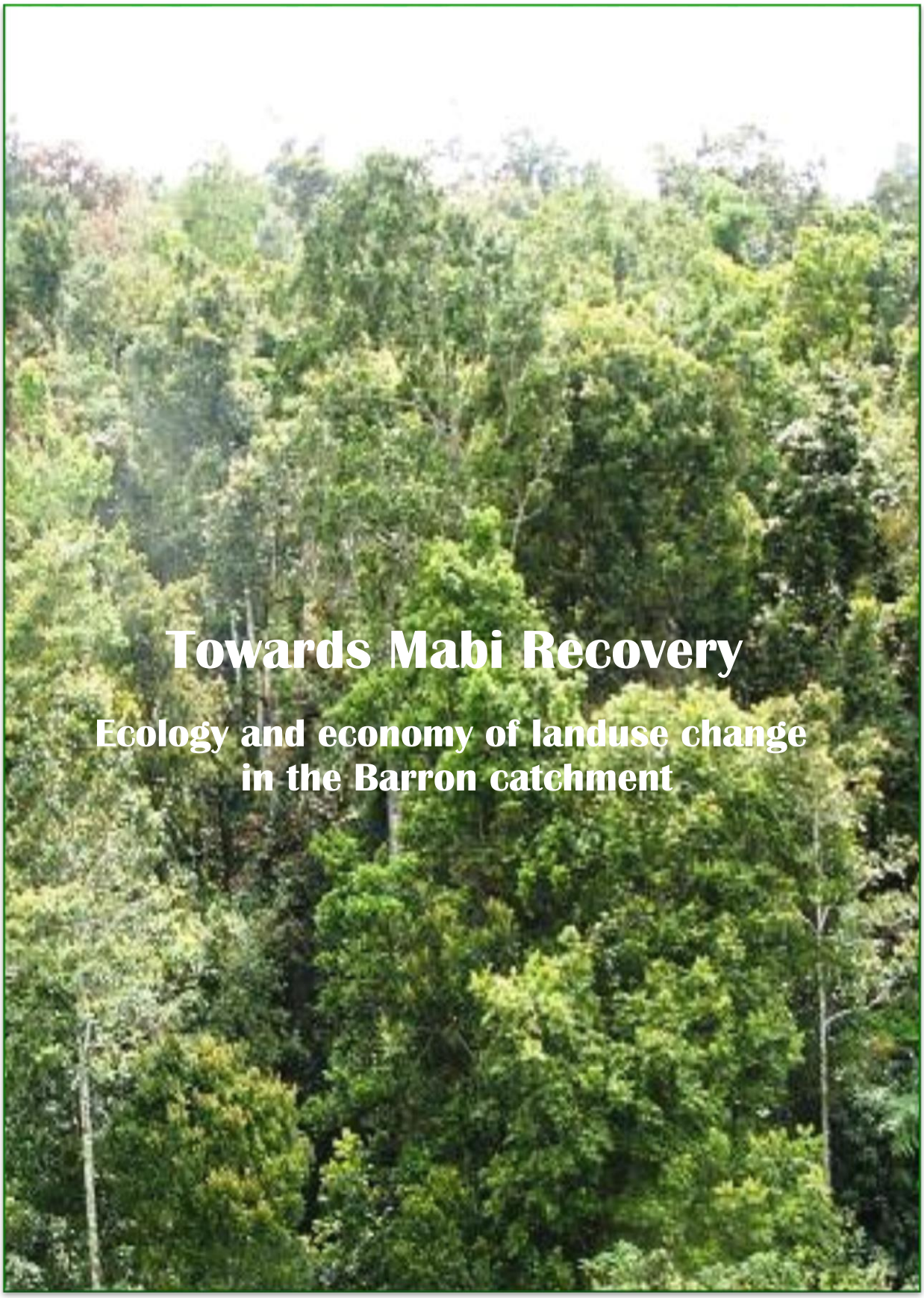

Towards Mabi Recovery

Ecology and economy of landuse change in the Barron catchment

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June 2008

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PREFACE

To ensure key stakeholder awareness of the study at its commencement, meetings were held between myself, as principle researcher, and the following: Alan Gillanders (Chair of Mabi Recovery Group), Peter Latch (principal author of the *Recovery Plan for Mabi Forest 2007-2011*), Kerry Hanrahan (Forestry Plantations Queensland), Kym Forde and Geoffrey Onus (Terrain and the Green Corridor Project), Dave Hudson (Conservation Volunteers Australia), the TREAT management committee, Larry Crook (Tree Kangaroo and Mammal Group) and the Scientific Advisory Committee of the Wet Tropics Management Authority.

In addition, representatives of the traditional owners Nola Joseph (Tableland Yidinji) and Ernie Raymont (Ngadjon-jii), were appraised of the thrust of the research, and its findings.

Three students at the Centre for Rainforest Studies, in the School for Field Studies, Yungaburra – where I was at that time Lecturer in Environmental Policy and Socio-economics – undertook research projects under my direction, in the fall semester of 2007. This report includes a synthesis of the work of the students, which is specifically acknowledged.

Colin Hunt
June 30, 2008

CITATION

Colin Hunt, *Towards Mabi recovery: Ecology and economy of landuse change in the Barron catchment*, A report for the Scientific Advisory Committee of the Wet Tropics Management Authority, Cairns.

ACKNOWLEDGEMENTS

The assistance of the following is gratefully acknowledged. Peter Latch, of Queensland Parks and Wildlife Service, Atherton, who provided aerial photography; Ian Sinclair of Natural Resources and Water, Atherton, who matched plan codes and lot numbers with the names of property owners, and Kerry Hanrahan, of Forestry Plantation Queensland, Atherton, who made available details of plantations and a map of Wongabel State Forest, and provided a permit for entry to the plantations.

Ross Chapman generously agreed to be a respondent in testing the landowner questionnaire, while the study benefited greatly from the cooperation of the following property owners in the oposed corridor: Bob and Anne Peever, Gary and Marilyn Scott, Frank and John Gallo, Margerie Morrison, Royd McInnes and Les Coleman.

Finally, Ian Breckheimer, a School for Field Studies Intern, is thanked for his assistance in using ArcGIS.

EXECUTIVE SUMMARY

AIM OF THE STUDY

The Australian government has classified the Mabi Forest as a "critically endangered ecological community" and the Queensland government lists the Mabi Forest, made up of regional ecosystem 7.3.37 and 7.8.3, as "endangered".

This study was inspired by the *Recovery Plan for Mabi Forest 2007-2011* developed by the Australian Government and the Environmental Protection Agency/Queensland Parks and Wildlife Service (Latch 2007).

Action to increase conservation outside reserves has been urged by the Scientific Advisory Committee (SAC) that advises the Board of the Wet Tropics Management Authority. In a submission to the Board in relation to potential impacts of climate change on the Wet Tropics World Heritage Area the SAC stressed that:

> There should be increased emphasis on off-reserve conservation to improve connectivity of reserves, allow movement of species and communities across the landscape in response to alerted climates, and maximise the resilience of the whole landscape to altered climates (SAC 2007).

This study aims to increase the emphasis on off-reserve conservation on both private and public land, and improve connectivity by proposing a corridor linking the major remnants of an endangered ecosystem.

More specifically the study follows up on the actions listed in the *Recovery Plan for Mabi Forest 2007-2011*:

- Refine the maps of remnant and rehabilitating Mabi Forest, since the long-term recovery of Mabi Forest is dependent on the recovery of habitat.

- Enhance management and protection of Mabi Forest on private land, through an investigation of incentives and non-regulatory approaches.

- Develop and implement a corridor plan to improve connectivity of Mabi forest remnants.

- Promote public awareness and participation.

- Develop strategies to enhance protection and management of Mabi Forest on private lands

- Facilitate Indigenous people's participation in the above actions.

STRUCTURE OF THE STUDY

Following Background that summarises the heritage values at Wongabel State Forest, the analysis is in three parts.

The first part establishes the ecological benefits of landuse change in the Wongabel State Forest from commercial plantations to conservation, and maps and establishes the ecological benefits of a reforested riparian corridor linking a Wongabel conservation area to the Curtain Fig National Park.

The second part discusses the socio-economic implications of changing the landuse from agriculture in the proposed corridor, maps the landowner-agreed corridor, and details landowner responses on impediments to and incentives for corridor establishment,

The third part examines the socio-economic implications of changing the landuse in Wongabel State Forest from commercial plantations to conservation.

FINDINGS

Ecological benefits of a change of landuse at Wongabel State Forest

The avoidance of harvesting of softwoods at Wongabel State Forest and allowing the forests to regenerate naturally will confer twofold benefits on the resilience of Mabi forest, which is listed as critically endangered by the Australian government.

First, it will mean that fragmentation of the present 263 hectares of Mabi Forest would be greatly reduced. When compartments are clear felled, edge effects in the Mabi are worsened and the remnant becomes much more vulnerable to cyclone damage.

Second, the 214 hectares of softwood plantations planted after 1988 will become invaded by rainforest species and will eventually become effective Mabi habitat. This regeneration will be facilitated by the close proximity of the seed source in the Mabi remnant. Accounting for the 48 hectares of old plantations that are already effectively regenerating would bring the total area protected at Wongabel to a total of 525 hectares – making it by far the largest remnant.

Fragmentation of the Mabi in Wongabel Sate Forest is exacerbated by forestry roads; those not needed for the management of Wongabel as a conservation forest should be closed and reforested.

The heritage values of Wongabel are considerable and these would be enhanced by protection and conservation of the area.

Economic and socio-economic benefits of a change of landuse at Wongabel State Forest

Turning to the economic benefits of landuse change at Wongabel it is found that the State Forest is worth far more as a carbon sink than it is as a plantation forest. The additional carbon sequestered in unharvested softwoods, compared with harvested softwoods, would make valuable additions to the carbon balance in the Australia's Landuse, Landuse Change and Forestry (LULUCF) inventory, given that net sinks in LULUCF offset Australia's greenhouse gas emissions. At a very minimum, the present value of the gain in value of carbon credits, due to foregoing harvesting, is estimated at $140,000, and at a maximum at $690,000. Moreover, the conservation of the plantations at Wongabel State Forest would avoid the substantial financial losses expected to be made by harvesting the plantations.

In the event of change of land use at Wongabel State Forest from commercial timber production to conservation, alternative supplies of softwoods would need to be found. Since most Wongabel plantings have taken place since 1988, the first harvest of logs of any quantity will not occur until year 2019 and the second in 2033; these will supply respectively 10% and 13% of current Ravenshoe Mill processing capacity. Subsequently, the major contributions to Ravenshoe Mill timber supply come in year 2043 and 2046, when 30% of its current capacity would be supplied by the Wongabel State Forest. It is possible that alternative supplies will be available from other Tablelands plantations of Forestry Plantations Queensland. However, this issue of mill impacts needs further clarification.

The employment impacts of ceasing plantation forestry at Wongabel State Forest, in terms of pruning, thinning and harvesting activity, are found to be minimum, given

the small proportion of the total forestry estate of Forestry Plantations Queensland in North Queensland that this area represents.

The enhancement of the considerable heritage values at Wongabel by their conservation and their presentation would lead to an increase in tourism at the site and generate an increase in economic benefits for the region.

The traditional owners have formally supported a change of landuse to conservation of Wongabel and have expressed a desire to be involved in the presentation of its enhanced heritage values.

Ecological benefits of a corridor linking Wongabel conservation area and the Curtain Fig National Park

Information is presented that suggests that a reforested corridor linking a forest conservation area at Wongabel with the Curtain Fig National Park which is part of the Wet Tropics World Heritage Area (WTWHA) would enhance the prospects for Mabi's long term persistence as an ecosystem, particularly in the face of climate change. The quality of remnants of endangered ecosystems within the corridor would also be enhanced.

A riparian corridor along both banks of the Barron River and Leslie Creek presents itself as the most economical and effective route for a corridor. The report maps the original vegetation and remnant vegetation on the eleven private properties that would host the corridor.

Socio-economic and financial implications of a corridor linking Wongabel conservation area and the Curtain Fig National Park

Landowner cooperation is crucial to the success of a corridor. Interviews of six of the eleven owners of land in the corridor revealed in-principle support for the initiative and several landowners willingly allocated land during the interview process. Survey responses suggest that landowners will respond even more positively to incentives that lessened the perceived opportunity costs of hosting the corridor.

Given that the Green Corridor Project is already rehabilitating the Upper Barron, this project would require additional financial and community organisational support to reforest only the Leslie Creek part of the corridor.

Reforestation in the Wet Tropics Region is a costly exercise. A preliminary estimate is that such a 50 metre corridor would require 16 hectares of reforestation. At present prices this area would cost $88,000 per year for ten years. Additional costs would be incurred for important landowner incentives such as stock fencing and the provision of stock watering infrastructure.

BACKGROUND

The Wongabel State Forest has important heritage values as well as economic and biodiversity values; to aid their appreciation they are summarised below.

HERITAGE VALUES

Indigenous heritage

The traditional owners of Wongabel used the area as a seasonal camp, hunting and gathering fruits and nuts and fishing in the Barron River and creeks.

There are no native title claims over the Wongabel forest area and traditional ownership is disputed, the Tableland Yidinji and the Ngadjon-jii both laying claim to the Wongabel State Forest area.

As part of the study, interviews with elders of the two two tribes were conducted to ascertain support for a change of land use, that is from production forest to restored rainforest at Wongabel State Forest. The proposals were explained and discussed with the elders of both tribes – Nola Joseph of the Tableland Yidinji and Ernie Raymont of the Ngadjon-jii.

Non-Indigenous heritage

All commercially valuable timber was removed from Wongabel State Forest in the early 1900s. The land was too stony for agriculture and was more suitable for forestry. In 1903 work started, and continued for three or four years, on returning red cedar to the forest. The forestry plantation program was the first of its kind in Queensland; plantings of a variety of species began in 1911, lapsed with the First World War but restarted again in 1929 through government employment schemes. Several compartments of that vintage remain. Forester Sam Dansie was influential in introducing a conservation ethos into forestry management resulting in the set aside of conservations areas within the Wongabel State Forest (EPA 2007a).

