Frances Creek

Ecological Assessment Report

Prepared by:

DR GREG CALVERT

21 Honeysuckle Drive
Annandale
Townsville QLD 4814

T: 0447 319 679
E: gregor_calvert@hotmail.com

Prepared for:

DEPARTMENT OF TRANSPORT AND MAIN ROADS

445 Flinders Street
Townsville, QLD, 4810

T: (07) 44218908/ 0437118479
E: rohan.j.wilson@tmr.qld.gov.au

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Contents

Introduction

The Department of Transport and Main Roads (TMR) requires an ecological assessment at Frances Creek bridge on the Bruce Highway south of Ingham. To enable construction of a new bridge and associated section of highway, it will be necessary to clear a small area of non-remnant vegetation. Remnant vegetation on the western side of the highway is mapped as Essential habitat for the Endangered mahogany glider. The proposed bridge construction will require extending the current gap in the tree canopy to 51m, which is in excess of what previous studies have estimated can be crossed by the Endangered mahogany glider. Therefore, the potential impact on mahogany gliders from widening the existing gap in the tree canopy needs to be assessed.

Although clearing of regulated vegetation is exempt for the purposes of a state-controlled road, there are no exemptions for impacts on Matters of National Environmental Significance (MNES), such as threatened species.

An ecological assessment has previously been undertaken by ARUP, and TMR require an assessment that tests the validity of their conclusions.

Scope of Works

The aim of this assessment is to:

Following a meeting with Rohan Wilson, Ben Cotton and Tony How Lum on 18th May 2015, it was agreed that the scope of the assessment is to:

1. Complete an ecological assessment of Frances Creek Creek including:
    - On ground confirmation of habitat, using known distribution, essential habitat factors and current understanding of mahogany glider ecology.
    - Review of relevant chapters in the ARUP report.
    - Significant Impact Assessment of mahogany gliders as per the EPBC guidelines.
    - Provision of mitigation measures as per the EPBC guidelines.
    - Location and design requirements of any fauna passage devices.
2. Verify existing assessments of potential Mahogany Glider glide trees to determine if Mahogany Gliders could use them.
3. Determine the requirement for a referral pursuant to the *Environmental Protection and Biodiversity Conservation Act* 1999.

Methodology

This assessment included a desktop review, ground traverse of remnant vegetation within and immediately adjacent to the proposed clearing footprint, and an assessment of the wildlife in corridor in general to determine likely utilisation. No trapping, spotlighting or use of motion sensitive cameras was used to detect mahogany gliders on site.

Desktop Review

Prior to undertaking the field inspection, an initial Desktop Review was undertaken of literature, reports and mapping of potential relevance to the impact of the proposed highway upgrade on Mahogany gliders at Frances Creek.

This review included, but not necessarily restricted to information from the following sources:

- ARUP (2014) Bruce Highway Action Plan - Cattle and Frances Creek Upgrade Project. Addendum Report: Southern extension and Frances Creek Rest Area - Review of Environmental Factors and Environmental management Plan. Report to Department of Transport and Main Roads
- A review of remnant vegetation and essential habitat as shown on the Vegetation Management Supporting Map (DNRM 2015).
- DEHP Wildnet search database.
- Mapped locations of threatened species in Atlas of Living Australia.
- Previous existing databases and reports.

A complete list of documents reviewed is included in the References section of this report.

These desktop searches were used to support an assessment into the potential impact of the proposed action on local mahogany glider populations, to determine if a referral is necessary under the *Environmental Protection and Biodiversity Conservation Act* 1999 (EPBC) and to assess what, if any mitigation measures would be appropriate.

Verification of Regional Ecosystems present on site were consistent with the Quaternary level assessment, as defined by the 'Methodology for Survey and Mapping of Regional Ecosystems and Vegetation Communities in Queensland' (Neldner *et al.* 2005), however, a more detailed description of the floristics was also recorded.

Mahogany Glider Habitat Assessment

Essential habitat for the Endangered mahogany glider (*Petaurus gracilis*) was identified as occurring on site in the Review of Environmental Factors (ARUP 2014), however, that report concluded that there is no functional connectivity between habitat areas east and west of the project area, and that there are no movement opportunities for gliders across the highway (ARUP 2014).

The ability of mahogany gliders to cross the existing Bruce Highway crossing was assessed by measuring the gap between tree canopies and trunks of potential glide trees. The height of the trees was assessed using a combination of an optical reading clinometer and tape measure, and use of a reference scale of known height. The potential glide distance from a tree of known height was then calculated using the glide angle and distance measurements provided by Jackson (2000).

The presence and potential for occurrence of the Endangered mahogany glider was assessed through site inspections of habitat, including the capacity of the Frances Creek

corridor to function as a wildlife corridor for Mahogany gliders. Site inspections were undertaken by Dr Greg Calvert and Rohan Wilson on 9th June 2015 and 16th July 2015.

Results

Vegetation

Regional Ecosystems

Vegetation on the western side of the Frances Creek site is mapped as (RE) 7.3.25a (Of Concern): “Riverine wetland or fringing riverine wetland. *Melaleuca leucadendra* open forest and woodland. Stream levees and prior streams on well-drained sandy clay loam alluvial soils".

The eastern side of the highway is mapped as 'non remnant', however, numerous mature remnant trees occur. Inspection of the site showed the non-remnant vegetation to be closely associated with Frances Creek and its associated riparian zone, with a canopy dominated by *Melaleuca leucadendra* and other typical gallery forest species such as *Corymbia tessellaris, Millettia pinnata* and *Nauclea orientalis.* A number of pioneer rainforest species were present in the mid storey, including such as *Elaeocarpus grandis, Glochidion harveyanum, Melicope elleryana,* and *Macaranga involucrata*.

An extract of the Vegetation Management Supporting Map is provided in Figure 1 below, showing the Regional Ecosystems present on the site.

