **Melzer A**. (1996) *Assessment of the significance of a proposed four hectare clearing on habitat utilisation by a population of koalas at the Coolangatta-Tweed Golf Club.* A report to AGC Woodward-Clyde Pty Ltd. Koala Research Centre of Central Queensland, Central Queensland University, Rockhampton.

62. **Melzer A**. (1996) *Assessment of the impact of modifications to the course of the Coolangatta-Tweed Golf Club on a resident population of koalas.* A report to AGC Woodward-Clyde Pty Ltd. Koala Research Centre of Central Queensland, Central Queensland University, Rockhampton.

63. **Melzer A**. (1996) Plan *of management for the koala population within the Coolangatta-Tweed Golf course.* Koala Research Centre of Central Queensland, Central Queensland University, Rockhampton.

64. **Melzer A**., Hendry R. and Pickering G. (1996) *Tramline assessment through SF840 Bingera.* A report to the Isis Central Sugar Mill. Centre for Land and Water Resources, Faculty of Applied Science, Central Queensland University, Rockhampton.

65. **Melzer A**., Houston W. and Porter G. (1996) *Fauna of Curragh Coal Mine, Blackwater, Central Queensland.* Centre for Land and Water Resource Development, Central Queensland University, Rockhampton.

66. **Melzer A**. and Melzer R. (1996) *Flora and fauna assessment of Gregory Mine Remnant - suitability of the remnant for bridled nailtail captive colony/ release site*. Central Queensland Environmental Surveys, Rockhampton.

67. **Melzer A**., Rayner D. and Cox M. (1996) *Flora and fauna on South Walker Creek Mine, Nebo, Central Queensland.* A report to BHP COAL Australia. Koala Research Centre of Central Queensland, Central Queensland University, Rockhampton.

68. **Melzer A**. and Riley S.J. (1996*) Maintenance and management of biodiversity around the Boyne Island Aluminium Smelter*. Centre for Land and Water Resource Management, Faculty of Applied Science, Central Queensland University, Rockhampton.

69. **Melzer A**., Brushe J. and Rey P. (1995) Vegetation *of the Boyne Smelters Ltd buffer zone.* A report to Boyne Smelters Ltd. Centre for Land and Water Resource Management. Central Queensland University, Rockhampton.

70. **Melzer A**. and Childs L. (1995) Terrestrial flora and fauna. In: *Biological and ecological data (excluding fisheries) on the Dawson River system with particular reference to the proposed Nathan Dam* (Author/editor L.J. Duivenvoorden). River and Wetland Ecology Group, Centre for Land and Water Resource Development, Central Queensland University, Rockhampton.

71. **Melzer A.,** Houston W., Clancy N., Childs L. and Rey P. (1995) *Fauna of the Boyne Smelters Ltd buffer zone.* A report to Boyne Smelters Ltd. Centre for Land and Water Resource Development, Central Queensland University, Rockhampton.

72. **Melzer A**. (1994) Evaluation *of the proposed Stanwell Power Station Nature Refuge.* Central Queensland Environmental Surveys, Rockhampton, Qld.

73. **Melzer A**. and Lamb D. (1994) *Koala habitat and its utilisation at Springsure in Central Queensland.* A report to the Australian Koala Foundation.

74. **Melzer A**. and Lamb D. (1994)) Koala *habitat and its utilisation at Springsure in Central Queensland.* A report to BHP Coal Australia.

75. **Melzer A**. and Melzer R. (1993) *Vegetation of Lot 5, Mulambin Beach - recommendations for an environmentally sensitive residential estate*. Central Queensland Environmental Surveys, Rockhampton.

76. **Melzer A**. (1991) The *Stanwell Power Station environs as koala habitat.* A report to the Queensland Electricity Commission.

Posters

Ball, T., Wake, J., **Melzer, A**. and Goldingay, R. (2004) Squirrel gliders in the Mackay area. Poster presentation. Australian Mammal Society Conference. 4th to 7th July 2004. Tanunda, South Australia.