Figure 1: Wongabel walking track

Photo: Courtesy of T. Vallance

Two walking tracks, of 0.75km through Mabi forest and 2.5km (see Figure 1) through Mabi forest and adjacent to hoop pine plantations (planted in year 2000), are under the jurisdiction of EPA/QPWS. The walking tracks are open 24 hours a day thus providing opportunities for viewing the forest, kangaroos and possums.

The tracks have interpretive signage and are designed for wheelchair access and for walkers who are vision impaired. Braille booklets, tactile maps and audio headsets are available from the Atherton Tableland Information Centre (EPA 2007b).

The documentation of common and botanical names of 190 trees, was used as a training tool for forestry employees (Queensland Department of Forestry 1987). Many of these trees are named on the walking track, providing a valuable source of information for people wanting to identify Mabi tree species.

1. MABI FOREST ECOLOGY AND THE ECOLOGICAL BENEFITS OF A CORRIDOR

1.1 BIODIVERSITY VALUES AND THE STATUS OF MABI FOREST

This first major section reports on the ecological benefits of changing the landuse at Wongabel from commercial forestry to conservation and of the establishment of a corridor linking a conserved Wongabel forest to the Curtain Fig National Park which is part of the WTWHA.

Complex Notophyll Vine Forest, unique to the Atherton Tableland, was first described in the 1960s by Tracey and Webb (1975), based on its physical characteristics and species composition. This type of forest occurs only on fertile basalt soils in areas where the annual rainfall averages between 1300 to1600mm, which includes Wongabel State Forest much of the proposed corridor and Curtain Fig National Park.

Type 5b forest, classified by (Tracey 1982), is now commonly referred to as Mabi Forest ("Mabi" is said to be the aboriginal name for the tree kangaroo (*Dendrolagus lumholtzi*)) (EPA 2007a:1).[1] Under Queensland's Regional Ecosystem framework, Mabi is identified as regional ecosystems 7.8.3 (Complex Semi-Evergreen Notophyll Vine Forest of uplands on basalt) and 7.3.37 (Complex Semi-Evergreen Notophyll Vine Forest of uplands on alluvium) (EPA 2005).

Over 130 species of birds inhabit the Mabi forest, many being endemic to the wet tropics. Red legged pademelons (*Thylogale stigmatica*) are often seen in Wongabel, while the Lumholtz's tree-kangaroo, the best known mammal inhabiting the Mabi, is declared rare. Also listed as rare are the greater large-eared horseshoe bat (*Rhinolophus philippinensis*, the diadem leaf nosed bat (*Hipposideros diadema reginae*), the Herbert River ringtailed possum (*Pseudochirulus herbertensis*) the green ringtail possum (*Pseudochirops archeris*) and the lemuroid ringtail possum (*Hemibelideus lemuroides*).

[1] However, elder Ernie Raymont (2007) advises that the pronunciation by the Ngadjon-jii of the word for tree kangaroo is "Mapi".

Several wet tropics endemics – the Boyds forest dragon (*Hypsilurus boydii*), the skinks (*Carlia rubrigularis)* and (*Saproscincus basilicus*) and the northern crown snake (*Cacophis churchilli*) – have been recorded in the Mabi (EPA 2007a).

Mabi forest once extended north and west of Malanda but European settlement and clearing has left only 2% of the original area. Of the remaining 1,050 hectares, 860 hectares is located on the Atherton Tableland (EPA 2005).

1.1.1 Mabi forest - A nationally threatened ecological community

The loss and fragmentation of Mabi habitat has led to a reduction in species abundance and diversity (Laurance 1991; 1997). The Mabi forest of the Tableland is not only greatly reduced, it is also highly fragmented, which further increases its vulnerability. The Curtain Fig National Park of 271 hectares is the largest remnant, and Wongabel State Forest of 263 hectares is the second largest, but the latter also suffers from a high degree of internal fragmentation.

Regeneration of fragments is further inhibited by cattle grazing where fragments are unfenced. Watercourses that once flowed through rainforest are now being encroached upon by crops and cattle, contributing to stream bank erosion and poor water quality, and affecting both humans and wildlife (Atherton Shire Council 2005, Barron River Integrated Catchment Management Association Inc. 2004). Additional serious threats to wildlife are feral and domestic dogs (Schmidt et al. 2000).

Mabi Forest is listed as a critically endangered ecological community under the *Commonwealth Environment Protection and Biodiversity Conservation Act, 1999*. The Mabi Forest ecological community meets criterion 1 as endangered for having had a severe decline in geographic distribution of more than 90%; criterion 2 as critically endangered for having a very restricted total area of occupancy coupled with demonstrable threats; criterion 3 as critically endangered for having a loss and decline in functionally important species; and criterion 4 as critically endangered for having a severe reduction in community integrity (Australian Government 2008a).

The 1,050 ha of Mabi Forest left is in a series of isolated patches, many of which are being invaded by exotic smothering vines and feral and domestic animals. The purpose of the listing is to prevent its further decline, and assist community efforts toward its recovery (Australian Government 2008b).

Under the *Queensland Vegetation Management Act* 1999 Mabi Forest is "endangered", and a range of Mabi forest flora and fauna have been designated as "vulnerable" or "rare" under the Queensland's *Nature Conservation Act*, 1992. Six

plant species are listed as rare, and two of these, the pink leaf Haplostichanthus (*Haplostichanthus sp.*) and the red-fruited sauropus (*Sauropus macranthus*) have been recorded in Wongabel forest (EPA 2007a). However, the valuable seed dispersers *Casuarius casuarius* (southern cassowary) and *Hypsiprymnodon moschatus* (musky rat-kangaroo) have become extinct in Mabi, hindering regrowth (Stocker and Irvine 1983; Dennis 2003). For the status of Mabi forest fauna and flora see Appendix 3.

1.1.2 Community action in restoration

The local community has been a key stakeholder in the fight for the protection of Mabi Forest. The concern of the local community over the decline of this unique rainforest was so great that the Mabi Forest Working Group was formed to promote the forest's conservation. Key participants in the Working Group include Queensland State and Local Government Agencies, Trees for the Evelyn and Atherton Tableland Inc. (TREAT), the Tree-Kangaroo and Mammal Group Inc. (TKMG), and the Barron River Integrated Catchment Management Association (BRICMA).

The Working Group has participated in and encouraged activities aimed at rehabilitating existing patches of Mabi Forest, and replanting areas where the rainforest once occurred. The Working Group also provides assistance to local landholders and community groups interested in preserving or replanting Mabi Forest on their land. There are approximately 10 sites currently being rehabilitated by the local community, using trees that were grown from seeds by volunteers (Australian Government 2008b).

1.2 MAPPING THE PROPOSED CORRIDOR

Together, the Wongabel and Curtain Fig fragments total 56 percent of the remaining Mabi Forest (EPA 2005) thus to connect them with native vegetation would enhance the resilience of both fragments and the Mabi forest as a whole. A riparian corridor along the Barron River and Leslie Creek would also enhance the endangered ecosystems 7.3.37, 7.8.3, 7.3.43, 7.12.16, 7.3.39 as well as to improving riparian and Tinaroo Dam water quality.

1.2.1 The optimum corridor

The Barron River and Leslie Creek offer an advantageous route for the corridor in terms of practicality and ecological benefits. The intended optimum width of the corridor is 50 meters wide on each bank (Tucker 2000). The corridor was mapped using aerial photos

obtained from the Queensland Parks and Wildlife Services, covering Wongabel State Forest, Curtain Fig National Park, the Barron River, and Leslie Creek. A map of the proposed corridor was created from the aerial photos using ArcGIS software (Hankinson 2007; Wong 2007).

The total area of the proposed corridor along the Barron River and Leslie Creek linking the Wongabel State Forest and Curtain Fig National Park is 101 hectares. Where the corridor turns north east, towards the Curtain Fig NP from Leslie Creek, it leaves the riparian zone and runs adjacent to a rock wall to meet Curtain Fig National Park (see Figure 2).

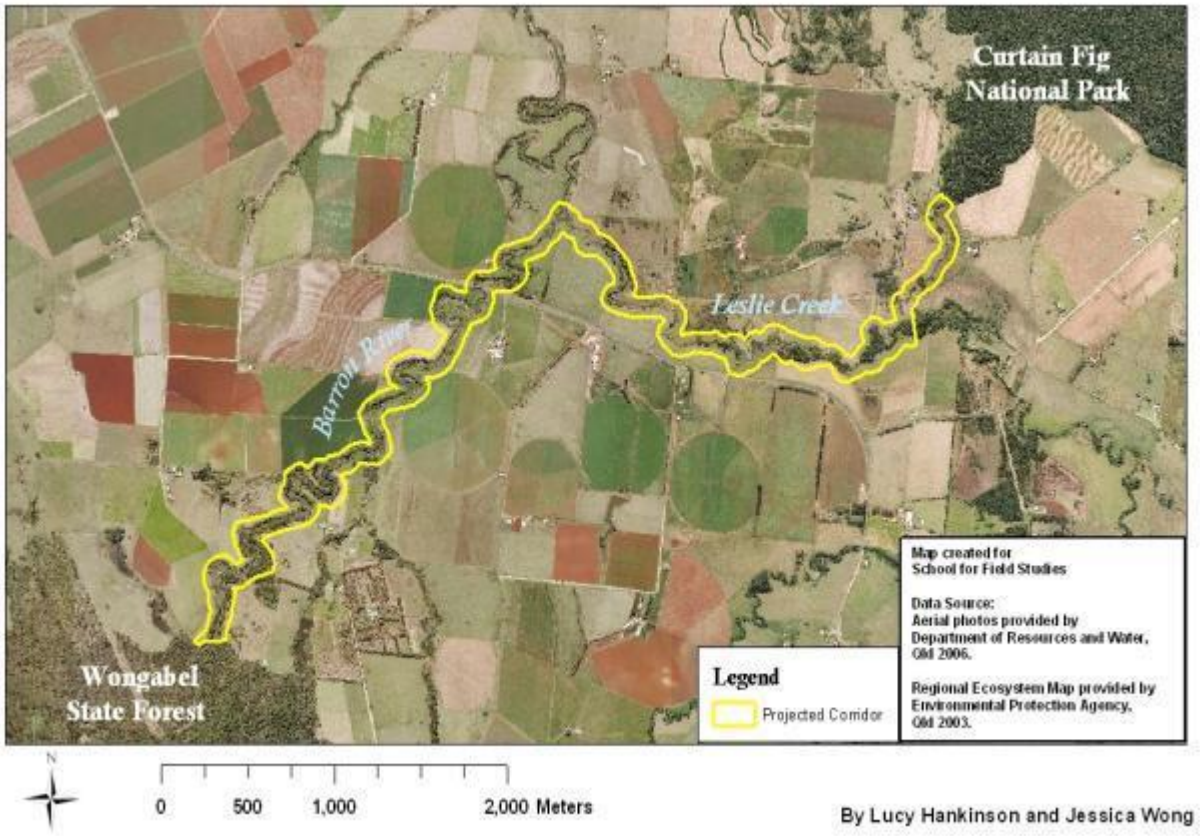


Figure 2: The 100 metre-wide wide proposed riparian corridor connecting Wongabel State Forest and the Curtain Fig National Park, sourced from 2006 aerial photographs and developed in ArcGIS

Source: Hankinson (2007); Wong (2007).

1.2.2 Identifying and mapping regional ecosystems

The identification and extent of regional ecosystems in the proposed corridor provides an indication of the biodiversity benefits to be gained *in situ*, in addition to the enhancement of biodiversity benefits by linking Mabi remnants.

The lot numbers of private properties within which the corridor lies were obtained from the *Plan of the Shire of Atherton* (Queensland Government 2004). Landowners' names were then matched with lot numbers (Sinclair 2007) enabling the mapping of ecosystems and remnant vegetation according to ownership. However, due to time constraints, only six of the eleven property owners that abut the Barron River and Leslie Creek were verified by contact and interviewed.

Five regional ecosystems within the proposed corridor are identified: 7.8.3, 7.3.37, 7.3.43, 7.12.16, 7.3.39. The section of the corridor along the Barron River is predominantly regional ecosystem 7.3.37. The section of the corridor along Leslie Creek includes the regional ecosystems 7.3.43, 7.8.3, and 7.3.39. The most prevalent regional ecosystems are 7.3.37 and 7.3.43. The least prevalent regional ecosystem is 7.12.16 (EPA 2005). (See Figure 3). These regional ecosystems are further described below.