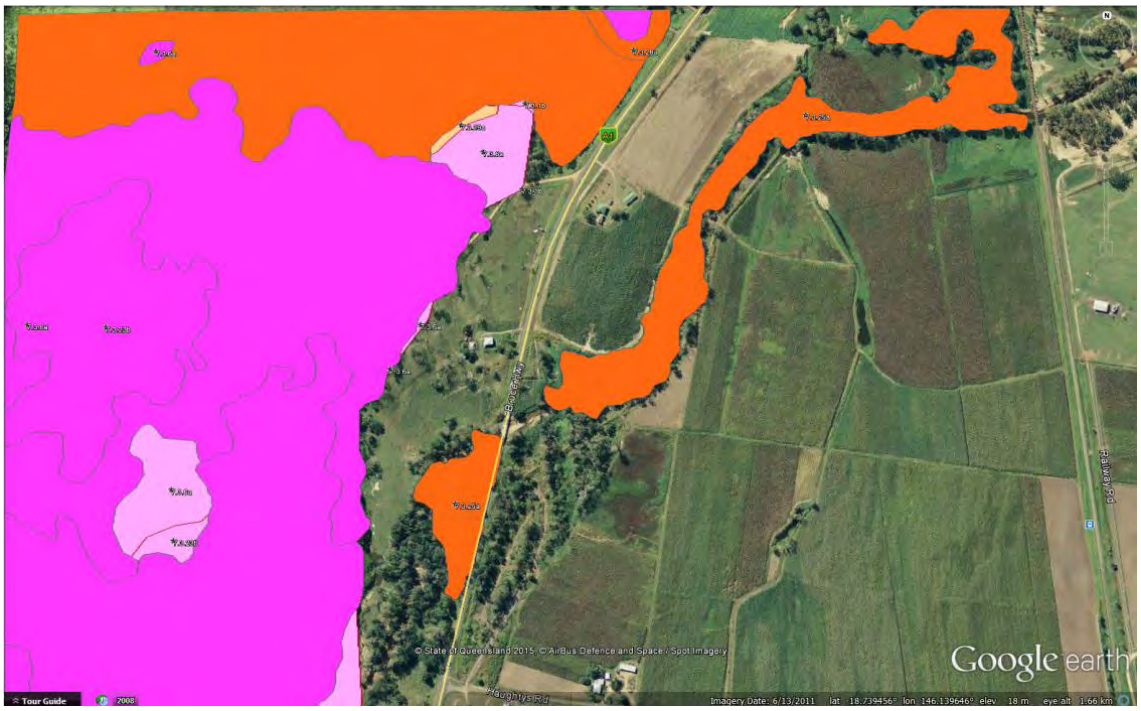

Figure 1: Extract of the Vegetation Management Supporting Map for Frances Creek
Pink = Endangered, Orange = Of Concern vegetation

The *Vegetation Management Act* 1999 (VMA) defines 'remnant vegetation' as vegetation forming the predominate canopy that:

- Covers more than 50% of the undisturbed predominant canopy; and
- Averages more than 70% of the vegetation's undisturbed height.

No Biocondition Benchmarks are available for any regional ecosystem in the Wet Tropics bioregion. However, examination of aerial photography of the site comparing the vegetation within the project area to remnant vegetation of the some Regional Ecosystem on the western side of the highway, shows canopy cover within the project area has been reduced to less than 50%. Although tree height measurements showed trees within the site to be of remnant height, this reduction in canopy cover would indicate the site is non-remnant. An examination of the structure and floristics of the non-remnant patch indicates that the site was previously an area of RE 7.3.25a.

Weeds

The area of non-remnant vegetation within the proposed clearing footprint is fairly degraded, and this is largely due to a powerline easement that traverses the site. The easement is dominated by Hamil grass (*Megathyrsus maximus* var. *maximus* cv. Hamil); a robust introduced grass that generates very high fuel loads. This zone of disturbance was also characterised by numerous other weed species.

Of the 35 plants species identified in the project area on the eastern side of the highway, 15 are introduced weeds. A list of all plants is included in Appendix 1.

Although the Review of Environmental Factors (ARUP 2014) noted that there were no declared plant species observed in the project area, the present survey identified two species listed as Declared weeds pursuant to the *Land Protection (Pest and Stock Route Management) Act* 2002. These were the Class 2 prickly pear (*Opuntia stricta*) and Class 3 African tulip (*Spathodea campanulata*).

Under the Act, land owners are required to take reasonable steps to keep their land clear of Class 2 weeds. Class 3 weeds such as the African tulip (*Spathodea campanulata*) must be controlled where they are growing adjacent to an environmentally significant area. Under the Act, an 'Environmentally Sensitive Area' includes an area of high nature conservation value under the *Vegetation Management Act* 1999. As remnant vegetation on the western side of the highway and along Frances Creek to the north-east is defined as an 'of concern' regional ecosystem, it would be defined in the Act as an environmentally significant area and therefore Class 3 weeds are required to be controlled. Additional declared weeds occur further downstream within the wildlife corridor.

In addition to the Act, the Hinchinbrook Local Government Area Pest Management Plan 2013 - 2017 also sets priorities on weeds in the Ingham region. Table 1 below lists these 15 weeds with their declaration status under the Lands Act and weed priority status under the Hinchinbrook Pest Management Plan.

Table 1: Introduced weeds present on the Frances Creek site

Species	Common name	Class	Hinchinbrook Pest Priority*	Form
Centrosema molle	Centro			vine
Cucumis anguria	burr gherkin			vine
Cyperus aromaticus	Navua sedge		24	grass
Hyptis capitata	knobweed			herb
Leucaena leucocephala	Leucaena			shrub/ tree
Macroptilium atropurpureum	siratro			vine
Megathyrsus maximus	Hamil grass			grass
Opuntia stricta	prickly pear	Class 2	17	cactus
Passiflora foetida	stinking passionfruit			vine
Pennisetum purpureum	elephant grass			grass
Sansevieria trifasciata	mother-in-laws tongue			herb
Sida rhombifolia	Paddy's lucerne			herb
Spathodea campanulata	African tulip	Class 3	14	tree
Stachytarpheta cayennensis	blue snake weed			herb
Urochloa mutica	Para grass			grass

*** Pest Management Plan Priority from Hinchinbrook Local Government Area Pest Management Plan 2013 - 2017**

Although control of all declared and priority weeds should be undertaken on the site, the presence of some non-declared environmental weeds is also of concern. These include Leucaena (*Leucaena leucocephala*) which can form dense thickets, Centro (*Centrosema molle*) which can also smother and suppress the growth of native plants, and Hamil grass (*Megathyrsus maximus* var. Hamil) which can fuel hot fires that degrade vegetation characteristics.

