Redbank: Gouldian Finch (*Erythrura gouldiae*) Management Plan

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Project: Redbank Copper ERL 94

Purpose: Provide for the conservation of Gouldian finch and other granivorous birds and their habitat on Redbank and a site within the near vicinity.

Scope: Redbank ERL and surrounds (2010 – 2011)

Authorisation:

Prepared by:	**AG**	**Date:**
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Purpose

The purpose of this plan is to establish the management framework specifically for the conservation of Gouldian Finch (*Erythrura gouldiae*) which may be utilising the Redbank ERL and the immediate surrounds for either breeding or critical early wet season feeding.

The Gouldian Finch (*Erythrura gouldiae*) is a species listed as vulnerable under both Commonwealth Legislation, *The Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and *Northern Territory legislation the Territory Parks and Wildlife Conservation Act 2000*.

Gouldian finches have been recorded at 5 separate localities on Redbank ERL. The Redbank area and its surrounds feature vegetation and proximity to permanent or near permanent waters which are typical of the preferred habitat for Gouldians.

Under the EPBC Act Redbank is required to minimise the impact for these species and provide offset management (off-site) where the impacts are of a magnitude judged to negatively impact local populations of the species. Management for Gouldians will also benefit a number of other small granivorous species which have also experienced population declines over the last 100 years, but not as significant as the Gouldian

Scope of this Plan

This plan guides and informs the management of Redbank ERL so as to minimise the impacts on the Gouldian Finch as much as possible, as well as direct investment which will contribute to a net gain for the conservation of local populations on or in the vicinity of Redbank ERL.

This plan is an initial step in developing a management approach based on the limited knowledge of local Gouldian populations. A number of separate sightings in May 2009 together with the Redbank ERL and the greater region featuring qualities of preferred habitat suggest that Gouldians are resident and possibly breeding either on site or nearby.

A high priority is to establish the status of any Gouldian finch populations and their habitat requirements on the Redbank ERL and the immediate surrounds. This critical step will enable specific assessment of the value and needs of this local population, the degree of impact that Redbank may impose and how to best target management (including offsets) for the long term benefit of this species.

If Gouldian finches are found to reside largely off-site on the Wollogorang Station, but visiting the Redbank ERL periodically, this management framework will be revised. The aim will be to inform the neighbouring land tenure, negotiate future offset management on this tenure, and ensure that activities on Redbank compliment conserving any populations in the immediate surrounds.

This plan provides:

- Background information to the Gouldian Finch, the overall status, significant populations, life strategies and habitat requirements, key threats and management priorities
- The context for the Redbank Local Population and potential habitat for Gouldians
- The Overall Management Framework
- Local threats by both mining development and other processes
- Risk Assessment for threatening processes to a local population
- Off Set Implications
- Management Priorities

- Ongoing assessment, monitoring and review

Linkages with other management plans:

This draft plan of management will align with the National Recovery Plan for the Gouldian Finch *Erythrura gouldiae* (O'Malley, 2006) as well as NT specific recovery and monitoring efforts.

This plan will also influence and align with the other management plans for Redbank ERL including those for pest species, fire and water management.

This plan will also influence and align with the management of the surrounding Wollogorang Station.

Background information

General Description and Distribution

The Gouldian Finch (*Erythrura gouldiae*) or painted finch is a small, granivious finch endemic to Northern Australia. It is a brightly coloured bird with three distinct facial colour morphs with either a black (most common about 75%), red or yellow face. Male birds are more brightly colored than females, mainly emerald green above, with a light-blue uppertail, and a large black, red or yellow-orange mask (depending on the morph) that is bordered behind by a light-blue band, a purple breast with yellow below and a cream undertail (DEWHA, 2010). The adult female is similar to the adult male, but is duller and paler overall with a shorter tail. Juveniles feature a nondescript olive-brown-grey plumage which can lead to them to being misidentified for other species.

Figure 1. Typical Gouldian finch markings

Historically the Gouldian Finch was the most common and widespread finches of the Northern Savannas. However, numbers have significantly declined, particularly since 1970 and is now absent from much of its former range. The Gouldian finch is now is sparsely distributed across northern Australia from the Kimberley region of north-western Western Australia to north-central Queensland. Its distribution has contracted markedly in Queensland (DEWHA, 2010).