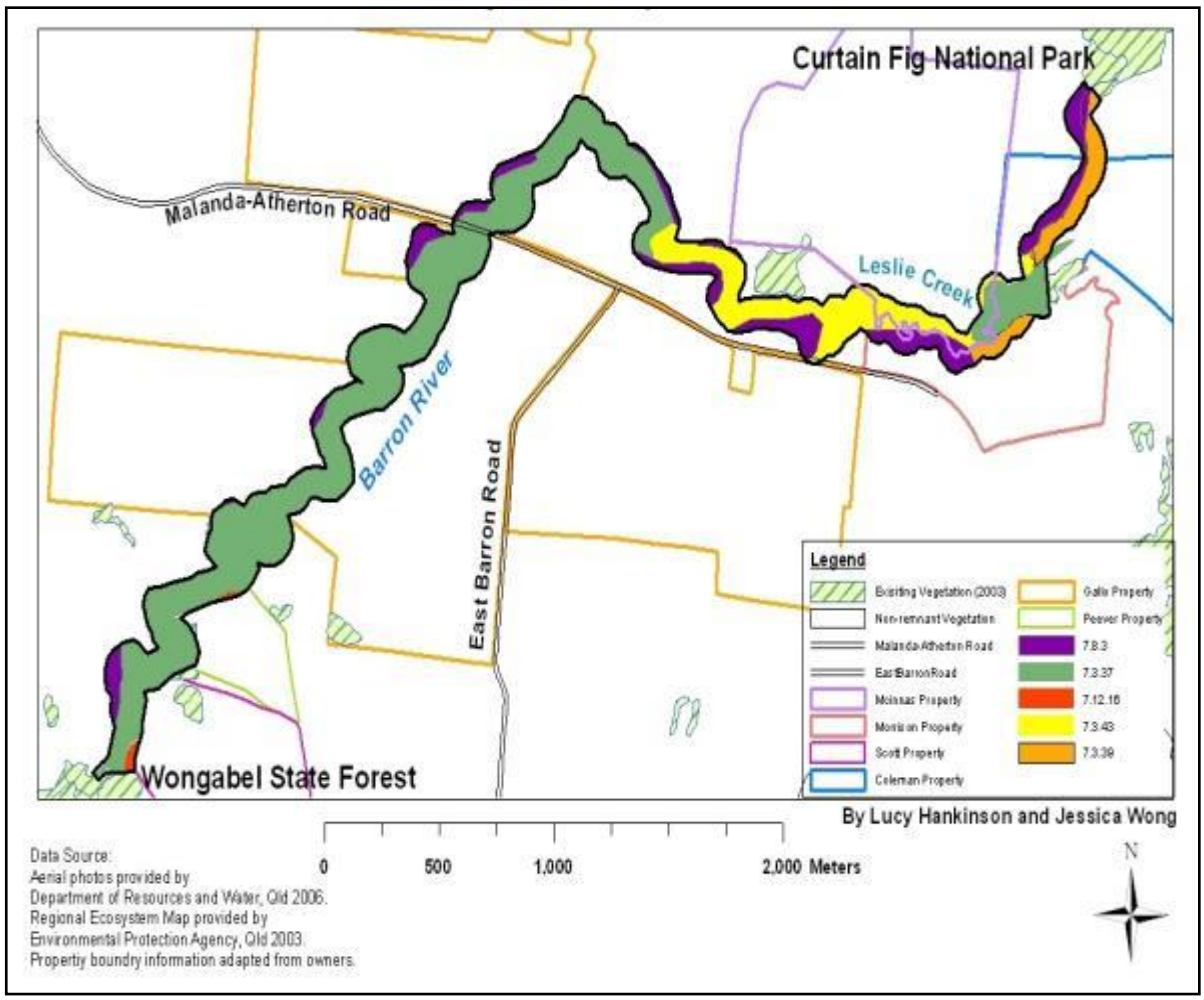


Figure 3: The distribution of regional ecosystems within the proposed corridor and boundaries of six private properties, developed in ArcGIS

Source: Hankinson (2007); Wong (2007).

The area of each regional ecosystem in the corridor is summarised in Figure 4.

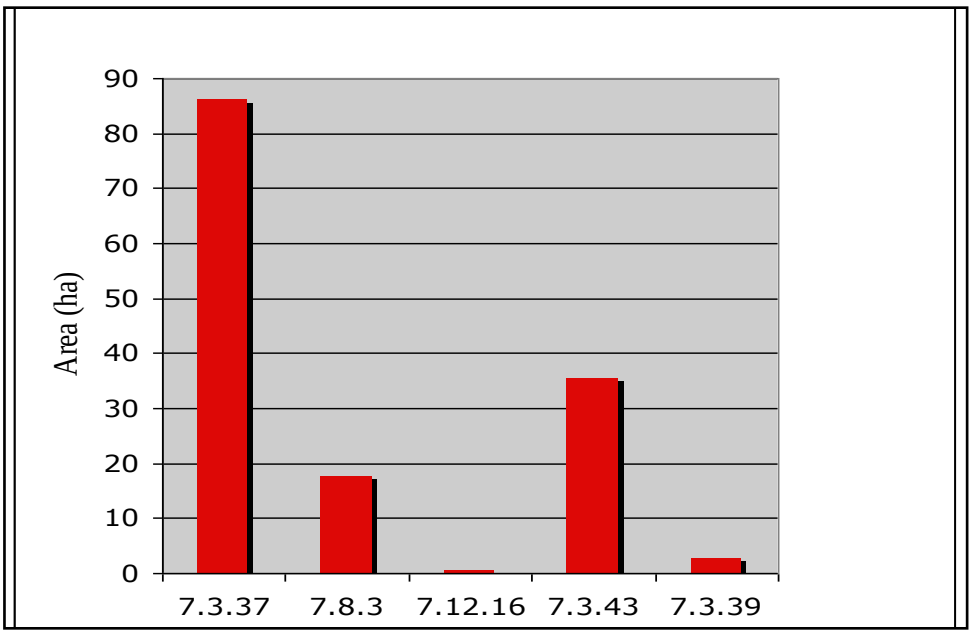


Figure 4: Areas of regional ecosystems within the proposed corridor

Source: Wong (2007).

1.2.3 Identifying and mapping remnant vegetation

The identification of location and area of remnant vegetation is important in that remnants would be beneficially incorporated into the tree planting program for the corridor.

Twenty two hectares of remnant vegetation exists within the corridor on the 11 private properties (see Figures 5 and 6), constituting some 20% of the total corridor area. The type of vegetation in the remnants may be determined by overlaying the ecosystem maps with the remnant vegetation maps. The property with the most remnant vegetation was Gallos' and it represented only 6.9% of the total property (Figure 7)). The smaller Peever property exhibited the greatest percentage of remnant vegetation, 62.2% .

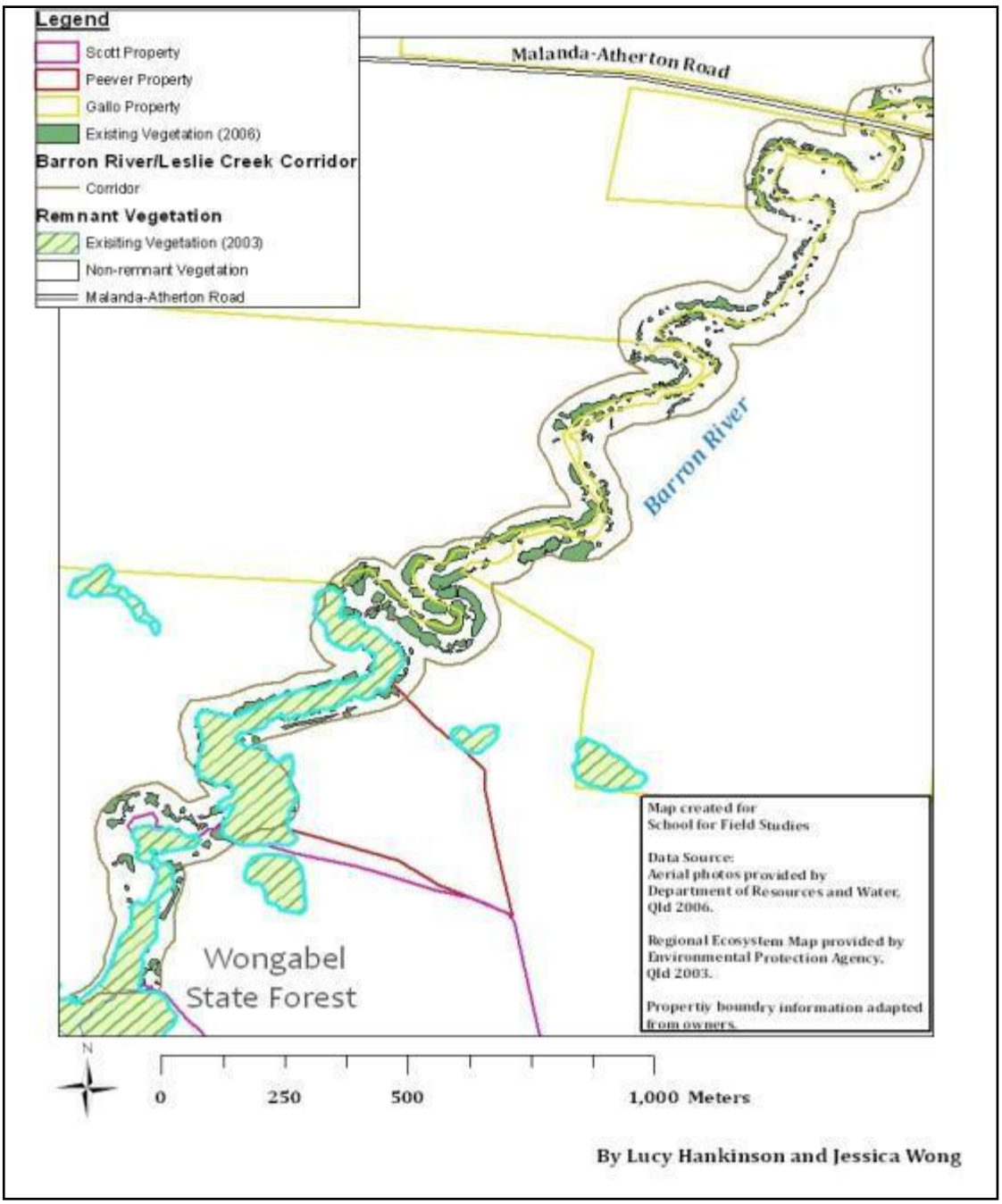


Figure 5: The Barron River section of the proposed corridor, showing property boundaries, and remnant vegetation as of 2006, developed in ArcGIS

Source: Hankinson (2007); Wong (2007).

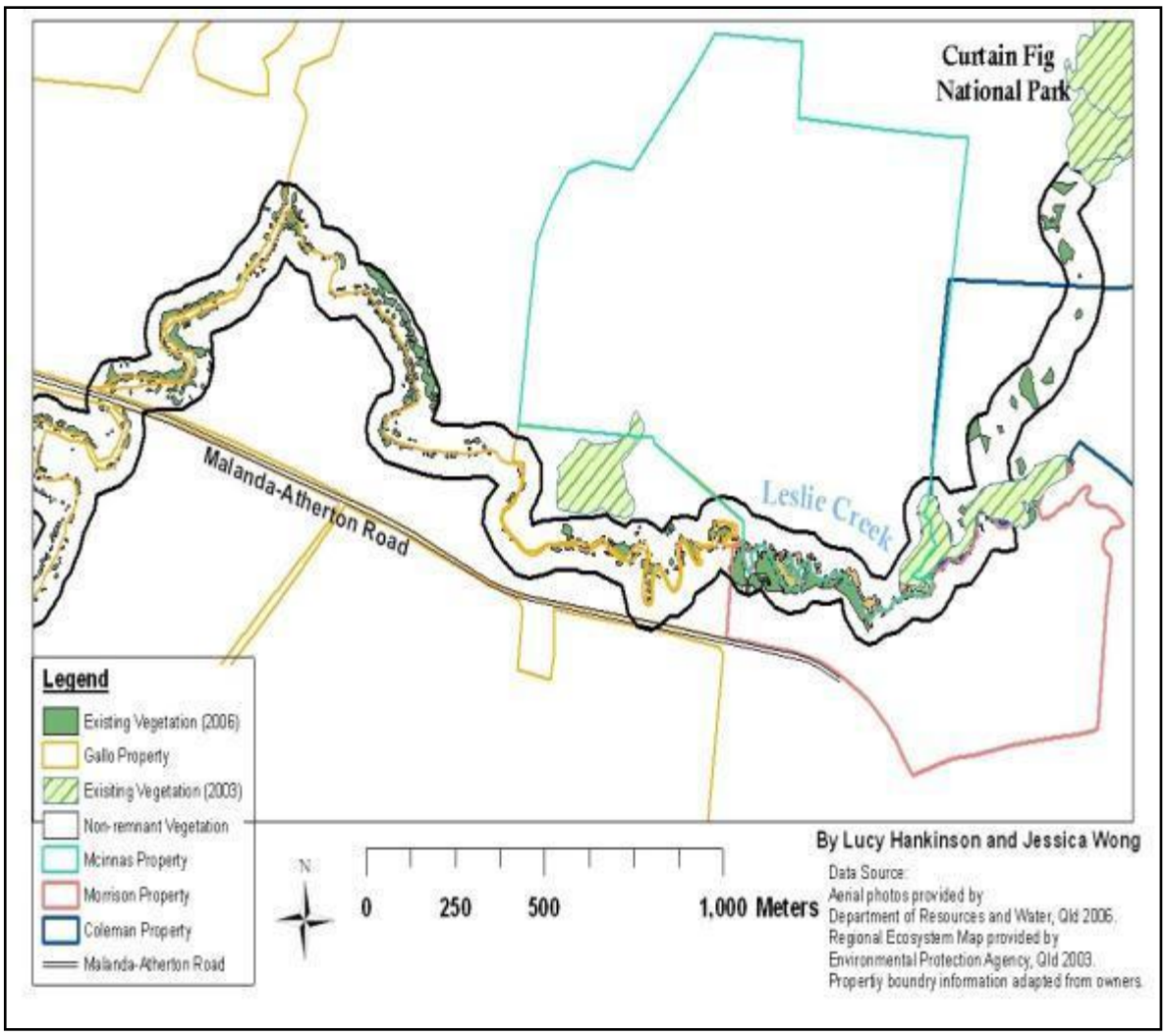
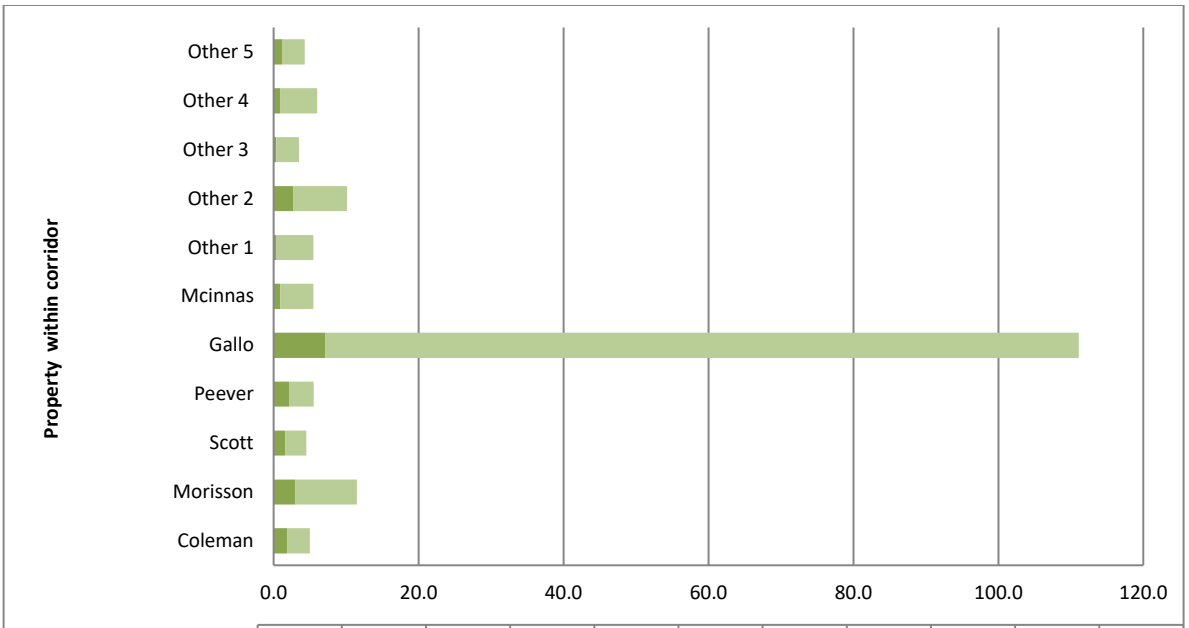