William Ellis PhD

Resume

27 Dudley St Bardon Q 4065 Ph 0428105275 email w.ellis@uq.edu.au

Tertiary Education

Master of Environmental Law: The Australian National University, Canberra ACT. *2003*

Doctor of Philosophy: The University of Queensland, Brisbane, Queensland. *1998.*

Bachelor of Science (Honours): The Australian National University, Canberra, ACT. *1986.*

Employment History

Current **Senior Research Fellow**

School of Agriculture and Food Science, The University of Queensland, Q 4072

Adjunct Research Fellow

Centre for Environmental Management, CQ University, Q 4702

2005 – 2011 **Clarke Endowed Conservation Postdoctoral Research Fellow**

San Diego Zoo Institute for Conservation Research, San Diego, USA

2000-2005 **Senior Research Officer**

School of Integrative Biology, The University of Queensland, Brisbane, 4072

1995-2000 **Research Officer**

School of Integrative Biology, The University of Queensland, Brisbane, 4072

1994-1995 **Research Assistant**

School of Integrative Biology, The University of Queensland, Brisbane, 4072

1992 – 1994 **Curator**

"Cairns Tropical Zoo", via Palm Cove, Cairns, 4870.

In brief

I am a behavioural ecologist specialising in the biology of the koala, with long-term field study sites and projects across peri-urban and rural Queensland. Based at The University of Queensland, I have collaborative research partnerships across a variety of institutions nationally and internationally.

Current Projects

1. Ecology of koalas in central Queensland: St Bees Island. Partners include CQ University, San Diego Zoo Global, The Earthwatch Institute, Queensland Parks and Wildlife Service Mackay Marine Parks, Queensland Department of Environment and Heritage Protection - Central Region, Queensland University of Technology.
2. Spatial dynamics of koalas: pathways of pathogen transfer. Queensland State Government Koala funding grant KRG024. St Bees Island.
3. Climate change and the koala: heat load in the koala. Queensland State Government Koala funding grant KRG022. State – wide. University of Queensland and CQ University (Dr Alistair Melzer)
4. Recolonising former koala habitat. Funded by Queensland Department of Environment and Heritage Protection. University of Queensland and Australia Zoo Wildlife Hospital.
5. Ecology of koalas in the Brisbane Valley, Queensland. Funded by Powerlink. (Principal Investigator).

PhD and M Phil Projects Supervised:

Current

1. Ph.D. Urban koalas-their role in a regional koala population. (Student: Diedre De Villiers, University of Queensland: Awarded 2015)

Recently Completed

1. PhD: Environmental water relationships of the koala, *Phascolarctos cinereus*, and the importance of the microenvironment in tropical habitats. (Student: Delma Clifton, Central Queensland University: PhD awarded 2010)

2. Ph.D. Diseases and the immune system: molecular genetics of koalas (Student: Kristen Lee, University of Queensland: PhD Awarded 2010)

3. M. Phil: The general ecology, growth and survival of sub-adult koalas on St Bees Island. (Student: Gail Tucker, Central Queensland University: M. Phil awarded 2009)

Referees

Dr. Robbie Wislon, Senior Lecturer, School of Biological Sciences, The University of Queensland, Brisbane 4072. Ph. +61 7 33652773 Email: r.wilson@uq.edu.au

Prof. F. B. Bercovitch, Wildlife Research Center, Kyoto University, Inuyama, Aichi 484-8506, Japan. Ph. 18583824157 Email: fbercovitch@gmail.com

Dr. Alistair Melzer, Director, Centre for Environmental Management, Central Queensland University, PO Box 1319, Gladstone, Queensland 4680 Ph. +71 7 49708310, Mob 0439875622, a.melzer@cqu.edu.au

Recent publications (2010 – present: full list available on request)

Ellis, W., S. FitzGibbon, et al. (2015). "The Role of Bioacoustic Signals in Koala Sexual Selection: Insights from Seasonal Patterns of Associations Revealed with GPS-Proximity Units." PLoS ONE **10**(7): e0130657.

Kjeldsen, S., K. Zenger, et al. (2015). "Genome-wide SNP loci reveal novel insights into koala (Phascolarctos cinereus) population variability across its range." Conservation Genetics: 1-17.

McAlpine, C., D. Lunney, et al. (2015). "Conserving koalas: A review of the contrasting regional trends, outlooks and policy challenges." Biological Conservation **192**: 226-236.Craig, A. P., J. Hanger, et al. (2014). "A 5-year Chlamydia vaccination programme could reverse disease-related koala population decline: Predictions from a mathematical model using field data." Vaccine **32**(33): 4163-4170.

Ellis, W., R. Attard, et al. (2014). "Faecal particle size and tooth wear of the koala (Phascolarctos cinereus)." Australian Mammalogy **36**(1): 90-94.

Melzer, A., R. Cristescu, et al. (2014). "The habitat and diet of koalas (*Phascolarctos cinereus*) in Queensland." Australian Mammalogy **36**(2): 189-199.