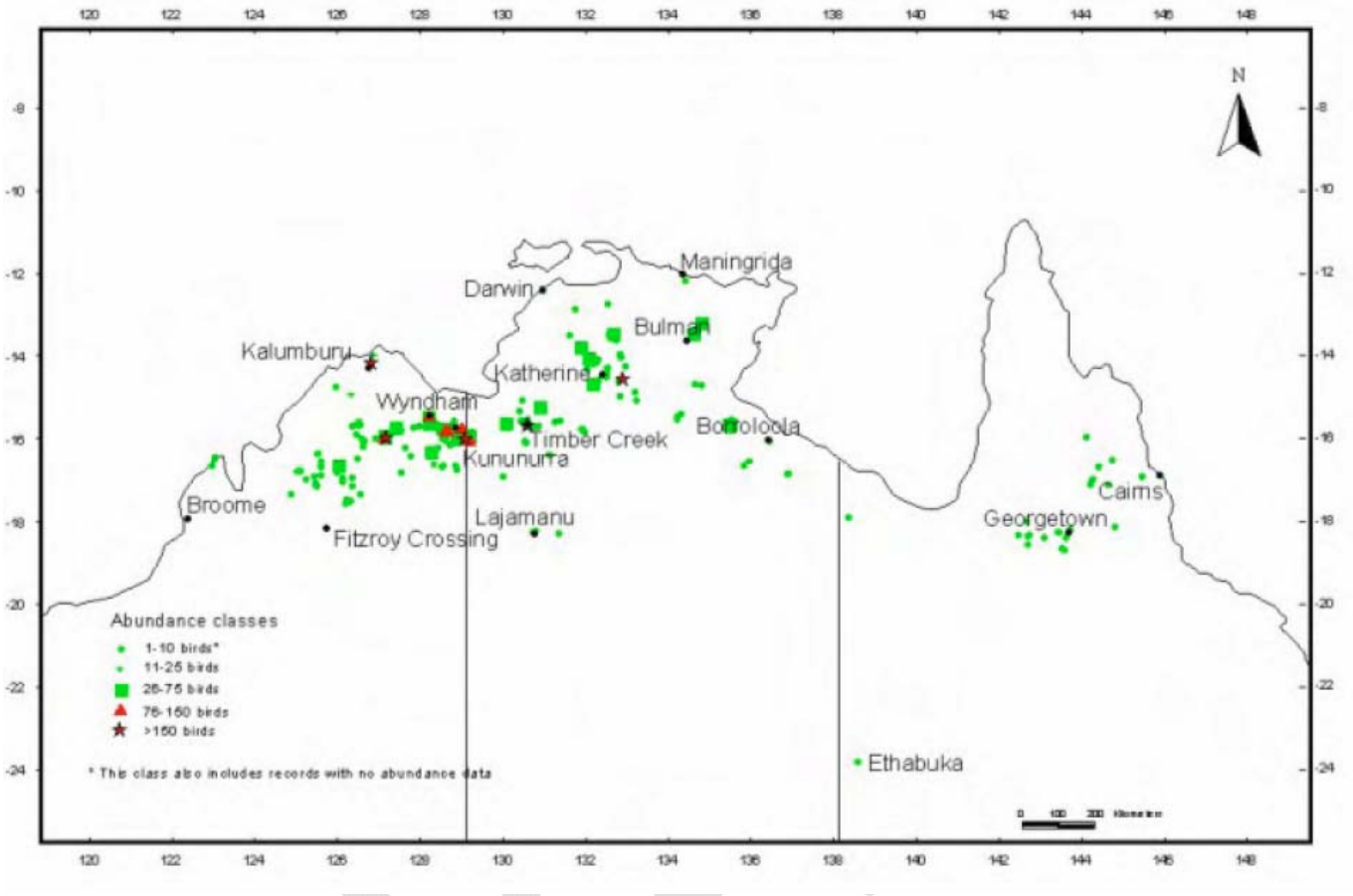


Figure 2: Known records for Gouldian finch sightings and significant populations – Gouldian finch Recovery Plan, 2006.

Remaining Significant Populations:

On-going population monitoring programs and incidental sightings lodged with the Gouldian Finch national database, over the past decade indicate that the Gouldian Finch is known to consistently occur in significant numbers (> 50 adult birds) at only 10 locations, including five in Western Australia; and five in the Northern Territory (O'Malley 2006).

The total population size of the Gouldian Finch is estimated at 2500 or more (O'Malley, 2006). They occur in a number of small local populations. The largest known population is at Yinberrie Hills estimated to support 150 to 250 adult birds. However, the Yinberrie population exhibits substantial annual fluctuations) in the numbers of adult and juvenile birds which are present (up to a 3 fold change in population size), possibly due to fluctuations in seed availability, fire and seasonal rains (O'Malley, 2006 & Griffiths et al, 2008).

The total number of locations occupied by the Gouldian Finch is unknown and difficult to estimate because of the scattered and widespread distribution in very remote locations (DEWR, 2010). Sightings of smaller numbers have been recorded at other sites in Northern Australia (DEWR, 2010). While the Gouldian Finch is not known to undergo extreme natural fluctuations in extent of occurrence or area, they have been known to appear at sites for which they have not been recorded for over 10 years (O'Malley, 2006). The reason for this is not known. It is likely that the Gouldian finch is utilising habitat which is less than optimal due to significant habitat alteration (O'Malley, 2006).