Figure 6: The Leslie Creek section of the proposed corridor, showing property boundaries and remnant vegetation, as of 2006, developed in ArcGIS

Source: Hankinson (2007); Wong (2007).



	Coleman	Morisson	Scott	Peever	Gallo	Mcinnas	Other 1	Other 2	Other 3	Other 4	Other 5
Area of remnant veg. (ha)	1.9	3.0	1.6	2.1	7.2	0.9	0.4	2.7	0.4	0.9	1.1
Total property (ha)	3.1	8.5	2.9	3.4	103.9	4.6	5.1	7.4	3.2	5.1	3.1

Figure 7: Area of remnant vegetation on the eleven properties in the proposed corridor

Note: "Other" denotes properties where ownership was not confirmed during the study

Source: Hankinson (2007); Wong (2007).

1.3 DISCUSSION OF THE ECOSYSTEM BENEFITS OF WONGABEL RESTORATION AND CORRIDOR ESTABLISHMENT

1.3.1 Reducing fragmentation

The Wongabel Mabi forest of 267 ha is highly degraded, compared to the Curtain Fig National Park, through fragmentation by the establishment since the early 1900's of commercial timber compartments of 213 hectares of plantations, as well as by forestry roads (EPA 2007a).

Fragmentation reduces biodiversity in several ways (see Pickett 1990):

- Fragments represent only a sample of the original habitat and species may die out by chance. Endemic species are particularly vulnerable to population loss or extinction if an area is eliminated or degraded. .
- Fragments are often uninhabitable by native species due to the modification of the adjacent landscape. The viability of smaller populations may be contingent on their ability to move between patches and farmland may pose an effective barrier: an example is shown in Figure 8.

Figure 8: Dairy cattle grazing in Leslie Creek

All vegetation has been completely eliminated from this stretch of the Creek forming a barrier to fauna movement, while cattle prevent any natural revegetation, directly pollute the creek and erode its banks.

Photo: Colin Hunt.

- Fragments are more vulnerable to climatic change and the entry of opportunistic predators and competitors.

- Species with large home ranges can suffer disproportionately. Examples are the Southern Cassowary (*Casuarius casuarius johnsonii*) and the Musky rat-Kangaroo (*Hypsiprymnodon moschatus*), both locally extinct in Mabi.

The fragmentation of Mabi in Wongabel State Forest has also left it vulnerable to cyclone damage. Figure 9 illustrates this vulnerability by showing how a westerly facing fragment in the Wongabel State Forest was heavily impacted by Cyclone Larry in 2006.

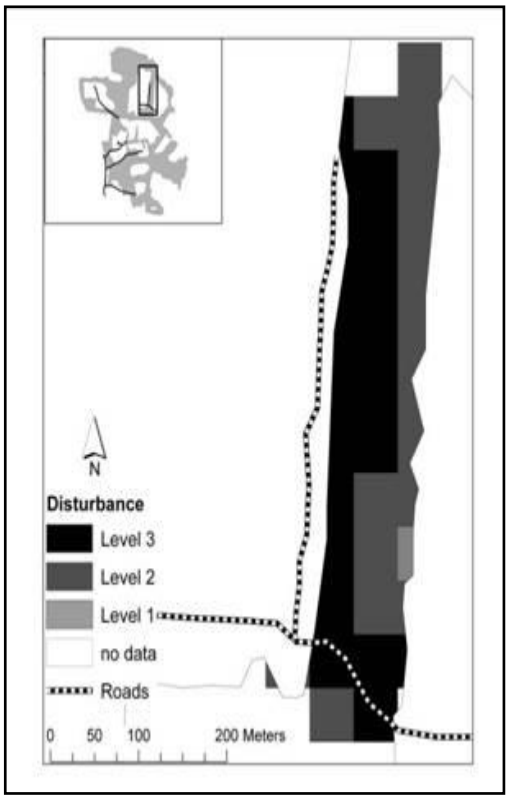


Figure 9: Cyclone disturbance levels in a westerly-facing fragment of Mabi forest

Source: Curran (2007).

The options in combating fragmentation are to increase fragment size, to create corridors between fragments or to create buffers around fragments (Tucker 2000). In this proposal, the increase in size of the Mabi forest at Wongabel due to the ceasing of harvesting will be complemented by the increase in fragment size in the corridor, as well as by the linkage between Wongabel, the enhanced corridor fragments and the Curtain Fig National Park. The remnants themselves will be a source of seeds for growing seedlings to be planted as well as a source of seeds dispersed by fauna subsequent to reforestation (Latch 2007).

1.3.2 Enhancing regional remnant ecosystems

Five regional ecosystems were found through mapping in the proposed corridor (Figure 6). The ecosystems that make up Mabi 5b Forest are 7.3.37 (Complex semi-evergreen notophyll vine forest; uplands on alluvium), and 7.8.3 (Complex semi-evergreen notophyll vine forest; uplands on basalt) (EPA 2005). There are only eight hectares of 7.3.37, divided into three smaller fragments, in existence (EPA 2005). A prominent ecosystem within the corridor was 7.3.43 (*Eucalyptus tereticornis* open forest to woodland; on uplands on well drained alluvium) (EPA 2005). Under Queensland's Vegetation Management Act, all three of the above ecosystems are listed as endangered.

Ecosystem 7.3.39 (*Eucalyptus tereticornis* ± *E. platyphylla* ± *Corymbia intermedia* ± *Lophostemon suaveolens*; open woodland to open forest, and associated sedgelands and grasslands, on broad drainage depressions of uplands) and 7.12.16 (Simple to complex notophyll vine forest of cloudy wet and moist uplands and highlands; on granites and rhyolites, including small areas of *Araucaria bidwillii*) are also present within the corridor.

Avoiding the harvesting of the hoop and carabaea plantations is an effective means of re-establishing Mabi forest in the Wongabel State Forest (Stanton 2007). This option is much cheaper than that of planting rainforest after the compartments have been harvested. The replanting option would not only involve the considerable expense of reforestation but would also involve losses in harvesting and sale of the softwoods and incurring an opportunity cost of reduced carbon credits (see the section on the economics of harvesting).

1.3.3 Ecological benefits of the corridor

Corridors have four main functions (Forman 1983):

1. Provision of habitat.
2. Facilitation of movement of plants and animals along the corridor.
3. Acting as barrier to the movement of certain species.
4. Provision of a source of environmental and biotic benefits to the surrounding landscape.

In some places along the proposed corridor there is a complete absence of vegetation, as illustrated in Figure 10.

Figure 10: Absence of riparian vegetation on the Barron River

This paddock is on a potato farm, on the western bank of the Barron River at the southern end of the proposed corridor. A riparian corridor would reduce sedimentation of the river as well as providing habitat and linking remnants to the north and south.

Photo: Colin Hunt.

Riparian corridors are especially important because they are natural corridors, rich in fauna and flora that may not be found in adjacent environments and where two distinct, yet complementary, ecosystems meet: aquatic and terrestrial. Trees shade the water and affecting the temperature and composition of the instream biota. Locally there is the experience of Donaghy's corridor, that was found to be effective in the allowing isolated fauna populations to interbreed (Tucker 2000).

1.3.4 Incorporation of remnant vegetation

The vegetation that has survived the extensive clearing of the landscape is a mix of different types of flora with different origins. Some trees were planted by property owners, while others were the result of natural regrowth. Most of the remnant vegetation in the study area consists of isolated patches of trees in paddocks coexisting with crops and cattle. Boak and Gibbons (2002) define paddock trees as "isolated trees, small modified patches and woodland remnants up to one ha". These highly modified examples of native vegetation still have important ecological functions as follows:

1. Provide habitat for species that feed on pollen, nectar, and seeds, habitat for invertebrates and nesting grounds.
2. Enable some species to move between larger remnants and contribute to viability of small subpopulations.
3. Control invertebrate populations (i.e. pests).
4. Provide a potential focus of restoration projects (Boak and Gibbons 2002).

1.4 CONCLUSIONS ON THE ECOLOGICAL BENEFITS OF A CHANGE ON LANDUSE AT WONGABEL STATE FOREST AND OF A CORRIDOR LINKING WONGABEL WITH CURTAIN FIG NATIONAL PARK

The natural regeneration of the plantations in Wongabel State Forest will, over the long term, enlarge the fragment considerably, thus increasing the likelihood that the fragment will persist in the long term. There is already 263 hectares of Mabi in the State Forest and the natural regeneration of the commercial plantations will add another 214 hectares. To these areas must also be added the 48 hectares of older plantations that will never be harvested and that have already been invaded by Mabi forest species. The eventual total area of the remnant, if this proposal is followed, would thus be 525 hectares, making it by far the largest in existence.

A corridor linking the Wongabel and Curtain Fig forests would increase the area, and therefore the likelihood of persistence, of endangered ecosystems other than Mabi. The persistence of the fauna in the Wongabel and Curtain Fig remnants would also be enhanced by the mixing of genetic pools.

2. LANDOWNER RESPONSES TO A and maps the landowner-agreed corridor.

ND SOCIO-ECONOMIC IMPLICATIONS OF A CORRIDOR

2.1 LANDOWNER ATTITUDES AND RESPONSES

The agreement of landowners is crucial in achieving a functional wildlife corridor in terms of continuity and width. This second major section is aimed at increasing the understanding of the benefits and costs that landowners perceive to be associated with hosting a corridor and the types of incentives that would ameliorate impediments to its adoption. A survey of landowners was carried out with these objectives in mind but also with the objective of actually mapping the riparian area that landowners agree to give over to reforestation. This section also estimates the financial costs of reforesting a corridor.

The questionnaire was tested with a landowner who had hosted a corridor in another catchment. Using the refined questionnaire, a survey was conducted of six of the eleven property owners abutting the Barron River and Leslie Creek in the proposed corridor. Five owners of land in the proposed corridor were unable to be interviewed because of time constraints. However, the lot numbers and names and addresses of these landowners are listed in Appendix 2. It should be noted that recent changes in ownership may not be reflected in the list where landowners were not visited.

2.2 MAPPING THE LANDOWNER-AGREED CORRIDOR

During property visits the remnant vegetation shown on aerial photography was verified. This information was then digitized using a Garmin GPS 12 unit and mapped, and the results are shown overlaying ecosystem mapping in Figures 11 and 12. The location of the corridor on the Coleman property where it leaves the Leslie Creek to link with the Curtain Fig National Park is shown in Figure 13.