Seddon, J. M., K. E. Lee, et al. (2014). "Testing the regional genetic representativeness of captive koala populations in South-East Queensland." Wildlife Research **41**(4): 277-286.

Ellis, W., S. FitzGibbon, et al. (2013). "Koala habitat use and population density: using field data to test the assumptions of ecological models." Australian Mammalogy **35**(2): 160-165.

Johnston, S. D., R. A. Booth, et al. (2013). "Is faecal cortisol or corticosterone a reliable index of acute serum cortisol secretion in the koala (*Phascolarctos cinereus*)?" Australian Veterinary Journal **91**(12): 534-537.

Kollipara, A., A. Polkinghorne, et al. (2013). "Genetic diversity of *Chlamydia pecorum* strains in wild koala locations across Australia and the implications for a recombinant *C. pecorum* major outer membrane protein based vaccine." Veterinary Microbiology **167**(3-4): 513-522.

Lee, K., J. Seddon, et al. (2013). "Genetic diversity in natural and introduced island populations of koalas in Queensland." Australian Journal of Zoology **60**(5): 303-310.

Lee, K. E., W. A. H. Ellis, et al. (2013). "Anthropogenic changes to the landscape resulted in colonization of koalas in north-east New South Wales, Australia." Austral Ecology **38**(3): 355-363.

Matthews, A., L. Ruykys, et al. (2013). "The success of GPS collar deployments on mammals in Australia." Australian Mammalogy **35**(1): 65-83.

Melzer, A., W. Ellis, et al. (2013). Central Queensland's Koala Islands. Conserving central Queensland's koalas. N. Flint and A. Melzer. Rockhampton, Queensland, Koala Research Centre of Central Queensland**:** 25-28.

Pye, G. W., W. Ellis, et al. (2013). "Serum vitamin D levels in free-ranging koalas (*Phascolarctos cinereus*)." Journal of zoo and wildlife medicine : official publication of the American Association of Zoo Veterinarians **44**(2): 480-483.

Schmidt, D. A., G. W. Pye, et al. (2013). "Fat-soluble vitamin and mineral comparisons between zoo-based and free-ranging koalas (*Phascolarctos cinereus*)." Journal of Zoo and Wildlife Medicine **44**(4): 1079-1082.

Charlton, B., W. Ellis, et al. (2012). "Perception of size-related formant information in male koalas (*Phascolarctos cinereus*)." Animal Cognition **15**: 999-1006.

Charlton, B. D., W. A. H. Ellis, et al. (2012). "Female koalas prefer bellows in which lower formants indicate larger males." Animal Behaviour(84): 1565-1571.

Charlton, B. D., D. Reby, et al. (2012). "Estimating the Active Space of Male Koala Bellows: Propagation of Cues to Size and Identity in a Eucalyptus Forest." Plos One **7**(9): e45420.

Cristescu, R., W. Ellis, et al. (2012). "North Stradbroke Island: an island ark for Queensland's koala population?" Proceedings of the Royal Society of Queensland **2012**: 309-334.

Pye, G., W. Ellis, et al. (2012). "Serum protein electrophoresis values for free-ranging and zoo-based koalas (*Phascolarctos cinereus*)." Journal of Zoo and Wildlife Medicine **43**(1): 177-180.

Woosnam-Merchez, O., R. Cristescu, et al. (2012). "What faecal pellet surveys can and can't reveal about the ecology of koalas *Phascolarctos cinereus*." Australian Zoologist **36**(2): 192-200.

Charlton, B. D., W. A. H. Ellis, et al. (2011). "Perception of Male Caller Identity in Koalas (*Phascolarctos cinereus*): Acoustic Analysis and Playback Experiments." Plos One **6**(5).

Charlton, B. D., W. A. H. Ellis, et al. (2011). "Cues to body size in the formant spacing of male koala (*Phascolarctos cinereus*) bellows: honesty in an exaggerated trait." Journal of Experimental Biology **214**(20): 3414-3422.

Ellis, W., F. Bercovitch, et al. (2011). "Koala bellows and their association with the spatial dynamics of free-ranging koalas." Behavioral Ecology **22**(2): 372-377.

Ellis, W. and F. B. Bercovitch (2011). "Body size and sexual selection in the koala." Behavioral Ecology and Sociobiology **65**(6): 1229-1235.

Melzer, A., C. Baudry, et al. (2011). "Tree use, feeding activity and diet of koalas on St Bees Island, Queensland." Australian Zoologist **35**(3): 870-875.