The Population structure and their longevity is generally unknown due to poor recapture rates (Lewis, 2007). Individual Gouldians are known to survive to five or more years of age in the wild (DEWHA, 2010).

The current trend in population size is unclear, but there is evidence to suggest that numbers may be stable (DEWHA, 2010).

Habitat Requirements and Life Strategy

The Gouldian was thought to be migratory but it is now believed that they are largely sedentary with annual seasonal movement (xkm daily) between two key habitat types. However, they may be capable of making long-distance movements as indicated by.....

Gouldian finches occupy two different regions of the landscape on an annual cycle driven by the availability of seed of a few native grass species and availability of water and tree hollows for breeding (NRETAS Gouldian Recovery Project, 2009 and). On an annual cycle Gouldian's move between the dry season breeding habitat in the rocky hills and during and with the onset of the wet season they move to Wooded lowlands where there is a greater diversity of early seeding perennial grasses.

Gouldians are specialist seasonal foragers. The nature of the extreme wet and prolonged dry season of the tropical savannas results in a very short growing season in which grasses produce abundant seeds (Lewis, 2007). The life strategy of annual grass species results in copious amounts of seed which remain dormant through the dry season waiting for the wet season rains. Seeds from native annual spear grass and sorghum or Sarga species (*Sarga intrans* and *S. Stipoideum*), which have dropped to the ground surface, provide the staple diet for Gouldians through the dry season. These seeds are utlised while they are nesting and raising young (between January and August).

Gouldians are most vulnerable to decline in the early wet season when food and water sources are low and the birds are physiologically stressed in completing a full moult. Availability of early seeding perennials in the low lands, particularly cockatoo grass (*Alloteropsis semialata)* which produces the first fresh seed after the dry season, is thought to be a significant bottle neck to Gouldian finch populations.

Breeding and Dry Season habitat

Unlike other finches the Gouldian nests are within tree hollows formed by termites. Known breeding habitat for Gouldian Finches in the Northern Territory are characterised by rocky hills with unburnt hollow-bearing smooth-barked gums (*Eucalyptus brevifolia, E. Tintinnans or Eucalyptus leucophloia)* within two to four kilometres of small waterholes or springs which persist throughout the dry season and ample cover of annual Sorghum or spear grass (Tidemann, etal 1999). The Gouldian needs to drink every day but the permanent waters they access need only be small (e.g 20cm in diameter).

Wet Season Feeding habitat

In the wet season (December – February) Gouldian's move from the hills into lowland drainages to feed upon a more diverse assemblage of scattered perennial grasses such as cockatoo grass (*Alloteropsis semialata*), golden beard grass (*Chysopogon fallax*) or spinifex-dominated communities (*Triodia bitextura; T. acutispicula; T. bynoei; T. Schinzii*) as well as giant spear grass (*Heteropogon triticeus*), white grass (*Sehima nervosum*), ricegrass (*Xerochloa laniflora*) and kangaroo grass (*Themeda triandra*, all which begin to seed in mid December (NRETAS Gouldian Recovery Project, 2009 and O'Malley, 2006).

Movements

Between the late wet season and the dry season (February to October), the Gouldian's move to rocky hills (O' Malley, 2006). During this period the Gouldian remain within this habitat and in close proximity (less than 2km) to waterholes and their nesting site.

Radio-tracking studies have shown that during the early wet season when A. Semialata seeds become available birds may move daily between the Hills to the Lowlands (Lewis, 2007). At this time they will spend most of the day feeding in the Lowlands and return to the Hill to roost at night. Gouldians can travel up to 17 km per day

Life Cycle

The Gouldian Finch can breed at less than one year of age (DEWHA, 2010). The Gouldian Finch has been recorded breeding in all months of the year except for October (DEWHA, 2010). The peak number of clutches is in April (DEWHA, 2010). Pairs breed together in loose colonies or clumps which may feature several pairs in neighbouring trees (DEWHA, 2010).

The female lays a clutch of three to eight white eggs which are incubated by both adults for a period of about 14 days. The nestling period is usually about 21 days in duration but can be as short as 14 days if the nest is disturbed (DEWHA, 2010). Gouldian Finch pairs can rear up to three broods in a single breeding season and the nestlings are fed and brooded by both adults (DEWHA, 2010). In terms of nest failure for Gouldian Finches, nest abandonment is more common than predation.

Breeding productivity is influenced by the amount and timing of rainfall during the wet season, which promotes the growth of *Sorghum* grasses, the seeds (DEWHA, 2010). While the mortality rate for juveniles is not known it is assumed to be high in their first year and perhaps higher for females than males (DEWHA, 2010).