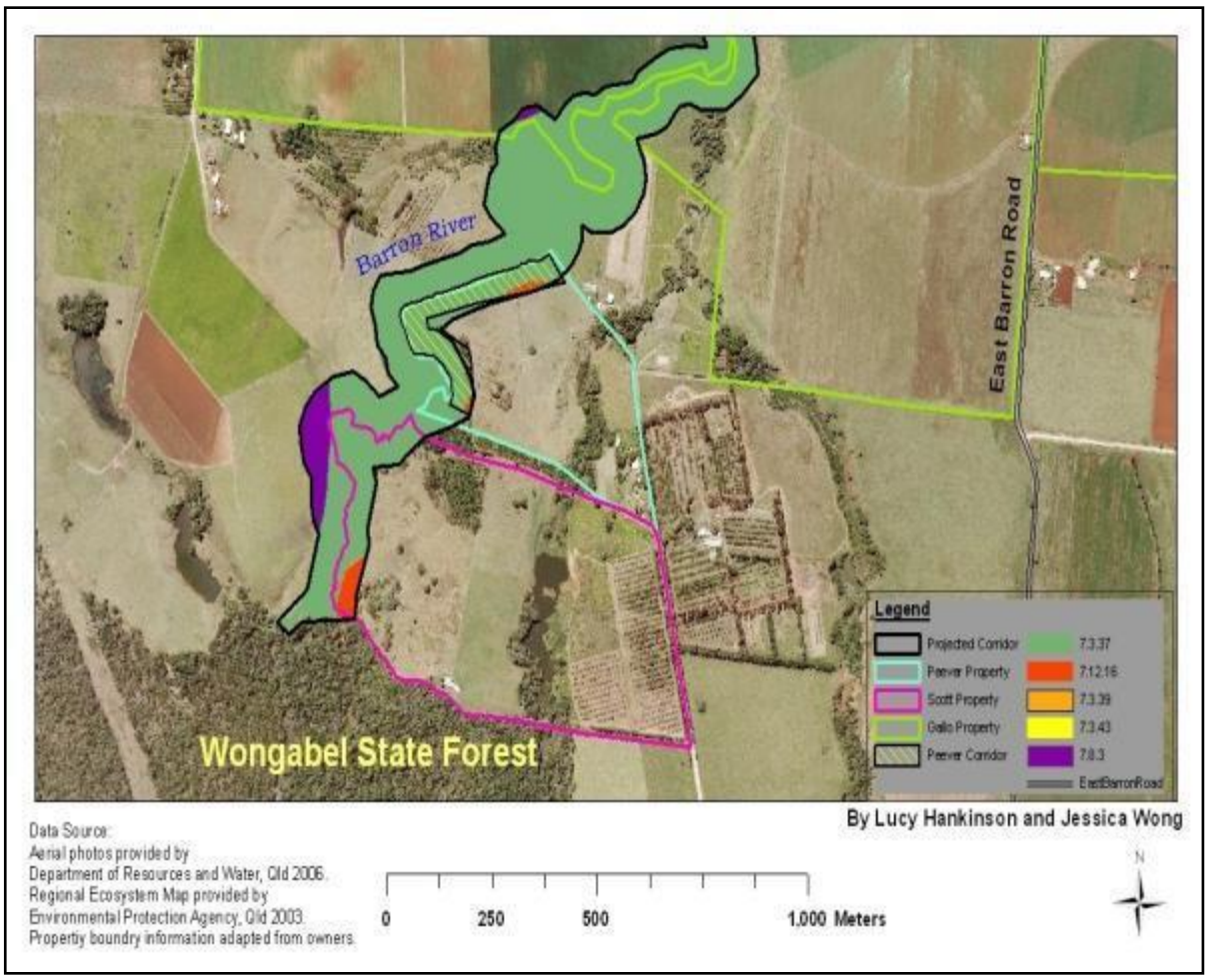


Figure 11: Property owner sanctioned corridor on the Barron River (GPS data inputted to ArcGIS)

Source: Hankinson (2007); Wong (2007).

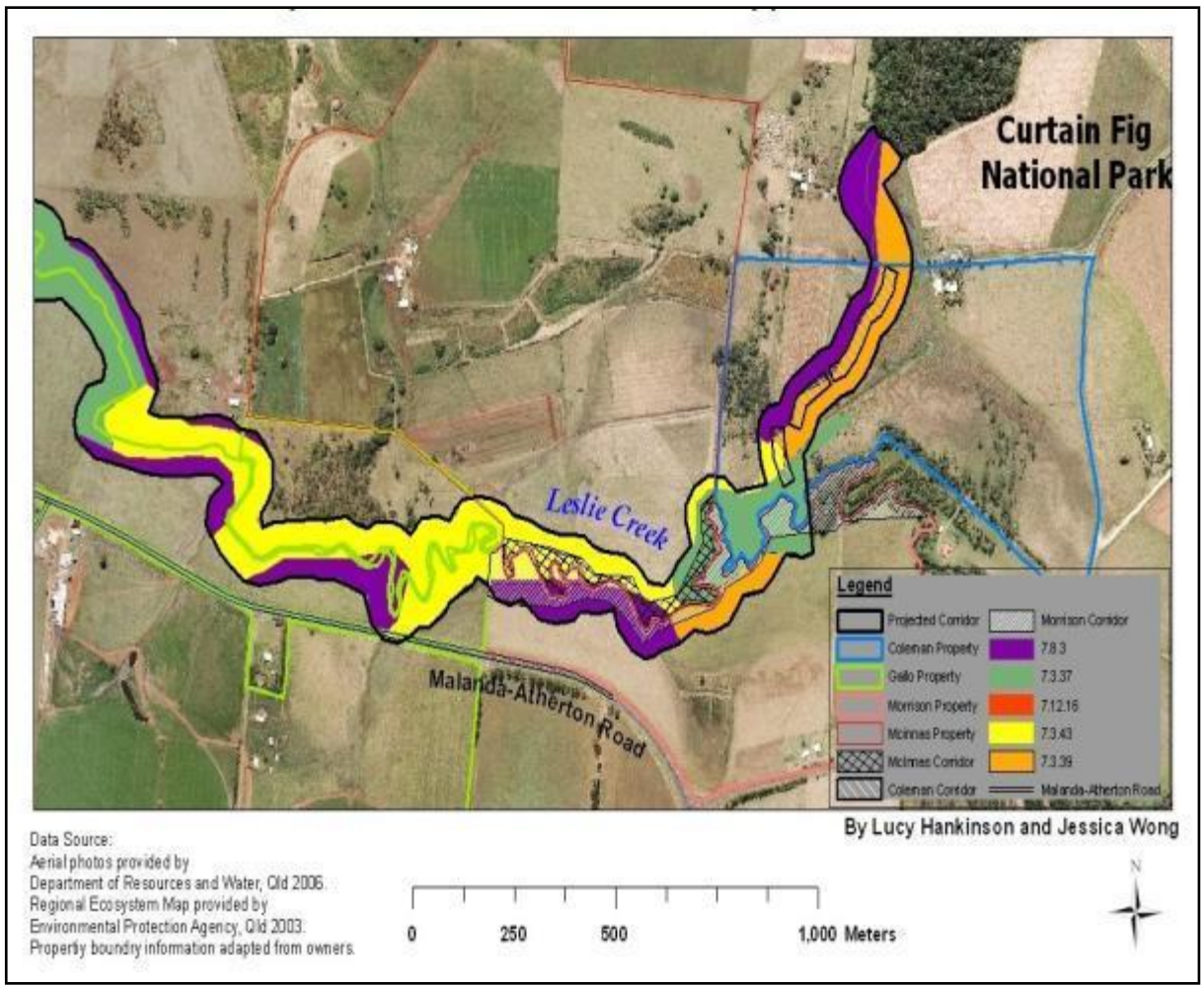


Figure 12: Property owner sanctioned corridor on Leslie Creek (GPS data inputted to ArcGIS)

Source: Hankinson (2007); Wong (2007).

Figure 13. The proposed corridor will link with the Curtain Fig National Park from Leslie Creek across the Coleman property adjacent to a stone wall

Photo: Colin Hunt.

2.3 LANDOWNER BENEFITS AND COSTS OF A CORRIDOR

When asked the open-ended question what would make the corridor more appealing, five landowners responded that fencing should be installed and maintained by agencies, while four suggested assistance in acquiring watering troughs or establishing watering points with associated gaps in the corridor for river access. When asked what the particular costs were that made the corridor unappealing, on a scale of high, medium, or low, the majority said loss of land (See Table 1).

Asked what benefits the landowners felt they would gain from having a corridor on a scale of high, medium or low, only four benefits were seen as being important by four or more people (Table 2). The four benefits seen as most important were:

1. Personal enjoyment of forest and wildlife,
2. Persistence of critically endangered Mabi forest,
3. Contribution to wildlife corridor linking Wongabel State Forest to the Curtain Fig National Park, and
4. An increase in biodiversity.

Table 1: Landowners' perceived costs of hosting a corridor

Cost category	High	Medium	Low
Loss of Land	5	0	1
Loss of creek access for stock	1	2	4
Increase in pest attacks on crops	1	1	4

Source: Hankinson (2007).

Table 2: Landowners' perceived benefits of hosting a corridor

Corridor benefit	High	Medium	Low
Prevention of cattle losses	1	1	4
Provision of cattle shade	0	0	6
Prevention of bank erosion	1	2	3
Personal enjoyment of forest and wildlife	4	2	0
Decrease in mustering time	0	0	6
Increase in property value	1	0	5
Carbon credits	1	3	2
Persistence of Critically Endangered Mabi 5b Forest	2	3	1
Increased farm safety	0	0	6
Contribution to wildlife corridor linking Wongabel SF to Curtain Fig NP	2	2	2
Increased biodiversity	2	2	2
Improved water quality	2	1	3

Source: Hankinson (2007).

There is no relationship between property size and amount of land offered for the corridor, nor did there seem to be a connection between land use and interest in hosting the corridor. Also absent was a relationship between knowledge of Mabi forest and landowners interest in Nature Refuges. Two landowners along the Barron

River were not in favour of a Nature Refuge while the three landowners along Leslie Creek were, and the landowner who had property on both, was undecided.

Table 3: Landowners' commitment to a corridor

Land'r	Property area (ha)	Corridor commit	Area offered (ha)	Land Use	Aware value of Mabi Forest	Interest in Nature Refuge/ Covenant	Aware Green Corridor Project	Barron River/ Leslie Creek
A	34	?	N/A	Beef	High	No	Yes	Barron
B	13	Yes	2.85	Beef/ Crop	Medium	No	Yes	Barron
C	400	?	N/A	Dairy/ Crop	Low	Undecided	No	Barron/ Leslie
D	100	Yes	2.02	Dairy	Low	Yes	N/A	Leslie
E	34	Yes	4.92	Beef/ Crop	Low	Yes	N/A	Leslie
F	32	Yes	1.48	Beef	Low	Yes	N/A	Leslie

Source: Hankinson (2007).

2.4 DISCUSSION OF LANDOWNER RESPONSES

While none of the 6 property owners interviewed were opposed to the corridor in principle, two of the owners were unable to commit riparian land at the time of interview. The remaining four assisted the research team in physically identifying the land that they were willing to dedicate to the corridor.

Landowner responses show that they would receive many of the same benefits that the community at large would receive by hosting a corridor, such as an increase in biodiversity, persistence of critically endangered Mabi forest, as well as personal enjoyment of forest and wildlife. One private benefit they would receive that the community would not, was the knowledge that they were contributing to a wildlife corridor. Improvement in water quality would be both a private and a public benefit.

There was some interest among landowners in the value of carbon credits generated by the reforestation. However, given that the state will be funding the revegetation, the landowners would not be able to claim the credits. Even where landowners on the Tablelands fund reforestation themselves, carbon credits are unlikely to cover more than a small proportion of the costs (Hunt 2007). Compared with the area in the Wongabel State Forest Given the area of reforestation in the corridor is small, the value of its carbon benefits is ignored.

According to the Mabi Recovery Plan, there are few to no adverse social and economic impacts in the restoration of Mabi forest on the Atherton Tablelands. The benefits are seen as far outweighing the costs. Most landowners interviewed have indeed participated in restoration on their properties at one time or another, which means that there is an existing commitment to conservation, and the resulting vegetation can form part of the corridor. Nevertheless, the opportunity cost of land given over to the corridor was an issue for all but one of the landowners. The availability of incentives that would reduce the opportunity costs to landowners – in the form of provision of stock fencing, and stock watering facilities and maintenance of the corridor – were important in the decision to commit to the corridor.

As well as conferring benefits on the landowners in terms of improved quality of stock water, the exclusion of livestock is essential for the successful reforestation of the riparian zone. In the Murray Catchment of New South Wales there was a publicly funded fencing program that allowed the recovery of native vegetation that was virtually extinct (Driver and Davidson, 2002). Public funding sources that have enabled TREAT and TKMG groups to successfully revegetate riparian zones in the Barron and Johnstone catchments do not always fully cover maintenance costs and the costs of fencing and associated stock watering infrastructure, thus some proportion of the costs have often fallen to landowners.

Most respondents expressed a desire to pass their land on to their children in a productive state. However, a downside to this expression of the intergenerational ethic is that it was a main reason for rejecting Nature Refuges; it was perceived that such a covenant would mean constraints on their children's future property management options. While the Nature Refuge instrument is a strong and virtually irreversible instrument that would protect in perpetuity the reforestation done at public cost, there appears to be a case for the development of alternative approaches that would increase the likelihood of adoption of covenants.

2.5 DISCUSSION OF COSTS OF ESTABLISHING A CORRIDOR

The responses of landowners suggest that the ideal corridor, averaging 50 metres width on each bank of the Barron River or Leslie Creek, will be difficult to achieve because of the associated opportunity costs. A corridor averaging 50 metres width in total is a more practical goal. Given that some 20% of the corridor is already composed of remnant vegetation, the additional area required to be reforested to complete a 50 metre wide corridor will be about 40 hectares.

Under the Green Corridor Project BRICMA and the Cairns Port Authority have a goal of rehabilitating 40 hectares per year along the river, and the Chapman Bridge area in the upper Barron – an area contiguous with the valuable Picnic Crossing remnant – has already been a focus of reforestation activity, but this area is downstream of the confluence of the Barron and Leslie Creek. However, the river reaches between Wongabel State Forest and the confluence with Leslie Creek will be targeted by the project in the future (BRICMA 2008). Therefore it is assumed that the Barron River stretch of the proposed corridor will require no more funding than is already anticipated under the Green Corridor Project.

The Leslie Creek stretch comprises about 40% of the proposed corridor, requiring some 16 hectares of revegetation with a corridor width of 50 metres. TREAT, TKMG and Eacham Shire Nursery are already active in sponsoring reforestation projects in the Barron and Johnstone River catchments. Their costs per hectare for establishment and maintenance were approximately $55,000 per hectare in 2007 (Crook 2007; Grundon 2007). Assuming that TREAT and TKMG will be the main carriers of the Leslie Creek part of the corridor, then its total cost will be approximately $880,000 in 2007 dollars, or some $88,000 per year over 10 years.

Additional costs for the provision of fencing, watering points for cattle and cattle troughs and pumps, will be additional costs incurred, varying on a property by property basis.