Melzer, A., W. Ellis, et al. (2011). "Unusual patterns of tooth wear among koalas *Phascolarctos cinereus* from St Bees Island, Queensland, require re-evaluation of criteria for aging koalas by tooth-wear class." Australian Zoologist **35**(3): 550-554.

Ellis, W., F. Bercovitch, et al. (2010). "Koala birth seasonality and sex ratios across multiple sites in Queensland, Australia." Journal of Mammalogy **91**(1): 177-182.

Ellis, W., A. Melzer, et al. (2010). "Climate change and the koala *Phascolarctos cinereus* : water and energy." Australian Zoologist **35**(2): 369-377.

Ellis, W. A., S. I. Fitzgibbon, et al. (2010). "Unraveling the mystery of koala vocalisations: acoustic sensor network and GPS technology reveals males bellow to serenade females." Integrative and Comparative Biology **50**: E49-E49.

Lee, K. E., J. M. Seddon, et al. (2010). "Genetic variation and structuring in the threatened koala populations of Southeast Queensland." Conservation Genetics **11**(6): 2091-2103.

Melzer, A., W. A. Ellis, et al. (2010). "Observations of male-on-male aggression among Queensland koalas (*Phascolarctos cinereus*) from central Queensland." Queensland Naturalist **48**(1-3): 36-44.

27 Dudley Street, Bardon Qld. 4065 ◆ Mob.0428 105 275 ◆ w.ellis@uq.edu.au

THE UNIVERSITY OF QUEENSLAND

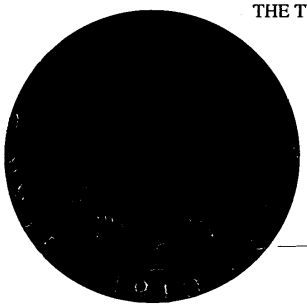
William Anthony Ellis

having fulfilled the conditions
prescribed by the University is this day admitted to
the degree of

DOCTOR OF PHILOSOPHY

in the field of Zoology

GIVEN UNDER THE COMMON SEAL
OF THE UNIVERSITY OF QUEENSLAND
THE TWENTY-THIRD DAY OF DECEMBER, 1997



Chancellor

Vice-Chancellor

Secretary and Registrar

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27 Dudley Street, Bardon Qld. 4065 ◆ Mob.0428 105 275 ◆ w.ellis@uq.edu.au

THE AUSTRALIAN NATIONAL UNIVERSITY

William Anthony Howell Ellis

AFTER DUE EXAMINATION FOLLOWING
THE COMPLETION OF A COURSE OF
STUDY APPROVED BY THE UNIVERSITY HAS
BEEN ADMITTED TO THE DEGREE OF

Master of Environmental Law

GIVEN UNDER THE SEAL OF THE AUSTRALIAN NATIONAL UNIVERSITY
THE SECOND DAY OF MAY 2003

Chancellor

Vice-Chancellor

27 Dudley Street, Bardon Qld. 4065 ◆ Mob.0428 105 275 ◆ w.ellis@uq.edu.au

THE

AUSTRALIAN NATIONAL UNIVERSITY

* * * * *

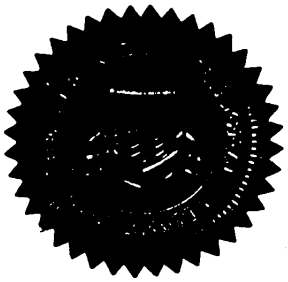
William Anthony Howell Ellis

after due examination following the completion of a course of study approved by the University has this day been admitted to the Degree of

BACHELOR OF SCIENCE

with Honours

Given under the Common Seal of The Australian National University
the *15th.* day of *May* 1986



Peter Karmel
Vice-Chancellor

R V Buts
Registrar

Certified as a true copy of the original
R Baeuer J. P.
13.7.87.