The disturbance of these species during construction represents an increased risk that these species will invade nearby sites.

Weed management is best undertaken through preventative measures, by minimising the disturbance footprint and undertaking rigorous weed management of disturbed areas prior to and following construction until suitable ground cover can be established. DTMR should develop and implement a pest management plan for works such as the proposed road construction, that includes and prioritises the removal of weed species that pose an environmental threat, and not only those that are declared species. This plan should specify the best management practice for different weeds. Care should be taken to ensure that all use of herbicides are used in accordance with their labels.

In the past, it was common practice to use exotic pasture grasses for roadside rehabilitation and this can be cause of weed invasion. Roadside revegetation should involve the use of suitable local native provenance grasses.

Additional mitigation measures include the following:

- Weed hygiene should be maintained for earthmoving equipment and vehicles operating on site. All removed weeds, weed-affected materials and rubbish are also recommended to be appropriately disposed of off-site. There should be no dumping of refuse into adjacent retained vegetation or gullies.
- Weed management should be undertaken following the works.

- It is recommended that an appropriately designed revegetation strategy (rehabilitation plan) for the purposes of minimising erosion potential and sediment loss in the project area should be developed to support the engineering works. Revegetation for the affected area should occur as soon as possible following the completion of construction.

Mahogany Gliders

Essential habitat

As discussed in the Review of Environmental Factors (ARUP 2014), the western side of the highway and along Frances Creek to the north-east is mapped as Essential Habitat for the mahogany glider (Figure 2). Essential habitat can only exist over remnant vegetation, so the degraded non-remnant vegetation on the eastern side of the highway is excluded.

Figure 2: Extract of Essential Habitat mapping on Frances Creek
Red = Mapped Essential habitat for Mahogany Gliders

The site was examined against published Essential Habitat factors for characteristics that determine the suitability of the site for those species.

Essential Habitat factors for the Mahogany glider includes

- **Vegetation Community**: Open, mature, medium to low sclerophyll woodland and forest (*Corymbia clarksoniana, C. intermedia, C. tessellaris, Eucalyptus platyphylla, E. tereticornis, E. drepanophylla, Lophostemon suaveolens; Melaleuca viridiflora, M. dealbata*) with open understorey (*Xanthorrhoea johnstonii, Albizia procera*); also in sclerophyll areas (*C. intermedia*) with rainforest invasion/closed understorey (*Dillenia, Melaleuca* and *Acacia* spp.).

- **Regional Ecosystem**: 7.1.3, 7.1.5, 7.2.2, 7.2.3, 7.2.4, 7.2.7, 7.2.8, 7.2.9, 7.2.11, 7.3.5, 7.3.6, 7.3.7, 7.3.8, 7.3.9, 7.3.10, 7.3.12, 7.3.16, 7.3.19, 7.3.20, 7.3.21, 7.3.25, 7.3.26, 7.3.28, 7.3.34, 7.3.35, 7.3.40, 7.3.43, 7.3.44, 7.3.45, 7.3.46, 7.3.49, 7.3.50, 7.8.2, 7.8.7, 7.8.18, 7.8.19, 7.11.1, 7.11.5, 7.11.10, 7.11.16, 7.11.18, 7.11.19, 7.11.34, 7.11.43, 7.11.50, 7.11.51, 7.12.1, 7.12.4, 7.12.5, 7.12.9, 7.12.12, 7.12.16, 7.12.17, 7.12.21, 7.12.22, 7.12.23, 7.12.24, 7.12.25, 7.12.26, 7.12.27, 7.12.28, 7.12.29, 7.12.34, 7.12.35, 7.12.37, 7.12.51, 7.12.52, 7.12.53, 7.12.59, 7.12.60, 7.12.61, 7.12.64, 7.12.65, 7.12.66
- **Altitude**: Sea level to 400m
- **Soils**: Quaternary alluviums and granite substrates
- **Position in Landscape**: Plains and rises

Of these five factors, the site matches the factors for Regional Ecosystem (7.3.25), Altitude (7m), Soils (Quaternary alluviums) and Position in Landscape (plains). The site is a loose match for the vegetation communities described, with only occasional occurrence of *Corymbia tessellaris,* however, the canopy is dominated by sclerophyllous tree species, notably *Melaleuca leucadendra,* which is listed by Jackson (2011) as an important food tree.

The vegetation community within the proposed footprint, although degraded and lacking remnant status, conforms to one of the four major habitat types of mahogany gliders listed by Jackson (2011):

- "*riparian forest along the creeklines that comprised different proportions of rainforest species and myrtaceous woodland species*".

These habitat types were further refined by Jackson *et al* (2015), defining the project area habitat as

- Mixed Open Forest (OF): Habitat that contains several species of Myrtaceae and Mimosaceae, including at least one species of bloodwood (*Corymbia*), generally *Eucalyptus tereticornis* and *E. pellita*, one or usually two species of *Melaleuca*, and several species of *Acacia*.

As Mahogany gliders appear to be inversely correlated with closed canopy communities (Jackson *et al.* 2015), the broken canopy in the project area would not be regarded as detrimental to their occurrence. Although a number of rainforest pioneer species were present on the site, these had not developed to the extent that they either dominated or significantly influenced the structure of the vegetation community. The declared African tulip (*Spathodea campanulata*) is colonising the site and would threaten the viability of the habitat in the longer term.

The site contains resources important for Mahogany gliders. Although the distinctive food plants Forest siris (*Albizia procera*), and grass tree (*Xanthorrhoea johnsonii*) were absent from the site, several other species listed as food plants by Jackson (2011) were present on site. One hollow-bearing tree was identified within the site, located to the east of the clearing footprint (Figure 3). As this tree is dead, it would not be expected to persist in the site in the long term.

In conclusion, although mapped as non-remnant, the site contains the elements of Essential habitat for the Mahogany glider.