2.6 CONCLUSIONS ON LANDOWNER PARTICPATION AND INCENTIVES

The responses of six of the eleven landowners in riparian zone linking the Wongabel State Forest and the Curtain Fig National Park suggest that willingness to host the

corridor, and ensuring continuity and an adequate width, would be enhanced by the following:

- The offer of a package that includes the full cost of establishment and maintenance of the trees together with the installation of fencing and stock watering.

- The issue of covenants by local government, in this case the Tablelands Regional Council, that allow for rate remissions for landowners for the corridor areas set aside for reforestation.

While there is already a strong base in the community to carry out the reforestation of the Leslie Creek part of the corridor, considerable financial support from the Australian government will be necessary.

3. THE SOCIO-ECONOMIC BENEFITS OF A CHANGE IN LANDUSE AT WONGABEL STATE FOREST

This third major section of the report compares the net benefits of harvesting the timber from the plantations with the alternative of foregoing harvesting.

Wongabel State Forest is comprised of 263 hectares of Mabi forest, 213.6 hectares of plantations, of which 154.6 is hoop pine (*Araucaria cunninghamii*), 10.5 is Caribbean pine (*Pinus caribaea var. hondurensis*) and 48.5 is of older compartments of various species. The Mabi remnant is the second largest after the Curtain Fig National Park, which is part of the WTWHA; see Figure 14.

In the past, the Mabi forest at Wongabel was selectively logged, but never fully cleared for agriculture because the bouldery ground is unsuitable for agriculture (EPA 2007a). Some 150,000 hectares of natural forest had been opened to harvesting on the Tablelands, and the plantation at Wongabel was one of the few established in the region prior to WTWHA listing in 1988. Of the 26 sawmills operating before 1988, only the Ravenshoe Mill remains, having been refurbished and expanded to create employment for displaced timber workers (Skelton 2007).

The Ravenshoe Mill and is now dedicated to processing pine species, with a capacity to process 35,000 m^3 of logs, mainly supplied from hoop pine plantations in State Forests, including Wongabel (Hanrahan, 2007).

Forestry Plantations Queensland manages the State Forest, having taken over from DPI Forestry in 2006 as the manager of the state's 199,000 hectares of plantation forests, and while the Environmental Protection Agency, through the Queensland Parks and Wildlife Service, protects the public walking tracks (EPA 2007b).

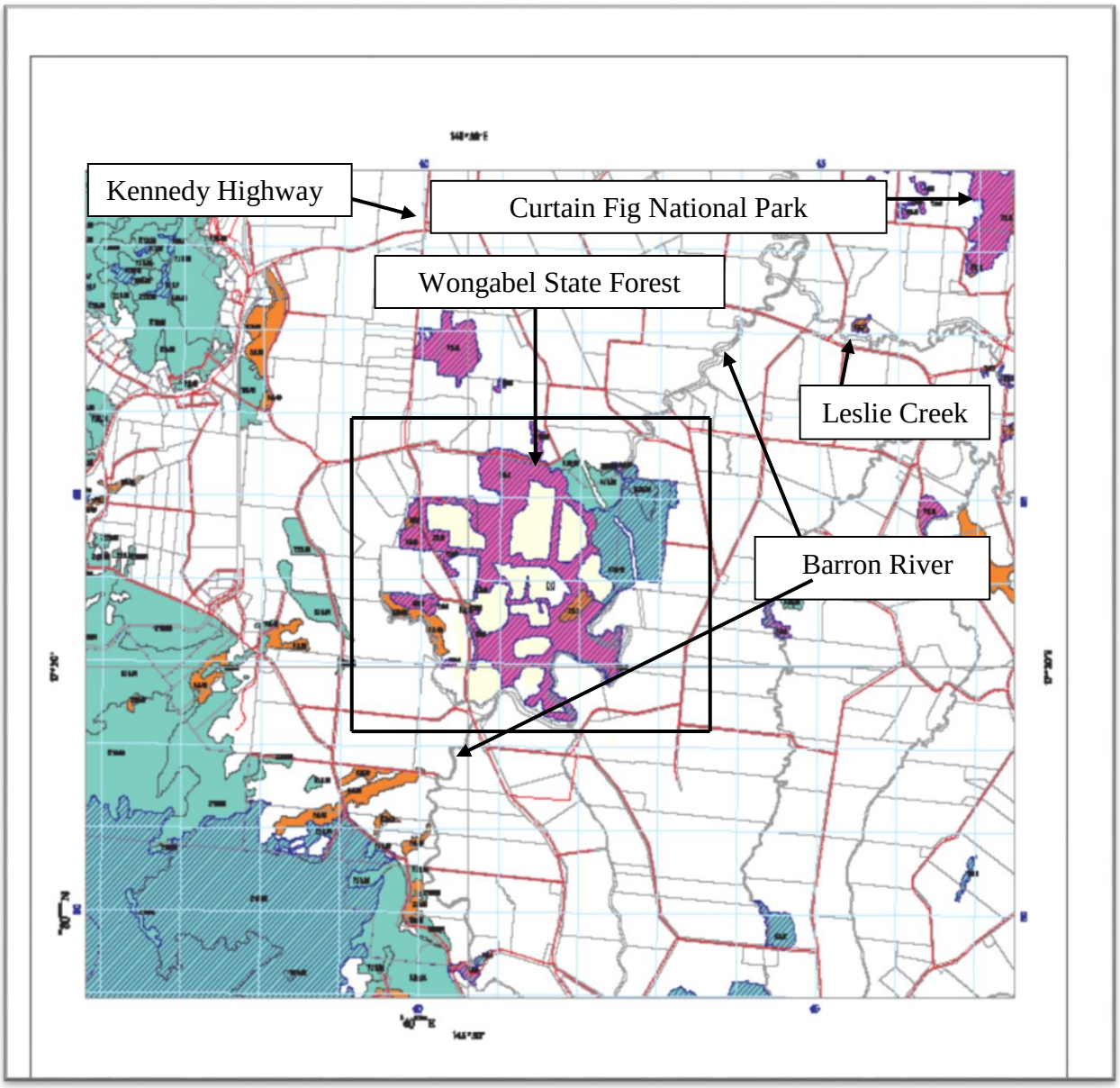


Figure 14: Wongabel State Forest, situated 7km south of Atherton on the Kennedy Highway

The outlined area in the centre of the Figure is the Wongabel State Forest, within which the blank areas are timber plantations and the surrounding pink is fragmented Mabi or type 5b forest, classified by EPA as a "remnant endangered regional ecosystem". The contiguous green hatched area to the north east of the Mabi is rainforest is "not of concern" but is essential cassowary habitat.

3.1 AIM OF SOCIO-ECONOMIC STUDY

The aim of this part of the study is to explore the market and non-market benefits and costs of alternative management options for the Wongabel State Forest. The first option is business as usual, where the hoop and Caribbean pine plantations are harvested at maturity and replanted. The alternative is to avoid harvesting the plantations, allowing them to regenerate naturally to Mabi forest.

Market benefits include the value of harvested timber and of sequestered carbon. Non-market benefits include the employment generated by the plantations and the biodiversity benefits of the reforested or regenerated plantations.

Australia has been intent on meeting its target of limiting increases of greenhouse gases in the year 2012 to an 8% increase over 1990 levels. In ratifying the Kyoto Protocol the Australia government will be accepting reductions in greenhouse gas emissions in future commitment periods under arrangements that will succeed the Kyoto Protocol. Under Kyoto arrangements countries account for changes in carbon sinks due to land use, landuse change and forestry (LULUCF).

Under Kyoto rules governing afforestation and reforestation, carbon sequestered in plantations, and verified as such, is credited in the LULUCF section of the national carbon account. After clear fell harvesting the accounts are debited with the total loss of above ground carbon. There is therefore a benefit, in terms of carbon accounting, of avoiding harvesting of plantations at Wongabel. The value of the carbon sequestered by avoiding harvesting is the value of carbon credits trading in Australian and international markets.

Given that the Ravenshoe mill is dependent on the supply of softwood logs from State Forests on the Tablelands, the degree of dependence on supply from Wongabel is also investigated.

3.2 METHOD OF SOCIO-ECONOMIC ANALYSIS

3.2.1 Establishment of the financial benefits of the softwood plantations

A model is constructed of the costs and benefits over time of the growing and harvesting of hoop and Caribbean pine under the business as usual approach. The

costs and timing of initial establishment, pruning and thinning are followed by benefits of harvesting and the sale of timber 30 year after planting for Caribbean and 44 years after planting for hoop, depicted in Figure 15. The costs of plantation management of hoop pine and the production and sale price are derived from Hunt (2007) and are detailed in the spreadsheet Appendix 1. Hoop pine plantations are thinned and pruned twice before harvest, while Carribean plantations are thinned and pruned three times. The harvest of both species generates 400m^3/hectare of saleable timber at a farm gate price of \$25/m^3 per hectare for a gross return of \$10,000 per hectare (Skelton, 2007).

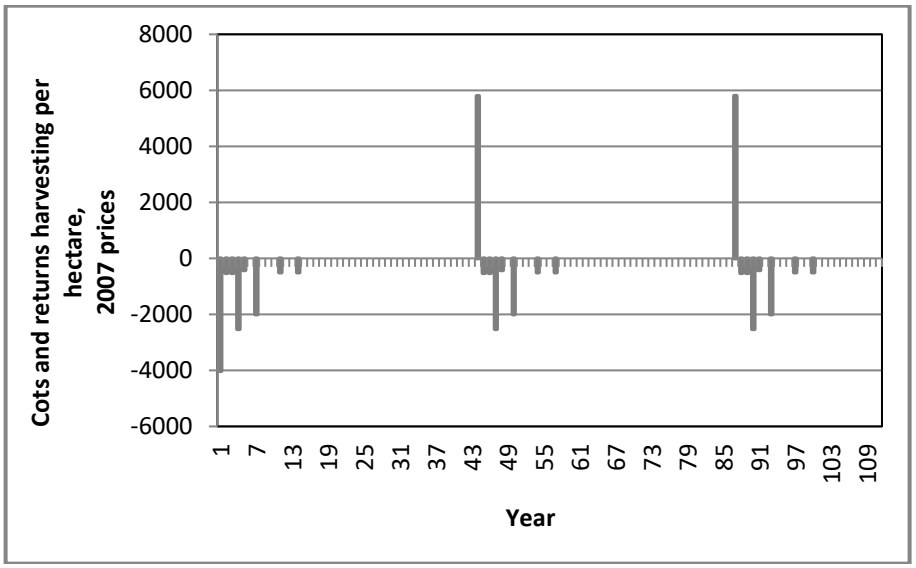


Figure 15: Annual costs and returns of one hectare of hoop pine planted and harvested at Wongabel State Forest

The initial costs of plantation establishment include land preparation, seedlings, herbicide and fertiliser, are followed by costs of thinning and pruning. These costs are repeated with replanting after harvesting. The returns from harvesting in years 44 and 88 are \$10,000 per hectare but replanting costs of \$4,020 per hectare are incurred in the same year as harvest so that the net return from harvesting is \$5,798 per hectare.

3.2.2 Estimating the carbon sequestered in pine plantations

A second model is constructed of the carbon sequestered and its value by hoop pine and Caribbean plantations, first under a business as usual scenario where harvesting takes place and second, in a situation where no harvesting takes place. Figure 16

shows the carbon sequestered by harvested and unharvested hoop pine plantations at Wongabel.

The source of the estimates of carbon sequestered is FullCAM modelling which enables estimation of carbon sequestered by plantation forestry throughout Australia. By entering the coordinates of the area (in the case of Wongabel State Forest Lat.17.3243º and Long. 145. 5091º) the model takes account of soil type, climate, species and management practices and generates a growth profile for the specified forest. Results so generated, and verified periodically by measurement, are accepted for inclusion in the LULUCF section of Australian government carbon accounts (Australian Government 2007).

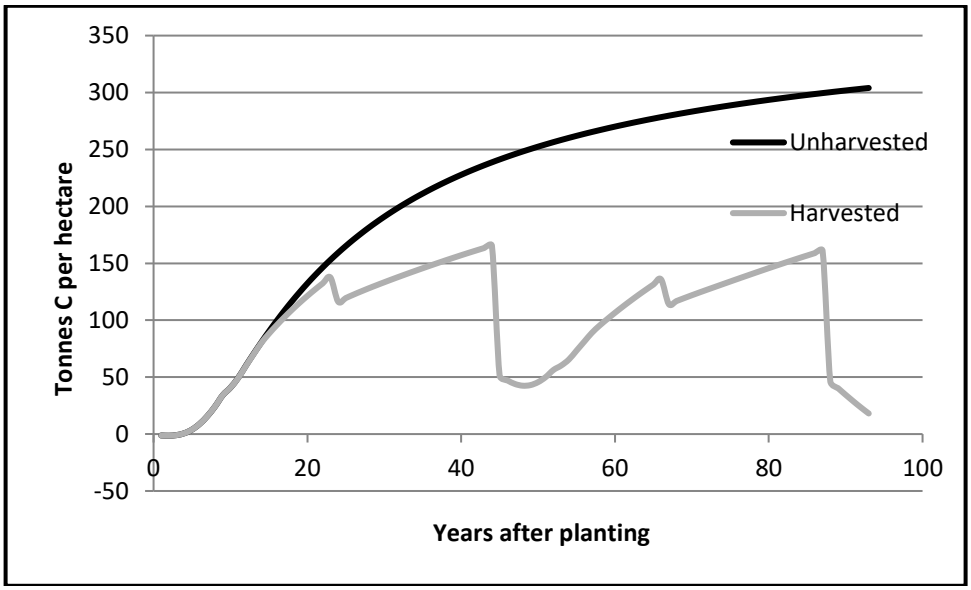


Figure 16: Prediction of total carbon sequestered per hectare, by unharvested and harvested hoop pine plantations, at Wongabel State Forest

The carbon sequestration predictions are derived by FullCAM modelling (Australian Government 2007).