27 Dudley Street, Bardon Qld. 4065 ◆ Mob.0428 105 275 ◆ w.ellis@uq.edu.au

Dr Benjamin J. Barth

111 Beerburrum St,
Aroona, QLD, 4551
Phone (m): 0404790 329
E-mail: b.barth@uq.edu.au

Educational qualifications

- PhD (Ecology). Thesis: The effects of urbanisation on wildlife. The University of Queensland, 7 June 2013

- Bachelor of Science Honours (Class 1). University of Queensland, 2007

Current and previous positions

Post-doctoral research fellow (2015-current). School of Agriculture and Food Sciences, University of Queensland.
- Analysis of koala movement data and home range analysis
- Analysis of koala social interactions
- Part time position

Ecological consultant – koala and fauna specialist (2010-current).
Examples of recent work:
- Radio tracking and health monitoring of koalas on the Moreton Bay Rail Link project- personally completing approx. 2000 tracking events
- Safe capture of koalas utilising multiple methods – tree climbing, ground flagging, trapping.
- Koala surveys and scat surveys
- Fauna surveys for bats, mammals, birds, reptiles and amphibians
- Collection and consolidation of survey data for reports

Ecological research assistant (Casual 2013 - 2014). Dr William Ellis, School of Agriculture and Food Sciences, University of Queensland.
- Analysis of koala movement data and home range analysis
- Capture and radio tracking koalas to examining movement, health and population processes

Field research assistant (casual appointments 2009-2013). Dr Robbie Wilson, School of Biological Sciences, University of Queensland.
- Investigating the ecology and movement of the northern quoll using mark recapture and radio tracking techniques

PhD student, (2008-2013) Supervisor: Dr Robbie Wilson. School of Biological Sciences, University of Queensland.

Research from my thesis examined:
- The effectiveness of retaining remnant trees and water courses in new urban housing developments to improve the diversity of bird species
- Changes in ecologically important dung beetle communities in urban landscapes due to

changes in environmental variables
- The effect of species loss on the provision of ecosystem services provided by dung beetle communities
- How changes in resources in urban environments can alter the morphology of sexually selected traits

Ecology tutor, (casual appointments 2009-2013). Dr Robbie Wilson, University of Queensland.
- Organisation and effective communication of teaching material
- Ensuring students follow and understand OH&S procedures for field courses

Postgraduate committee co-ordinator/treasurer, (2010-2011). School of Biological Sciences
- Organisation of postgraduate conference and social functions
- Fund raising and accounting

Professional associations
- Ecological Society of Australia
- Australian mammal society

Publications

- Ellis, W., Fitzgibbon, S., Pye, G., Whipple, B., Barth, B., Johnston, S., Seddon, J., Melzer, A., Higgins, D. and Bercovich, F. (2015). The role of Bioaccoustic Signals in Koala Sexual Selection: Insights from seasonal patterns of associations revealed with GPS-proximity units. PLOS one.

- Barth, B. J., Fitzgibbon, S. and Wilson, R. S. (2015). New urban developments that retain more remnant trees have greater bird diversity. Landscape and Urban Planning. 136.

- Barth, B.J. and Wilson, S, R. (2010). Life in acid: interactive effects of pH and natural organic acids on growth, development and locomotor performance of striped marsh frogs (*Limnodynastes peronii*). Journal of Experimental Biology 213(8) 1293-1300

- Barth, B.J. van Uitregt V. and Wilson, R.S. (submitted to Functional Ecology, currently in review). Male dung beetles from urban forest fragments possess larger sexual signals when competition for resources is lower

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Scientific conferences
- Australian mammal society. 2015. Oral presentation. Titled: How common are physical interspecific interactions between individual wild koalas (*Pascolarctos cinereus*)?
- Australian mammal society. 2014. Oral presentation. Titled: Understanding koala movement and the occurrence of intra-specific interactions within a home range.
- School of biological sciences post graduate conference. 2011. Oral presentation
- SICB, Society for integrative and comparative biology, 2010. Oral presentation
- INTECOL, International congress of ecology, 2009. Oral presentation
- Ecological society of Australia, 2008. Poster

Research grants

- Ecological Society of Australia - student research award $1000
- University of Queensland – student travel awards $1200

Referees

Dr William Ellis
Post-doctoral Research Fellow
The University of Queensland
0428 105 275
w.ellis@uq.edu.au

Dr Sean Fitzgibbon
Post-doctoral Research Fellow/ Environmental consultant
The University of Queensland
0401 336 066
s.fitzgibbon@uq.edu.au

Dr Robbie Wilson
Lecturer/ Researcher
The University of Queensland
07 3365 2773
0458 204 962
r.wilson@uq.edu.au

Personal Details

Address	Work:	School of Food & Agricultural Sciences *and* Centre for Mined Land Rehabilitation (*split appointment*) The University of Queensland St Lucia QLD 4072 Australia Ph: +61 401 336 066
	Postal:	PO Box 6154 St Lucia Post Office St Lucia QLD 4069 Australia
Email		s.fitzgibbon@uq.edu.au
Date & Place of Birth		4th April 1976; Brisbane, Australia
Citizenship & Passports		Australian