Figure 3: **Tree hollow and potential glider den**

Corridor Potential and Functionality

The recently released Mahogany Glider Recovery Plan Storymap (Richards 2015) identifies the Wharps Holding population of Mahogany gliders connected to the west of the project site as a 'core population', and the Halifax Bay population at the eastern end of Frances Creek as a 'secondary population'. No surveys for Mahogany gliders have been conducted at 'The Orient' at the eastern extent of the Frances Creek corridor (Mark Parsons pers.comm), however, significant areas of mapped essential habitat exists in the area.

The Frances Creek riparian zone is described as the Toobanna Linkage, and described as a High priority Mahogany Glider corridor. The stated aim for high priority wildlife corridors is that they will be established and maintained, achieved by undertaking 5ha of revegetation per year and reducing high threat weeds by 50% throughout an additional10ha per year in high priority corridors (Richards 2015).

The Review of Environmental Factors (ARUP 2014) concluded that there is no functional connectivity between habitat areas east and west of the project area, and that there are no movement opportunities for gliders across the highway, however, there is no mapping or further information provided to support that conclusion.

Mahogany gliders have a fall : glide ratio of 1:1.91 and have been observed to glide an average of 30 m per glide although the longest glide recorded is 60 m (Jackson, 2000). The glide distance is therefore directly proportional to tree height. The heights of six potential glide trees and distances between them were measured in the field. The

location and distances between trees is shown in Figure 4 below, while the tree heights and potential glide distances are provided in Table 2. From these measurements, it can be seen that potential connectivity exists at the highway crossing at the three locations FA, FB and FC.

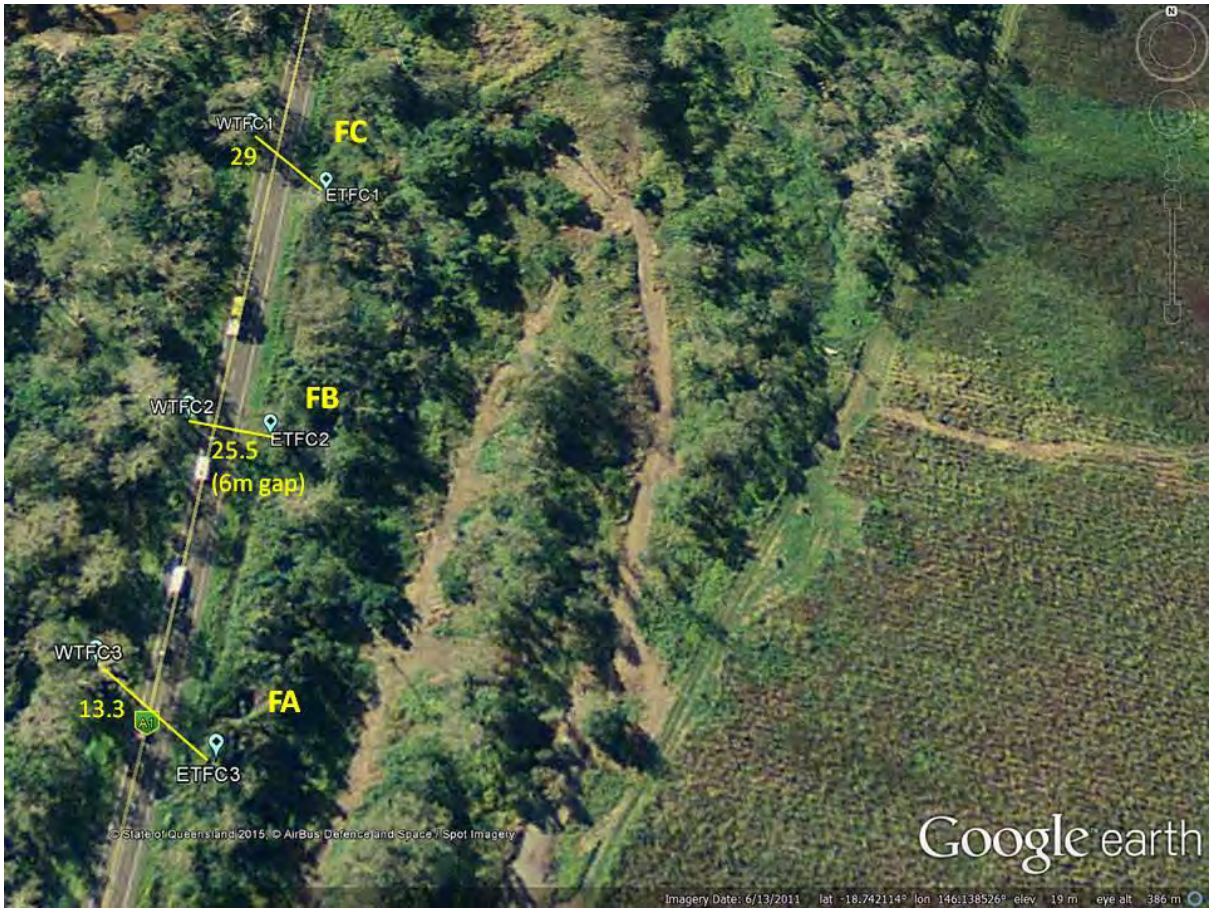

Figure 4: Distances between potential glide trees

Table 2: Tree heights and maximum potential glide distances

Tree/ Pole Number	Species	Height (m)	Maximum glide *
WTFC1	*Melaleuca leucadendra*	15.5	29.6
ETFC1	*Melaleuca leucadendra*	17.7	33.81
WTFC2	*Melaleuca leucadendra*	17	32.47
ETFC2	*Melaleuca leucadendra*	21.5	41.1
WTFC3	*Melaleuca leucadendra*	17	32.47
ETFC3	*Melaleuca leucadendra* (dead)	16	30.56

*Maximum glide distance = tree height X 1.91 (from Jackson 2000)

Distances provided in Figure 4 are measurements between tree trunks, however, in most instances the tree canopy and potential glide points often extend further from the tree trunks, further reducing the necessary glide distance. At location FB, the canopies between trees WTFC2 and ETFC2 are only six metres apart (Figure 5).