The age of the pine plantations vary, the earliest being 1981 and the latest 2004. Modelling takes account of the fact that costs and benefits are generated by compartments of varying ages and area. Figure 17 shows the numbered compartments and Table 4 the area by planting date and species.

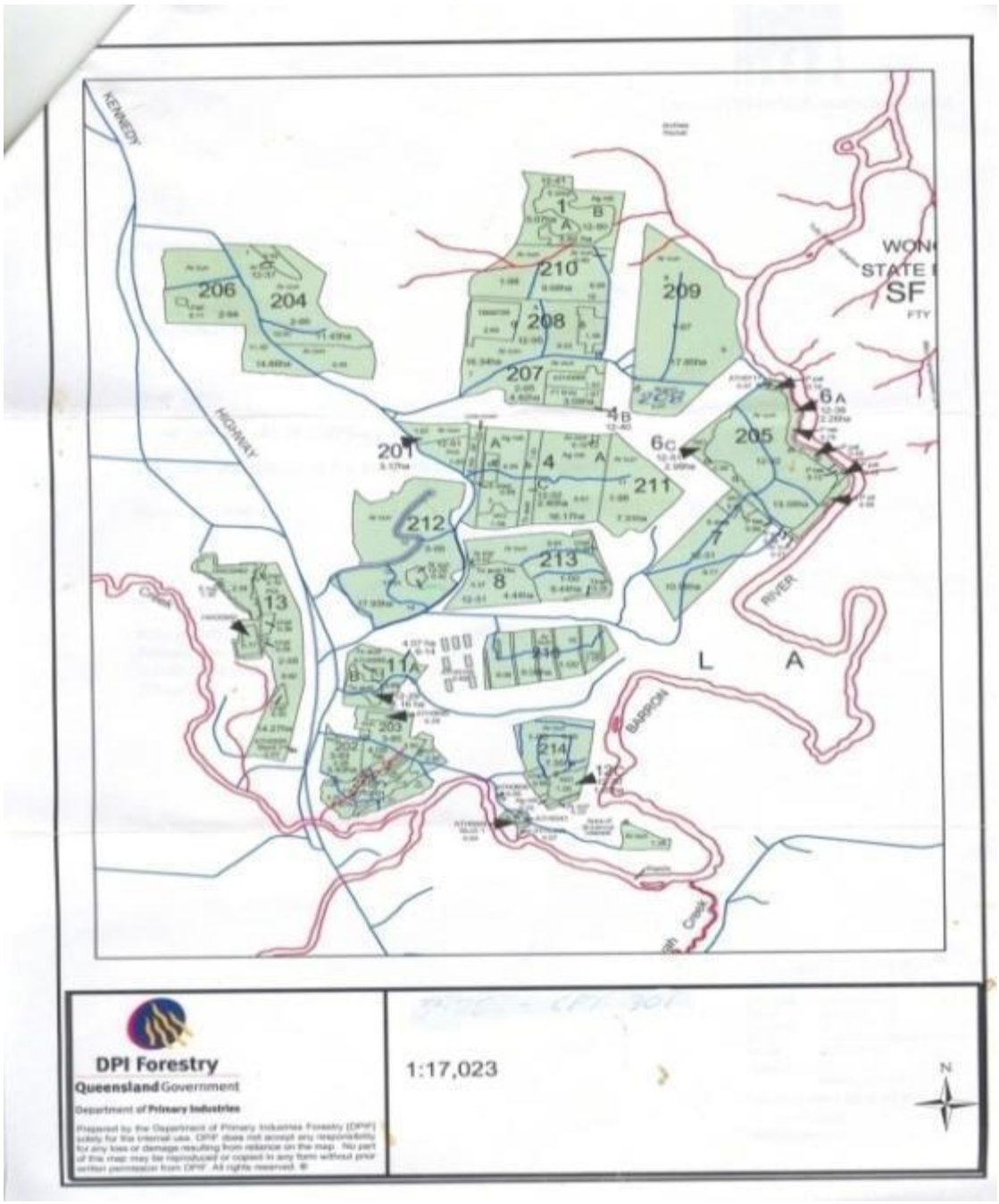


Figure 17. Wongabel State Forest showing numbered compartments

Source: DPI (2007).

The compartment numbers corresponds to the numbers in Table 4.

Source: Forestry Plantations Queensland.

Table 4: Plantations of Wongabel State Forest

Plantation History State Forest 191 Wongabel

Location Number	Planting Date	Planted Area (hectares)	Species
1A	12/1941	5.07	Agathis Robusta
1B	12/1980	3.82	Eucalyptus drepanophylla
4A	12/1932	13.12	Agathis Robusta
4B	12/1940	3.09	Flindersia brayleyana
6A	12/1938	2.19	Various Pinus species
7	12/1931	10.06	Eucalyptus drepanophylla
8	12/1931	4.44	Toona ciliata
11A	06/1914	3.93	Toona ciliata
11B	12/1929	1.16	Toona ciliata
12C	12/1930	1.65	Agathis Robusta
201	12/1981	3.17	Hoop pine & Pinus caribaea var hondurensis
13	02/1988	8.92	Pinus caribaea var hondurensis
204	02/1990	11.43	Hoop pine
205	12/1992	13.59	Hoop pine
206	02/1994	14.88	Hoop pine
207	02/1995	4.42	Hoop pine
208	12/1995	16.34	Hoop pine
209	01/1997	17.85	Hoop pine
210	01/1998	9.68	Hoop pine
211	01/1998	7.31	Hoop pine
212	03/1999	17.93	Hoop pine
213	01/2000	9.44	Hoop pine
214	01/2000	7.35	Hoop pine
215	01/2000	9.08	Hoop pine
216	12/2001	5.90	Hoop pine
301	12/2004	7.78	Hoop pine

The compartments 1A to 12C, totalling 48.53 hectares, have never been harvested and there are no plans for their future harvest (Hanrahan 2007). The mixed hoop and Caribbean pine compartment 201 is assumed to contain hoop and Caribbean in equal proportions, the Caribbean compartment 13 and the hoop pine compartments 204 to 301, totalling 165 hectares, are the subject of economic analysis in this report.

Source: Forestry Plantations Queensland.

3.2.3 The present value of management alternatives

In bringing the benefits and costs over time to a single figure representing present value in year 2008, two rates of discount, 5% and 10%, are applied to the stream of future benefits and costs generated by the business as usual approach, and also by avoiding harvesting. The finite time horizon of modelling is year 2100.

All plantation costs prior to 2008 are regarded as sunk costs and are excluded from the analysis. In contrast, the carbon sequestered by the plantation prior to 2008 has a present value and this is brought into the analysis.

Global emissions trading is in terms of tonnes of CO_2e abated or removed from the atmosphere in sinks. Our analysis is conducted in terms of carbon sequestered in plantations. Carbon sequestered is converted to the equivalent CO_2e removed from the atmosphere by applying the following formula: 1 tonne of carbon = 3.67 tonnes of CO_2e.

In the analysis, two prices are adopted for one tonne of CO_2e, $A20, which is equivalent to present prices on the world market and a conservative price of $A10.

3.2.4 The dependence of Ravenshoe Mill on supply of hoop pine logs from Wongabel State Forest

It is expected that hoop pine plantations will be harvested at 44 years of age. Knowing the area of hoop pine compartments and the time of planting enables the estimation of the supply and timing of logs supplied from the Wongabel State Forest. The annual supply can then be compared with the annual capacity of the Ravenshoe Mill, which is 35,000 m^3, in order estimate the degree of reliance on that source.

3.3 RESULTS OF SCIO-ECONOMIC ANALYSIS

3.3.1 Value of timber sales

The present value of growing and harvesting of hoop pine in plantations is negative at both the 5% and 10% rates, as shown in Table 5. This result is a function of the relatively low prices for hoop pine sold to the Ravenshoe Mill as well as the long

delay in the realisation of income and the fact that costs are incurred in early years after planting, as was illustrated in Figure 15.

Table 5: Present net value of sales of timber from Wongabel State Forest plantations, at 2007 prices and 5% and 10% discount rates

Discount rate (%)	5	10
Present net value of timber sales ($)	-87,429	-99,764

The annual net returns from harvesting all compartments of hoop and Caribbean pine at various ages and sizes, totalling 165 hectares, are discounted at two rates of interest and summed to obtain the total present value of harvesting and sales.

3.3.2. Value of carbon credits

The value of CO_2e removed from the atmosphere by the pine plantations is obtained by first predicting the annual incremental carbon sequestered by plantations, assigning a price to this carbon, and then discounting annual values obtained to give present values. Aggregate values are obtained by summing the values obtained from the compartments of various ages and sizes.

As would be anticipated, the net value of CO_2e removed from the atmosphere and released to the atmosphere by unharvested hoop pine is greater than that by harvested hoop pine, at both 5% and 10% discount rates, and at both high and low prices per tonne of CO_2e removed.

Under Kyoto Protocol rules, carbon in the timber harvested is lost to the atmosphere, as illustrated in Figure 2. At the 5% discount rate, future CO_2e removals by unharvested hoop pine are more than twice the value of removals by harvested hoop pine. In other words there is an opportunity cost of harvesting, in terms of carbon credits foregone, of a minimum of $142, 631 (10% discount and $10/tonne of CO_2e) and $690,561 (5% discount and 20/tonne of CO_2e). See Table 6. For a full accounting of the cost of harvesting versus allowing the forests to regenerate, this opportunity cost must be added to the losses made from harvesting and sale of softwoods.

Table 6: Present value of carbon sequestered by Wongabel State Forest pine plantations, at 2007 prices and 5% and 10% discount rates

Discount rate (%)	5		10	
Price CO_2e/tonne ($)	10	20	10	20
(1)Value of CO_2e offset with harvest ($)	320,691	641,382	276,871	553,742
(2) Value of CO_2e offset without harvest ($)	665,971	1,331,943	419,502	839,005
(2-3) Net value of CO_2e w'out harvest ($)	345,280	690,561	142,631	285,263

The price of $20/tonne for CO_2e reflects current prices in Australian and world markets, while the discount rates reflect the opportunity cost of capital.

3.3.3. Timber supply reductions to Ravenshoe Mill

Little impact on supplies will be felt before 2020, when 10% of supply will be affected. Subsequently the decade after 2033 will be affected by supply reductions ranging from 13% to 39%, as illustrated in Figure 18. The availability of supply from other government plantations on the Tablelands needs to be investigated in order to determine whether the viability of Ravenshoe Mill will be threatened by the cessation of harvesting at Wongabel.

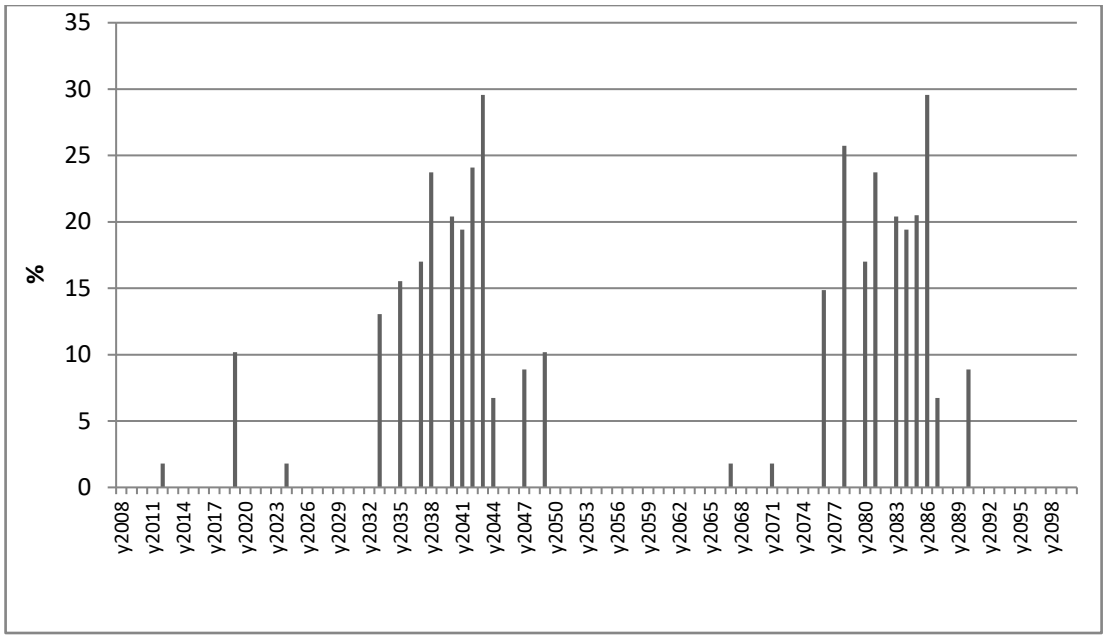


Figure 18: Supply of softwood logs from Wongabel State Forest as a proportion of Ravenshoe Mill capacity by calendar year

Caribbean pine is harvested 30 years after planting or replanting and hoop pine 43 years after planting or replanting. The peak years for supply to Ravenshoe Mill from Wongabel State Forest are 2043 and 2086, when 30% of capacity is supplied.

3.4 DISCUSSION OF SOCIO-ECONOMIC BENEFITS OF LANDUSE CHANGE

A socio-economic issue that needs to be considered as a result of adopting a no harvesting regime at Wongabel State Forest is the effect of employment generated by management activities.

Without further investigation it is difficult to determine the affect on the Raveneshoe Mill viability and therefore on the employment it generates. However, given the fact thst most softwood plantings at Wongabel Sate Forest are recent any impacts will not be felt for many years. Moreover, its is possible that there are other Queensland government plantations that could meet Ravenshoe Mill's requirements.

Forestry Plantations Queensland contracts six people for planting, pruning, and weed control for the 3,500 total hectares under its authority in the region and the same number are contracted by the Ravenshoe Mill for the harvesting operation

(Hanrahan, 2007). Given that the Wongabel State forest softwood plantations of 213 hectares constitute 6% of the total forest estate, there will be little reduction in the employment by the contractors.