Tertiary Education

PhD	2005	Dept. of Zoology & Entomology, The University of Queensland, Australia. Recipient of an Australian Postgraduate Award Scholarship. Thesis title: Life in the suburbs: The survival of the northern brown bandicoot (*Isoodon macrourus*) in bushland of suburban Brisbane, with implications for the conservation of native ground-dwelling mammals.
BSc (Hons)	1998	Dept. of Zoology & Entomology, The University of Queensland, Australia. Awarded First Class Honours. Thesis title: The ecology of a bimodally breathing Australian freshwater turtle (*Elseya* sp.); management and conservation implications.
BSc	1994	The University of Queensland, Australia. Majors in Zoology and Conservation Ecology.

Wildlife Consultancy Experience

December 2006 – current	Ecological Consultant (sole trader), specialising in koala management matters. Contracts have included: Review of Ruthven Quarry koala management program; Coordination of koala monitoring program at Bluesfest site (Tyagarah); Development of the Bluesfest site-specific Koala Plan of Management (in conjunction with another consultancy); Review of numerous development applications to provide expert opinion on koala management matters for local councils in South East Queensland and northern New South Wales.

December 04 – June 2005	Senior Ecologist (contract), AustralAsian Resource Consultants; Brisbane, Australia. Conduct baseline fauna surveys on various mining leases across Queensland; Monitor the environmental rehabilitation of various open-cut mines; Prepare wildlife management reports.
April – Dec 1997	Environment Officer (contract), Dept. Environment & Heritage, Queensland State Government; Brisbane, Australia. Digital mapping of National Park boundaries; Consult experts for information to include in a wildlife database (WildNet); Assist with the formulation of abatement plans for several threatened plant species.

Research & Teaching Experience

December 2005 – current	Research Fellow, The University of Queensland; Brisbane, Australia. Conduct various koala research and monitoring programs in Queensland and New South Wales, including Tyagarah, Clermont, North Stradbroke Island, Mt Byron, Coomera .
August 2006 – 2011	Postdoctoral Research Fellow, School of Biological Sciences, The University of Queensland; Brisbane, Australia. Conduct an urban wildlife research program at new urban developments in South East Queensland (ARC Linkage Project 'Conserving native wildlife during urbanisation').
February 2006 – 2011	Casual lecturer at the School of Biological Sciences, The University of Queensland; Brisbane, Australia. Occasional lecturing to first, second and third year students (mostly BSc) on themes of native wildlife biology, wildlife conservation and urbanisation, and biodiversity and habitat fragmentation.
July – December 2005	Research Officer (contract), Dept. Zoology & Entomology, The University of Queensland; Brisbane, Australia. Conduct laboratory experiments on various species of freshwater fish and crayfish from Fraser and Stradbroke Islands, and Gold Coast Hinterland, Queensland.
October – Nov 2003	Research Assistant (contract), Dept. Zoology & Entomology, The University of Queensland; Brisbane, Australia. Conduct radio-tracking and tag-&-release program on a population of brush-tailed rock wallabies (*Petrogale penicillata*) in dry-rainforest of Warwick, Queensland.
April – May 2003	Research Assistant (contract), Dept. Zoology & Entomology, The University of Queensland; Brisbane, Australia. Assist with radio-tracking and tag-&-release program on a population of koalas (*Phascolarctos cinereus*) in semi-arid woodlands of inland central Queensland.

Selected Publications

FitzGibbon, S. (2015) Reproductive ecology of the northern brown bandicoot (Isoodon macrourus) in habitat fragments of urban Brisbane. *Australian Mammalogy* 37: 253-259.

Kollipara, A., Polkinghorne, A., Wan, C., Kanyoka, P., Hangar, J., Loader, J., Callaghan, J., Bell, A., Ellis, W., **FitzGibbon, S**., Melzer, A., Beagley, K. and Timms, P. (2013) Genetic diversity of *Chlamydia pecorum* strains in wild koala locations across Australia and the implications for a recombinant *C. pecorum* major outer membrane protein based vaccine. *Veterinary Microbiology* 167: 513-522.

FitzGibbon, S., Ellis, W. and Carrick, F. (2013), 'Koala reproduction and the effect of drought in central Queensland; lessons from the Koala Venture project' in Flint, N. and Melzer, A. (eds), *Conserving central Queensland's koalas*. pp. 91-94, Koala Research Centre of Central Queensland, CQUniversity Australia, Rockhampton, Queensland.