Figure 5: Canopy gap at location FB, showing 6 m gap between trees WTFC2 and ETFC2

These measurements indicate that connectivity across the Bruce Highway does currently exist at Frances Creek.

The condition of the corridor was also examined. Along the length of the corridor, there was a good tree cover along the banks of the stream, consisting of a mixture of weeping paperbark (*Melaleuca leucadendra*), river cherry (*Syzygium tierneyanum*), Leichardt tree (*Nauclea orientalis*) and other typical gallery forest species. Eucalypts such as Moreton Bay ash (*Corymbia tessellaris*) and Forest blue gum (*Eucalyptus tereticornis*) were commonly encountered. A number of rainforest species and introduced woody weeds were present throughout, but forest thickening was not a significant issue in any of the areas inspected.

A 3.4km section of the corridor is mapped as non-remnant as canopy cover is reduced to less than 50%, however, individual trees along the length of the creek are large mature specimens of expected average maximum height for the community. Gaps in the tree

canopies did not exceed Mahogany glider gliding capacity. An example of non-remnant riparian forest is shown in Figure 6 below.

Figure 6: Non-remnant vegetation along the Frances Creek wildlife corridor (-18.7353 146.1577)

A significant break in the corridor occurs at a railway easement at location -18.735 146.157. The gap in the tree canopy at this location varied from 33 to 38m wide. The height of the adjacent *Melaleuca leucadendra* ranged from 9.5m to 15.2m, allowing a maximum glide distance of 29.03m. To cross this point, the gliders would need to land on the ground and move across the ground for four metres. In discussion with Mark Parsons (Department of National Parks, Recreation, Sport and Racing) on 3rd August 2015, he confirmed that this is a significant break in connectivity. The reluctance or willingness of a Mahogany glider to attempt to cover a gap of this size is unknown. Mahogany gliders have a preference for landing on tree trunks, and this also decreases the opportunity of being taken by predators from the ground (Jackson 2000). It should be noted however, that Mahogany gliders regularly feed on grass trees (*Xanthorrhoea johnsonii*), and this would necessitate some movement on the ground. Sugar gliders and Greater gliders have been observed gliding to the ground when threatened (pers.obs), and it is possible that Mahogany gliders would also do this. Although the frequency of a Mahogany glider crossing this canopy gap is unknown, it would only require an occasional individual to maintain a genetic exchange between the populations (Mark Parsons pers.comm). Although the ability for Mahogany gliders to use the corridor would be significantly improved by installation of a gliding pole on either side of the crossing, it is concluded that the corridor is functional.

Significant Impact Assessment

The impact of the proposed project on the Mahogany glider is assessed using the 'significant impact criteria' set out under Matters of National Environmental Significance – Significant Impact Guidelines 1.1 (the Guidelines). These criteria are intended to assist in determining whether the impacts of a proposed action on a nationally threatened species are likely to be significant impacts.

For an Endangered species such as the Mahogany glider, an action is likely to have a significant impact if there is a real chance or possibility that it will:

- lead to a long-term decrease in the size of a population
- reduce the area of occupancy of the species
- fragment an existing population into two or more populations
- adversely affect habitat critical to the survival of a species
- disrupt the breeding cycle of a population
- modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline
- result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat
- introduce disease that may cause the species to decline, or
- interfere with the recovery of the species.

The criteria are intended to provide general guidance on the types of actions that will require approval and the types of actions that will not require approval. Comments / responses are provided in relation to each of the significant impact criteria below.

Jackson *et al*. (2015) notes that the greatest threat to Mahogany gliders is

1. habitat loss and fragmentation of the remaining habitat,
2. degradation and alteration of the remaining habitat as a result of transition to closed forest and sclerophyll thickening due to reduced fire frequency,
3. intensive grazing and weed invasion,
4. mortality and dissection of habitat as a result of easement corridors,
5. mortality from barbed wire fencing; and
6. extreme climatic events including tropical cyclones and severe wildfires.

This current project relates specifically to the widening of a transport corridor in a high priority Mahogany glider corridor, containing areas mapped as Essential Habitat, however, its presence on the site has not been verified.

Lead to a long-term decrease in the size of a population

A size estimate of the population of Mahogany gliders in the vicinity of the proposed road corridor is not available, nor is an estimate of population density. Numerous surveys and location data were examined including Atlas of Living Australia, Ingham district surveys by Lyon (1993) and unpublished surveys, however, there are no records for the gliders on Frances Creek and until now, no surveys have been undertaken there (Mark Parsons

pers comm.). The western side of Frances Creek is directly connected to the Wharps Holding population, described as a 'core population' by Richards (2015), however, the long and narrowly linear shape of vegetation along Frances Creek is of greater value as a movement corridor than as habitat for resident animals. The proposed project proposes to remove 0.7ha, which does not include any potential denning trees, so is unlikely to displace any animals or reduce the size of a population. Mitigation measures will be put in place to ensure connectivity is maintained.

Therefore, the proposed action will not lead to a decrease in the size of a population.

Reduce the area of occupancy of the species

Of the original extent of Mahogany glider habitat, only 20 percent (106,669ha) of former habitat remains available (Parsons & Latch 2007). Within the remaining areas of Mixed Open Forest habitat, 45% has diminished habitat suitability due to sclerophyll thickening or transition to rainforest (Jackson *et al*. 2011).

The narrow corridor is sub-optimal as an area likely to be occupied by a glider, as it exposes them to higher levels of predation, results in lower numbers of individuals of food trees and has a lower availability of dens (Jackson *et al* 2015). In continuous habitat, gliders maintain a home range of 19 ha for males and 20 ha for females, while in fragmented habitats, home ranges can be as small as 11 ha for males and 7 ha for females, with a combined home-range of male and female pairs being 12 ha (Jackson *et al* 2015). To be able to provide the smallest home range for a pair of Mahogany gliders (12ha), the first length of 1.12km of the Frances Creek corridor would be required. There is evidence, however, that Mahogany gliders can live in fragmented landscapes, as long as the patch is at least 60m wide and contain sufficient number of food tree species to provide a year-round supply of food, such as along creek lines in open areas (Jackson *et al* 2015). The non-remnant forest in the project area and adjacent wildlife corridor would satisfy these criteria.