3.5 CONCLUSIONS ON BENEFITS OF LANDUSE CHANGE AT WONGABEL

At present prices for softwood logs the continuation of growing and harvesting hoop and Caribbean pine at Wongabel State Forest will incur a loss for Forestry Plantations Queensland approaching $100,000 in present value terms.

In addition there is an opportunity cost of several hundred thousand dollars to the Australian Government in allowing harvesting, rather than retaining the carbon in the plantations and allowing carbon sequestration to continue. The carbon credits generated by forests planted since 1990, which include all the softwood plantations for which harvesting is contemplated, are claimable against Australia's 2012 emissions target. By foregoing the harvesting of these plantations, the carbon credits generated post-2012 and contributing to meeting the Australian government's future targets for emission reductions set under post-Kyoto Protocol arrangements, will be considerably increased.

The Wongabel State Forest is already a tourist attraction. The enhancement of the considerable heritage values at Wongabel, by their conservation and their presentation, would lead to an increase in tourism at the site and generate economic benefits for the region.

Elders of the Tableland Yidinji and the Ngadjon-jii are supportive of a change in landuse to conservation of Wongabel. They expressed a desire for the traditional owners to be involved in the presentation of the area's enhanced heritage values.

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APPENDICES

APPENDIX 1. Status of flora and fauna of Mabi rainforest under the Queensland Nature Conservation (QNC) and the Environmental Protection and Biodiversity (EPBC) Acts

Common name	Proper Name	QNC Act	EPBC Act
Flora			
Flame silky oak	*Alloxylon flammeum*	Vulnerable	Vulnerable
Atherton sauropus	*Sauropus macranthus*	Rare	Vulnerable
	Marsdenia straminea	Vulnerable	
Atherton turkey bush	*Hodgkinsonia frutescens*	Least Concern	Vulnerable
Pink leaf haplostichanthus	*Haplostichanthus sp.*	Rare	
Brown quandong	*Elaeocarpus coorangooloo*	Rare	
	Firmiana papuana	Rare	
	Alectryon semicinerreus	Rare	
	Argyrodendron sp.	Rare	
	Phyllanthera grayi	Rare	
Fauna			
Southern cassowary*	*Casuarius casuarius johnsonii*	Endangered	Endangered
Macleay's fig-parrot	*Cyclopsitta diophthalma macleayana*	Vulnerable	
Rufus owl (southern subspecies)	*Ninox rufa queenslandica*	Vulnerable	
	Lophoictinia isura	Rare	
Square-tailed kite			
Grey goshawk	*Accipiter novaehollandiae*	Rare	

White-rumped swiftlet	*Collocalia spodiopygius*	Rare
Spectacled flying fox	*Pteropus conspicicllatus*	Least Concern
Lumholtz's tree-kangaroo	*Dendrolagus lumholtzi*	Rare
Herbert River ringtail possum	*Pseudochirulus herbertensis*	Rare
Green ringtail possum	*Pseudochirops archeri*	Rare
Lemuroid ringtail possum	*Hemibedlideus lemuroides*	Rare
Skink	*Lampropholis robertsi*	Rare
Skink	*Eulamprus tigrinus*	Rare

* The southern cassowary, as well as the musky rat-kangaroo (*Thylogale stigmatica*), is extinct from the Mabi Forest.

APPENDIX 2: Lot numbers and registered owners, Barron River/Leslie creek corridor

Lot Number	Plan Code	Registered owner	Address
103	N157460	FRANCIS IRA ROCKLEY, HELEN MARGARET ROCKLEY	DALIP RD, ATHERTON QLD 4883
2	RP715411	FRANCIS IRA ROCKLEY, HELEN MARGARET ROCKLEY	DALIP RD, ATHERTON QLD 4883
219	N157178	JOHN PETER GALLO	47 DALIP RD, ATHERTON QLD 4883
2	RP743177	AILSA ISABEL EDWARDS	261A MELTON ROAD, NORTHGATE QLD 4013
207	SP116178	ROBERT PEEVER*	155 MOSELEY RD, EAST BARRON QLD 4883
232	NR296	GARY EDWARD SCOTT, MARILYN KAY SCOTT*	117 MOSELEY ROAD, EAST BARRON QLD 4883
207	SP116178	FRANCESCO RALPH GALLO, FILOMENA GALLO*	ATHERTON-MALANDA RD, EAST BARRON QLD 4883
208	SP116178	FRANCESCO RALPH GALLO, FILOMENA GALLO*	ATHERTON-MALANDA RD, EAST BARRON QLD 4883
169	SP124699	FRANCESCO RALPH GALLO, FILOMENA GALLO*	ATHERTON-MALANDA RD, EAST BARRON QLD 4883
41	SP164497	MARCO ANTONIO FRANCESCO GALLO*	MCKEOWAN RD, EAST BARRON QLD 4883
1	NR804846	FRANCESCO RALPH GALLO, FILOMENA GALLO*	ATHERTON-MALANDA RD, EAST BARRON QLD 4883
131	NR6283	KAREPO PTY LTD (ROYD MCINNES)	223 MCKEOWAN ROAD, EAST BARRON, QLD 4883
34	RP748661	MARJORIE MORRISON*	ATHERTON-MALANDA RD, EAST BARRON QLD 4883
9	SP146490	LESLIE DAVID COLEMAN*	39 COLEMAN RD, EAST BARRON QLD 4883
5	SP146490	MICHAEL DAVID COLEMAN	CURTAIN FIGTREE RD, EAST BARRON QLD 4883
8	SP146490	GREGORY NEIL COLEMAN	COLEMAN RD, EAST BARRON QLD 4883

Sources: Queensland Government (2004); Sinclair (2007).

APPENDIX 3: Costs and returns per hectare of growing and harvesting hoop pine at Wongabel State Forest, ($)

(Per hectare costs are multiplied by the number of hectares to find costs in any one year.)

		Hectares										
	Calendar year	1.58	11.43	13.59	14.88	20.76	17.85	16.99	17.93	25.87	5.9	7.78
Sunk costs 1981-2008	1981	-4020										
	1982	-522										
	1983	-522										
	1984	-2522										
	1985	-424										
	1986	0										
	1987	-2000										
	1988	0										
	1989	0										
	1990	0	-4020									
	1991	-500	-522									
	1992	0	-522	-4020								
	1993	0	-2522	-522								
	1994	-500	-424	-522	-4020							
	1995	0	0	-2522	-522	-4020						
	1996	0	-2000	-424	-522	-522						
	1997	0	0	0	-2522	-522	-4020					
	1998	0	0	-2000	-424	-2522	-522	-4020				
	1999	0	0	0	0	-424	-522	-522	-4020			
	2000	0	-500	0	-2000	0	-2522	-522	-522	-4020		
	2001	0	0	0	0	-2000	-424	-2522	-522	-522	-4020	
	2002	0	0	-500	0	0	0	-424	-2522	-522	-522	

	2003	0	-500	0	0	0	-2000	0	-424	-2522	-522	
	2004	0	0	0	-500	0	0	-2000	0	-424	-2522	-4020
	2005	0	0	-500	0	-500	0	0	-2000	0	-424	-522
	2006	0	0	0	0	0	0	0	0	-2000	0	-522
	2007	0	0	0	-500	0	-500	0	0	0	-2000	-2522
Costs accounted for 2008-2100	2008	0	0	0	0	-500	0	-500	0	0	0	-424
	2009	0	0	0	0	0	0	0	-500	0	0	0
	2010	0	0	0	0	0	-500	0	0	-500	0	-2000
	2011	0	0	0	0	0	0	-500	0	0	-500	0
	2012	0	0	0	0	0	0	0	-500	0	0	0
	2013	0	0	0	0	0	0	0	0	-500	0	0
	2014	0	0	0	0	0	0	0	0	0	-500	-500
	2015	0	0	0	0	0	0	0	0	0	0	0
	2016	0	0	0	0	0	0	0	0	0	0	0
	2017	0	0	0	0	0	0	0	0	0	0	-500
	2018	0	0	0	0	0	0	0	0	0	0	0
	2019	0	0	0	0	0	0	0	0	0	0	0
	2020	0	0	0	0	0	0	0	0	0	0	0
	2021	0	0	0	0	0	0	0	0	0	0	0
	2022	0	0	0	0	0	0	0	0	0	0	0
	2023	0	0	0	0	0	0	0	0	0	0	0
	2024	5798	0	0	0	0	0	0	0	0	0	0
	2025	-522	0	0	0	0	0	0	0	0	0	0
	2026	-522	0	0	0	0	0	0	0	0	0	0
	2027	-2522	0	0	0	0	0	0	0	0	0	0
	2028	-424	0	0	0	0	0	0	0	0	0	0
	2029	0	0	0	0	0	0	0	0	0	0	0
	2030	-2000	0	0	0	0	0	0	0	0	0	0
	2031	0	0	0	0	0	0	0	0	0	0	0
	2032	0	0	0	0	0	0	0	0	0	0	0
	2033	0	5798	0	0	0	0	0	0	0	0	0

	2034	-500	-522	0	0	0	0	0	0	0	0	0
	2035	0	-522	5798	0	0	0	0	0	0	0	0
	2036	0	-2522	-522	0	0	0	0	0	0	0	0
	2037	-500	-424	-522	5798	0	0	0	0	0	0	0
	2038	0	0	-2522	-522	5798	0	0	0	0	0	0
	2039	0	-2000	-424	-522	-522	0	0	0	0	0	0
	2040	0	0	0	-2522	-522	5798	0	0	0	0	0
	2041	0	0	-2000	-424	-2522	-522	5798	0	0	0	0
	2042	0	0	0	0	-424	-522	-522	5798	0	0	0
	2043	0	-500	0	-2000	0	-2522	-522	-522	5798	0	0
	2044	0	0	0	0	-2000	-424	-2522	-522	-522	5798	0
	2045	0	0	-500	0	0	0	-424	-2522	-522	-522	0
	2046	0	-500	0	0	0	-2000	0	-424	-2522	-522	0
	2047	0	0	0	-500	0	0	-2000	0	-424	-2522	5798
	2048	0	0	-500	0	-500	0	0	-2000	0	-424	-522
	2049	0	0	0	0	0	0	0	0	-2000	0	-522
	2050	0	0	0	-500	0	-500	0	0	0	-2000	-2522
	2051	0	0	0	0	-500	0	-500	0	0	0	-424
	2052	0	0	0	0	0	0	0	-500	0	0	0
	2053	0	0	0	0	0	-500	0	0	-500	0	-2000
	2054	0	0	0	0	0	0	-500	0	0	-500	0
	2055	0	0	0	0	0	0	0	-500	0	0	0
	2056	0	0	0	0	0	0	0	0	-500	0	0
	2057	0	0	0	0	0	0	0	0	0	-500	-500
	2058	0	0	0	0	0	0	0	0	0	0	0
	2059	0	0	0	0	0	0	0	0	0	0	0
	2060	0	0	0	0	0	0	0	0	0	0	-500
	2061	0	0	0	0	0	0	0	0	0	0	0
	2062	0	0	0	0	0	0	0	0	0	0	0
	2063	0	0	0	0	0	0	0	0	0	0	0
	2064	0	0	0	0	0	0	0	0	0	0	0

	2065	0	0	0	0	0	0	0	0	0	0	0
	2066	0	0	0	0	0	0	0	0	0	0	0
	2067	5798	0	0	0	0	0	0	0	0	0	0
	2068	-522	0	0	0	0	0	0	0	0	0	0
	2069	-522	0	0	0	0	0	0	0	0	0	0
	2070	-2522	0	0	0	0	0	0	0	0	0	0
	2071	-424	0	0	0	0	0	0	0	0	0	0
	2072	0	0	0	0	0	0	0	0	0	0	0
	2073	-2000	0	0	0	0	0	0	0	0	0	0
	2074	0	0	0	0	0	0	0	0	0	0	0
	2075	0	0	0	0	0	0	0	0	0	0	0
	2076	0	5798	0	0	0	0	0	0	0	0	0
	2077	-500	-522	0	0	0	0	0	0	0	0	0
	2078	0	-522	5798	0	0	0	0	0	0	0	0
	2079	0	-2522	-522	0	0	0	0	0	0	0	0
	2080	-500	-424	-522	5798	0	0	0	0	0	0	0
	2081	0	0	-2522	-522	5798	0	0	0	0	0	0
	2082	0	-2000	-424	-522	-522	0	0	0	0	0	0
	2083	0	0	0	-2522	-522	5798	0	0	0	0	0
	2084	0	0	-2000	-424	-2522	-522	5798	0	0	0	0
	2085	0	0	0	0	-424	-522	-522	5798	0	0	0
	2086	0	-500	0	-2000	0	-2522	-522	-522	5798	0	0
	2087	0	0	0	0	-2000	-424	-2522	-522	-522	5798	0
	2088	0	0	-500	0	0	0	-424	-2522	-522	-522	0
	2089	0	-500	0	0	0	-2000	0	-424	-2522	-522	0
	2090	0	0	0	-500	0	0	-2000	0	-424	-2522	5798
	2091	0	0	-500	0	-500	0	0	-2000	0	-424	-522
	2092	0	0	0	0	0	0	0	0	-2000	0	-522
	2093	0	0	0	-500	0	-500	0	0	0	-2000	-2522
	2094	0	0	0	0	-500	0	-500	0	0	0	-424
	2095	0	0	0	0	0	0	0	-500	0	0	0

	2096	0	0	0	0	0	-500	0	0	-500	0	-2000
	2097	0	0	0	0	0	0	-500	0	0	-500	0
	2098	0	0	0	0	0	0	0	-500	0	0	0
	2099	0	0	0	0	0	0	0	0	-500	0	0
	2100	0	0	0	0	0	0	0	0	0	-500	-500