Ellis, W., **FitzGibbon,S.**, Melzer, A., Wilson, R., Johnston, S., Bercovitch, F., Dique, D. and Carrick, F. (2013) Koala habitat use and population density: using field data to test the assumptions of ecological models. *Australian Mammalogy* 35: 160-165.

Pye, G., Ellis, W., **FitzGibbon, S.**, Opitz, B., Keener, L. and Hollis, B. (2013) Serum vitamin D levels in free-ranging koalas (*Phascolarctos cinereus*). *Journal of Zoo and Wildlife Medicine* 44: 480-483.

Ellis, W., **FitzGibbon, S.**, and Melzer, A. (2013) 'Regional research: perspectives from the field in central Queensland' in Flint, N. and Melzer, A. (eds), Conserving central Queensland's koalas. pp. 11-15, Koala Research Centre of Central Queensland, CQUniversity Australia, Rockhampton, Queensland.

Lee, K., Seddon, J., Johnston, S., **FitzGibbon, S.**, Carrick,F., Melzer, A., Bercovitch, F. and Ellis, W. (2013). Genetic diversity in natural and introduced island populations of koalas in Queensland. *Australian Journal of Zoology* http://dx.doi.org/10.1071/ZO12075

Matthews, A., Ruykys, L., Ellis, W., **FitzGibbon, S.**, Lunney, D., Crowther, M., Glen, A., Purcell, B., Moseby, K., Stott, J., Fletcher, D., Wimpenny, C., Allen, B., Van Bommel, L., Roberts, M., Davies, N., Green, K., Newsome, T., Ballard, G., Fleming, P., Dickman, C., Eberhart, A., Troy, S., McMahon, C. and Wiggins, N. (2013) The success of GPS collar deployments on mammals in Australia. *Australian Mammalogy* 35: 65-83.

Pye, G., Ellis, W., **FitzGibbon, S.**, Opitz, B., Keener, L., Arheart, K., and Cray, C. (2012). Serum protein electrophoresis values for free-ranging and zoo-based koalas (*Phascolarctos cinereus*). *Journal of Zoo and Wildlife Medicine* 43(1): 177-180.

Campbell, H.A., R.G. Dwyer, **S. FitzGibbon**, C.J. Klein, G. Lauridsen, A. McKeown, A. Olsson, S. Sullivan, M.E. Watts, D. A. Westcott (2012). Prioritising the protection of habitat utilised by southern cassowaries *Casuarius casuarius johnsonii*. *Endangered Species Research* 17:53-61.

Ellis, W., Bercovitch, F., **FitzGibbon S.I.**, Melzer, A., Roe, P., Wimmer, J. and Wilson, R. (2011). Koala bellows and their association with the spatial dynamics of free-ranging koalas. *Behavioral Ecology* 22(2): 372-377.

FitzGibbon, S.I., R.S. Wilson & A.W. Goldizen (2011). The behavioural ecology and population dynamics of a cryptic ground-dwelling mammal in an urban Australian landscape. *Austral Ecology* 36(2): 722-732.

FitzGibbon, S.I. & C.E. Franklin (2010) The importance of the cloacal bursae as the primary site of aquatic respiration in the freshwater turtle, *Elseya albagula*. *Australian Zoologist* 35(2): 276-282.

Barth, B.J., **FitzGibbon, S.I.**, Carter, A.J. and Wilson, R.S. (2010). Effects of resource availability on dung beetle abundance and male horn size in Australian urban forest fragments. *Integrative and Comparative Biology* 50(1).

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Name: Rolf Jakob Schlagloth

Contact details: Central Queensland University
Building 361
Rockhampton Qld 4072
Phone: 0419200768
Email: r.schlagloth@cqu.edu.au

Date of birth: 9 June 1965
Citizenship: Australian

Rolf Schlagloth (PhD candidate Koala Ecology CQU) has been working on many aspects of the Koala in different capacities, in Victoria and Queensland since 1992. Mr Schlagloth has worked with universities, industry, government and community to investigate issues associated with koala ecology and management. These include:

- flora and fauna surveys, some associated with formal impact assessment (e.g. Golden Plains Shire, Ballarat (Vic); St Lawrence, St Bees Is (Qld)),
- Koala management plans (KPoM) and associated monitoring,
- revegetation strategies and restoration projects, restoration of koala habitat (e.g. Ballarat KPoM, Golden Plains Koala Habitat Atlas, Framlingham Koala Habitat Revegetation Project) and,
- Koala conservation biology (e.g. current research on Koala diet and movement in a roadkill blackspot).