Therefore, there is a possibility, considering the existing connectivity across the Bruce Highway, that vegetation in the project area may form part of a home range of a Mahogany glider. A study by Asari *et al* (2010) identified a male glider utilising a narrow strip of woodland at the opposite side of the highway as supplemental habitat for foraging. In the absence of any radio tracking studies, there is the possibility of the removal of this area of vegetation being a residual environmental impact.

Fragment an existing population into two or more populations

Major transport corridors are the single largest known contributor to mahogany glider fatalities, and the width of the Bruce Highway has been suggested as a formidable barrier to dispersal (Parsons & Latch 2007).

Impacts of transport corridors such as the Bruce Highway may have several negative impacts including:

1. direct mortality from road crossing because the breaks caused by the road and side clearing are too large to afford sufficient gliding space;
2. the dissection of habitat occurs as female gliders appear to be less likely to cross over roads than males; and

3. potentially increased predation along the forest edge from arboreal predators (Jackson *et al* 2015).

The current gap between trees at Frances Creek is approximately 25 metres, with a canopy gap as small as 6 metres, allowing for movement of gliders across the highway at this point. However, the widening of the road corridor will increase the gap to approximately 51m, which will have the impact of both removing potential glide trees and substantially increasing the gliding distance required.

This further widening of the highway will prevent potential dispersal and movement, thereby fragmenting existing habitat and partially severing the Trebonne wildlife corridor. Without mitigation, this has the potential to be a significant impact.

To ensure that these impacts are reduced as far as practical, a priority of DTMR is to address connectivity issues wherever a project has the potential to restrict movement of access. DTMR notes that one of the objective of the Draft recovery plan (Jackson *et al* 2015) is to ensure that all stakeholders influencing the restoration and management of Mahogany Glider habitat are promoting and/or conducting best practice management methods within priority areas to maximise the efficiency of the recovery plan.

The Draft recovery plan (Jackson *et al* 2015) recommends that gaps in habitat across roads should ideally not be greater than the average glide distance of 30m, however, this is not a feasible short term outcome for this project. Installation of glider poles and rope bridges have been used at other locations where limited connectivity for gliders needs to be addressed. Although an objective of Recovery Plan is to assess the effectiveness of wildlife corridors, glider poles and rope bridges, the plan also suggests the use of glide pole arrays to reduce the threats arising from new and upgraded transport and easement corridors.

Studies on the use of the use of glider poles has been primarily on Squirrel gliders (e.g. Goldingay *et al* 2011, Soanes *et al*. 2015), but have shown their effectiveness in restoring habitat connectivity. By reducing roadkill and allowing even a few dispersing individuals to successfully cross and reproduce, they are likely to benefit populations (Soanes *et al* 2015). Recent studies showed the use of those poles decreases as the number of poles and the distance between the poles increases, so the use of pole arrays with fewer poles placed closer together are likely to be more successful for squirrel gliders (Soanes *et al* 2015). Additionally, the use of rope canopy bridges have been shown to benefit a wider range of species than glider poles, and have been recommended as the preferred mitigation method where feasible (Soanes *et al* 2015).

The actual placement and height of the poles and placements of any rope canopy bridges is a level of detail that will need to be incorporated into the final planning design, The use of barrier fencing may allow the poles to be positioned closer to the highway than would be possible otherwise, but a glide distance of less than 30 metres with a glide height over the highway in excess of 3 metres will be the design objective.

Adversely affect habitat critical to the survival of a species

In line with the EPBC guidelines for assessing significant impact, habitat critical to the survival of a species refers to areas that are necessary:

- For activities such as foraging, breeding, roosting, or dispersal;
- For the long-term maintenance of the species;
- To maintain genetic diversity and long term evolutionary development, or
- For the reintroduction of populations or recovery of the species or ecological community.
- Such habitat may be, but is not limited to: habitat identified in a recovery plan for the species or ecological community as habitat critical for that species or ecological community; and/or habitat listed on the Register of Critical Habitat maintained by the minister under the EPBC Act.

The Draft recovery plan (Jackson *et al* 2015) also defines 'critical habitat' to include areas of suitable habitat that contribute to Priority Wildlife Corridors, regardless of whether they are identified on a Vegetation Management Supporting Map as being 'Essential Habitat'.

The proposed action will impact on approximately 0.7ha portion of non-remnant vegetation. This vegetation is neither in a noted large habitat area or one of the small, isolated and highly fragmented areas listed in the SPRAT profile for mahogany gliders (2015a). The proposed clearing is not in an area mapped as Essential Habitat for the species, though it represents a fragmented and disturbed area that was previously a community listed as Essential habitat.

Considering the extent of habitat clearing and the existing alteration of habitat by vegetation thickening, areas mapped as Essential Habitat should be regarded as Habitat Critical to the Survival of the species. On the basis of that logic, non-remnant vegetation that provides linkages between areas of suitable habitat should also be regarded as being Critical to the Survival of the species, as these connecting patches prevent the isolation and inevitable extinction of these small populations.

The Draft recovery plan (Jackson *et al* 2015) notes that corridors are prone to a broad range of negative impacts, so the long-term persistence of Mahogany Gliders within corridors is a problem. The plan concludes that the aim of the conservation program should not be for these wildlife corridors to be the sole refuge of gliders, but instead as areas that facilitate movement between larger populations.

We therefore conclude that the non-remnant patch on the eastern side does constitute habitat critical to the survival of the species, and that the removal of 0.7ha of this patch does constitute a residual environmental impact.

Disrupt the breeding cycle of a population

The Mahogany Glider breeds during the dry season (April - October), with the young being weaned during the wet season when more insect food is available (Jackson *et al* 2015). The young are weaned at 4–5 months of age, and considering all adult females

breed each year (Jackson *et al* 2015), most months of the year represent some phase of their breeding cycle.

The area impacted by the proposed clearing may potentially include habitat for one or two gliders, but not a population.

We therefore conclude that the proposed action is unlikely to disrupt the breeding cycle of a population.

Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline

It is proposed to remove approximately 0.7ha of non-remnant habitat on the eastern side of the Bruce Highway at Frances Creek. As previously demonstrated, the area impacted by the proposed clearing may potentially include habitat for one or two gliders, but not a population.

The site provides a tenuous linkage between two populations and, considering the size of the existing gap at the railway crossing, it is unlikely to be used frequently. Considering issues relating to connectivity will be mitigated for, the only residual impact will be the removal of this area of non-remnant vegetation.

On the basis of the ecologically small size of clearing, location outside a significant population and continued connectivity, we do not believe that the proposed action will modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.

Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat

Habitat degradation through weed invasion, and predation by feral animals are both identified as threatening the Mahogany glider (Parsons & Latch 2007). Weeds suppress grass growth which in turn reduces the ability of fire to progress through the vegetation patch.

A number of invasive species are already present on site. Surveys undertaken identified 15 introduced weed species, including two declared species. Two of the weeds are large robust perennial grasses that generate high fuel loads and can carry hot destructive wildfires. The wildfires in turn can increase the loss of canopy trees, and consequently sever connectivity. Woody weeds such as Leucaena and African tulip can cause vegetation thickening, reducing the ability of Mahogany gliders to be able to traverse the site.

As a component of the project, DTMR will undertake normal weed hygiene precaution to prevent the spread of additional weeds and will undertake a range of weed control activities within the road corridor, including the control of prickly pear and African tulip; a Class 2 and 3 weed respectively under the *Land Protection (Pest and Stock Route. Management) Act* 2002. Old road alignments are known to often provide an excellent opportunity for weed invasion as can be seen from the previous highway alignment at Frances Creek. To manage the risk of a significant impact through weed invasion, for the

area of the current alignment that will become offline revegetation with endemic native species will need to occur.

After mitigation, the proposed action will not result in a harmful invasive species becoming established.

Introduce disease that may cause the species to decline

No infectious diseases or known to occur in Mahogany gliders, and captive animals are not given vaccinations against any disease or infection (Whiteford 2007). The proposed project is unlikely to introduce any disease that may be harmful to the gliders.

Of concern in the region is the spread of the Myrtle rust (*Uredo rangelii*); a fungus of plants in family Myrtaceae which contains most of the species critical to the survival of Mahogany gliders. Myrtle rust infection can cause defoliation, twig mortality and abortion of flowers and fruits so could reduce food availability for cassowaries. It is known to occur in Girringun National Park since June 2012, however, its spread through the Ingham area has been notably slow, considering that *Melaleuca leucadendra* which lines many of the waterways in the area is known to be susceptible (pers.obs). There are multiple ways in which Myrtle rust can be spread including wind, water, animals, movement of infected plant material, contaminated equipment, humans and vehicles. While hygiene practices will be followed for all work on vegetation, it is not possible to entirely prevent the movement of the microscopic spores. The potential impact of Myrtle rust on Mahogany gliders and their habitat cannot be accurately predicted, as its spread and rate of infection is currently much slower than that initially predicted.

After mitigation, the proposed action is unlikely to contribute to the spread of a harmful introduced disease.

Interfere with the recovery of the species.

The recovery plan for the Mahogany glider was prepared by Mark Parsons and Peter Latch in 2007 has been updated and replaced with a new draft recovery plan (Jackson *et al* 2015). This recovery plan includes a comprehensive list of goals and objectives that guide investment in recovery actions for the species:

1) maintain and deliver prioritised conservation planning for Mahogany Glider.
    (1) Ensure the implementation of the recovery plan is effective at reducing the threats to Mahogany Gliders and their habitat and is implemented with maximum stakeholder participation.
    (2) Ensure that all stakeholders influencing the restoration and management of Mahogany Glider habitat are promoting and/or conducting best practice management methods within priority areas to maximise the efficiency of the recovery plan.
    (3) Identify and prioritise key areas of Mahogany Glider habitat for protection management and recovery.
2) answer the biological questions required to improve the recovery of the Mahogany Glider.

(1) Identify and resource, research into improving the knowledge of Mahogany Glider population dynamics, genetic structure, distribution and overall health to inform the recovery process and evaluation of the Mahogany Glider conservation status.

(2) Increase knowledge of the ecology, habitat requirements and threat abatement options available for the Mahogany Glider.

(3) Monitor the recovery trend of Mahogany gliders across the extent of their distribution.

3) mitigate threats to the Mahogany Glider at priority sites.

(1) Improve the long term management of Mahogany Glider habitat through the adoption of appropriate conservation land management practices.

(2) Influence industry, institutions, organisations and local, state and federal government through the development of relevant policy and guidelines to inform planning and disaster recovery processes, to ensure the protection of remaining habitat areas and reduce the threats to Mahogany Gliders.

(3) Ensure that the effect of cyclones on Mahogany Gliders and their habitat is recognised by all levels of Government, industry, institutions and organisations and considered during all aspects of the recovery process.

4) engage the community in the recovery of the Mahogany Glider.

(1) Engage private landholders in adopting land management practices that balance Mahogany Glider conservation needs with other land uses.

(2) Increase the awareness, knowledge and involvement of the community in the conservation of the Mahogany Glider

Many of these goals and objectives are not directly relevant to Department of Transport and Main Roads in the present project. However, DTMR have recognised the contribution and impact of the Bruce Highway on fragmenting populations. Demonstrating a commitment to the recovery of the Mahogany Glider species, DTMR have previously installed Mahogany glider poles and crossing points at a number of strategic crossings such as Mosquito Creek (south of Bambaroo) Corduroy Creek (Murray Flats), Cardwell Range and Easter Creek (south of Helens Hill).

DTMR are committed to utilising best practice management methods to facilitate the ongoing movements of Mahogany Glider along the Frances Creek corridor, and to monitoring the effectiveness of these structures.

The proposed action does assist in the recovery plan by the proposed mitigation measures adopted for the site, which aims to ensure no net loss of connectivity for the gliders along the corridor between two important populations.

Summary and Recommendations

In conclusion, the linear vegetation traversed by the Bruce Highway at Frances Creek

contains both non-remnant and mapped remnant essential habitat, but contains only enough habitat for residence for a couple of individuals. The combination of the remnant and non-remnant vegetation is likely to provide a corridor between two important glider populations, however, a significant gap in the corridor does exist at the railway easement.