He has provided impartial, expert advice to community, industry, state (Victoria) - federal agencies (e.g. National Koala Strategy) and local governments (e. g. Ballarat, Golden Plains, Moorabool, Macedon, Central Goldfields) on a variety of issues associated with koala conservation.

Mr Schlagloth has also worked as a science teacher and consultant *Australian Wildlife & Flora Research*. He has authored a number of technical reports (e.g. Koala Plan of Management for Ballarat) and co-authored scientific papers. He is very skilled in all aspects of koala research, including handling animals and surveying their habitat.

Mr Schlagloth has focused most of his studies and work around the Koala. The thesis for his undergraduate degree was centred on radio-tracking koalas along a highway with a high incidence of koala road-kill, his master's thesis 'Using the Koala as a community education flagship species: For what purposes, with what outcomes?' explored the purposes and outcomes of a community Koala conservation programme in Ballarat (Vic) and his current PhD research 'Modelling koala road-kill black spots' investigates how these animals use the habitat near a black spot but most importantly it aims at determining the parameters that contribute to koalas being killed on our roads.

QUALIFICATIONS

Master of Education Studies (2014) University of Ballarat
Graduate Diploma of Education (2008) University of Ballarat
Bachelor of Applied Science (1994) University of Ballarat
Certificate IV Training & Assessment (2011) ProSkills Mackay

In Progress
PhD CQUniversity

COMMITTEE MEMBERSHIPS

Central Queensland University (Qld) Research Committee of Academic Board	2013
Local Marine Advisory Committee for the Great Barrier Reef Marine Park Authority	2015 - current
Department of Primary Industries (Vic)	
Wildlife and Small Institutions Animal Ethics Committee	2005 – current
University of Ballarat Animal Experimentation Ethics Committee	2002 – current
Mt Buninyong Reserve Advisory Committee	2002 – 2011
Department of Human Services (Vic) Victorian Biotechnology Advisory Committee	2006 – 2008
Ballarat Region Conservation Strategy Implementation Committee	2001 – 2004

OTHER ASSOCIATIONS

Australasian Wildlife Management Society	1998 – current
Koori Heritage Trust	2002 – current
Australian Association for Environmental Education	2002 – current
Science Teachers Association of Australia	2008 – current
Central Qld Frog Society	2012 – current
Capricornia Landcare Group	2012 – current

Skills

Flora & fauna surveying; wildlife handling
Heavy articulated Driver Licence / 4WD, chainsaw & 1st aid training

PUBLICATIONS

Published research (and in progress)

Santamaria, F.; Keateley, M. and Schlagloth, R. (2005). Does size matter? (Tree use by translocated koalas). The Victorian Naturalist Vol. 122 (1).

Schlagloth, R.; Cahir, F. and; Clark, I. (in progress). The Historic Importance of the Koala in Aboriginal Society in Victoria (Australia): A Reconsideration of the Archival Record Koala in literature. Anthrozoös.

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Published reports

Schlagloth, R., Mitchell, D. and Rhodes, J. (2008). Use of Blue Gum Plantations by Koalas. A report to stakeholders in the plantation industry.

Schlagloth, R., Thomson, H. and Mitchell, (2006). Comprehensive Koala Plan of Management for Ballarat City Council (Part 1- The Plan, part 2 – resource document)

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Schlagloth, R. and Santamaria, F. (2001). Koala Survey for Ballarat. Report on an extensive survey of ratepayers' attitude to, and experiences with, koala conservation. City of Ballarat / Australian Koala Foundation.

Conference presentation & proceedings

Schlagloth, R. (2013). 'Koalas and roads: a case study in Ballarat, Victoria' in Flint, N. and Melzer, A. (eds), *Conserving Central Queensland's koalas*. Pp. 101-105, Koala Research Centre of Central Queensland, CQUniversity Australia, Rockhampton, Queensland.

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Schlagloth, R. (2001). How does GIS mapping help the Koala and the City of Ballarat? Newtech Conference for Regional People. Land Victoria. Deakin University Geelong.

Schlagloth, R. (2001). The Koala Conservation Project in Ballarat. Proceedings of a Conference on the Status of the Koala in 2001. Canberra, ACT. Australian Koala Foundation, Brisbane.

Appendix D: Ecological Assessment – Potential Offset Site (Kleinfelder, 2015)