Although mapped as non-remnant, the 0.7ha area of vegetation within the proposed clearing footprint does contain foraging resources and may potentially form part of the home range of a glider. The existing tree canopy over the Bruce Highway is narrow enough to provide connectivity, however, the proposed widening of the transport corridor to 51m width will sever the connectivity.

Mitigation Measures

Mitigation measures in the form of glider poles and rope bridges are a suitable solution to addressing issues of habitat connectivity. The exact height and placement of the poles will need to be calculated in details, but should follow the following principles:

- A cluster of poles is preferable to many spaced poles
- Poles should be positioned at a maximum distance of 30m, so should be preferentially placed where the new road corridor easement is narrowest
- Using a glide ratio of 1:1.91, a glide height over the highway in excess of 3 metres will be the design objective
- The use of barrier fencing may allow the poles to be positioned closer to the highway than would be possible otherwise
- The use of rope bridges should be installed in conjunction with the glider poles

Once the new alignment is completed, the current alignment can be ripped and revegetated. Additional revegetation could restore the non-remnant area to the east into remnant. These options should be proposed as partial or complete fulfilment of any possible offset requirement.

Other recommended mitigation measures relate to weed hygiene protocols and undertaking weed control in and adjacent to the road easement following construction.

The removal of 0.7ha of suitable, albeit non-remnant vegetation is a residual impact not otherwise mitigated for.

Referral

The present study demonstrates that the project has the potential to have a significant impact on Matters of National Environmental Significance, because the project requires clearing of vegetation that comprises a High Priority corridor for the Endangered Mahogany Glider. Although issues relating to severed connectivity can be adequately addressed through the stated mitigation measures, the removal of 0.7ha of non-remnant vegetation from the corridor is a residual impact that cannot be addressed by either avoidance or mitigation.

It is recommended that DTMR refer the project to the Commonwealth Department of Environment for assessment under the *Environment Protection and Biodiversity Conservation Act* 1999.

Offsets

It is likely that an offset may be required and the provision of an offset will be part of the referral approval decision process. In those types of cases, the offsets may be applied as an approval condition under the EPBC Act (DEWR 2007).

It was expected that the separate offset requirements of the EPBC and the Queensland Government's Environmental Offsets Policy would be merged under the EPBC Amendment (Bilateral Agreement Implementation) Bill 2014, however, the bill contains no specific discussion of offsets.

Prior to submitting a referral, it would be prudent to assess the Frances Creek project using the balance sheet provided under the EPBC Offsets assessment guide to determine the likely extent and suitability of an offset. Potential offsets should be discussed with the Mahogany Glider Recovery Team to ensure the maximum strategic value of the offset, however, SEWPaC (2012) provides the following principles that suitable offsets should adhere to:

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
2. be built around direct offsets but may include other compensatory measures
3. be in proportion to the level of statutory protection that applies to the protected matter
4. be of a size and scale proportionate to the residual impacts on the protected matter
5. effectively account for and manage the risks of the offset not succeeding
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,
7. be efficient, effective, timely, transparent, scientifically robust and reasonable
8. have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced.

DTMR should consider whether they have existing exemptions under the Queensland Government's Environmental Offsets Policy.

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Appendices

Flora species recorded on site

Table 3: Plant species recorded along the proposed alignment at Frances Creek (* - Introduced)

Species	Common name	Family	Status	Class	Form
Acacia mangium	hickory wattle	Mimosaceae			tree
Alphitonia excelsa	soap bush	Rhamnaceae			tree
Cayratia trifolia	native grape	Vitaceae			vine
Centrosema molle	centro /soft butterfly pea	Fabaceae	*		vine
Corymbia tessellaris	Moreton Bay ash	Myrtaceae			tree
Cryptocarya hypospodia	northern laurel	Lauraceae			shrub
Cucumis anguria	burr gherkin	Cucurbitaceae	*		vine
Cyperus aromaticus	Navua sedge	Cyperaceae	*		sedge
Eclipta prostrata	white eclipta	Asteraceae			herb
Elaeocarpus grandis	blue quandong	Elaeocarpaceae			tree
Entada rheedii	matchbox bean	Mimosaceae			vine
Ficus opposita	sandpaper fig	Moraceae			tree

Species	Common name	Family	Status	Class	Form
Glochidion harveyanum	buttonwood	Phyllanthaceae			shrub / tree
Hyptis capitata	knobweed	Lamiaceae	*		herb
Imperata cylindrica	blady grass	Poaceae			grass
Leucaena leucocephala	leucaena	Mimosaceae	*		tree
Macaranga involucrata	brown macaranga	Euphorbiaceae			tree
Macaranga tanarius	heart leaf	Euphorbiaceae			tree
Macroptilium atropurpureum	siratro	Fabaceae	*		vine
Megathyrsus maximus var. maximus	Guinea grass	Poaceae	*		grass
Melaleuca leucadendra	weeping paperbark	Myrtaceae			tree
Melicope elleryana	pink evodia	Rutaceae			tree
Millettia pinnata	pongamia	Fabaceae			tree
Mucuna gigantea	burney vine	Fabaceae			vine
Nauclea orientalis	Leichhardt tree	Rubiaceae			tree
Opuntia stricta	prickly pear	Cactaceae	*	2	cactus
Pandanus cookii	screw pine	Pandanaceae			tree

Species	Common name	Family	Status	Class	Form
Passiflora foetida	stinking passionfruit	Passifloraceae	*		vine
Pennisetum purpureum	elephant grass	Poaceae	*		grass
Sansevieria trifasciata	mother-in-laws tongue	Dracaenaceae	*		herb
Sida rhombifolia	Paddy's lucerne	Malvaceae	*		herb
Spathodea campanulata	African tulip tree	Bignoniaceae	*	3	tree
Stachytarpheta cayennensis	blue snake weed	Verbenaceae	*		herb
Terminalia microcarpa	native damson	Combretaceae			tree
Urochloa mutica	para grass	Poaceae	*		grass