All birds, adult and juvenile, unlike other finches, complete a rapid full moult at the finish of the breeding season but prior onset of the early wet season rains and fresh seeding grasses (O'Malley, 2006b). Unlike other finch species living in the same locality, Gouldian's do not increase in body condition during the wet season (NRETAS Gouldian Recovery Project, 2009). Given that the moult period finishes close to the time of year when seed resources are at their lowest, there is a potential for high levels of physiological stress in Gouldian Finches and particularly young birds (O'Malley, 2006b).

Sarga intrans germinates early in the wet season and possibly provides essential amino acids which assist the Gouldian Finch in successfully completing a full moult (Lewis, 2007).

Critical Food Species and their Patterns

Gouldian Finches rely on the seed for a select range of annual and perennial grasses which are patchily distributed through the landscape. The seed productivity of their preferred species is dependent on a combination of rainfall, fire history (frequency, periodicity and intensity) and grazing or disturbance. The essential perennial grass species in the Lowlands seed asynchronously. While the cycle of seed production is relatively predictable from year to year the abundance of seeds is not. (Lewis, 2007). The Hill grass species (the Gouldian's staple) are fire tolerant or positively respond to fire (Lewis, 2007). However, the perennials in the Lowlands vary in their response to fire. Rainfall distribution is extremely patchy which can result in highly unpredictable patterns in seed production year to year.

The staple food of the Gouldian ***S. Intrans*** is fire tolerant and responds positively to fire. It is abundant in the Hills or breeding habitat of the Gouldian but no so in the Lowlands. *How prone it is to grazing?*

In the early wet they switch from feeding on the germinating Sorghum ***Saga intrans*** to Cockatoo grass ***Alloteropsis semialata*** which is the first flush of fresh seed for the Gouldian after they have been feeding on dry *S intans* for nearly

8 months. The following details some of the key grass species and their patterns in productivity (taken from Lewis, 2007).

Cockatoo Grass *Alloteropsis semialata*
Occurance: *A. Semialata* is patchily distributed on both hills and the lowlands but it is more common in the lowlands and in creek beds.
Seed availability: *A. Semialata* seeds with the first rains
Fire response: *A. Semialata* is most productive if is not burnt or only burnt in the early wet season fires started by lightening.
Grazing response: A. semialata –could be targeted by cattle or pigs in early wet only as it cures rapidly after seeding.

Ribbon Grass *Chrrysopogon fallax*
Chrrysopogon fallax is preferred over A. Semialata
Occurance: This species occurs in the Lowlands (not the hills) adjacent to creek lines
Seed availability: there is generally a 3 week window where the bulk of seed for this species is produced which can be followed by pockets of further seeding for longer periods
Fire response: *C. fallax* can tolerate intense fires but the best productivity is achieved if stands get a break from being burnt every 3 years
Grazing response: Moderately favourable to cattle

Curly Spinifex *Triodia bitextura*
Occurance: *T. Bitextura* occurs between ridgelines in the lowlands and stony outcrops in the hills
Seed availability: *T. Bitextura* can potentially produce lots of small seeds but availability variable: *Dec and January*. Gouldians may feed on this species exclusively at times but more study is required to confirm this.
Fire response: *T. Bitextura* does not set seed for at least two years after hot fires but cooler fires may benefit seeding the following season
What happens with fire suppression??
Grazing response: This species is not favoured by cattle

Giant Spear Grass *Heteropogon triticeus*
Little is knows of this species
Occurance: *H triticeus* largely occurs along the edges of creeks in the Hill habitat along some creeks in the Lowlands
Seed availability: *Feb - March*
Fire response: *Little is know*
Grazing response: This species is not favoured by cattle

Both ***Heteropogon triticeus*** & ***Saga intrans*** *have a* positive association with fire and need to be burnt at least every 7 years otherwise it can disappear (see ref by Scott etal, 2009).*C. fallax* and *T. bitextura* are more vulnerable to being burnt too often or too hot. A. semialata –could prefer more sheltered moister patches and possibly more protected from fire but likely to be targeted by cattle or pigs in early wet only (as it cures so quickly)

Palatability for all grasses drops off significantly as the grasses cure.

Conditions which lead to increased tree cover and litter will decrease abundance of all grasses.

Key Threatening processes

Many factors are suggested in contributing to the widespread decline in range and size of Gouldian Finch populations. The three principle threats which are thought to be continuing to affect population size and range, as indicated in the 2009 Gouldian Finch Recovery Plan, include:

- vegetation change through changed fire regimes leading to reduced seed production
- grazing by stock and feral herbivores reducing the abundance and diversity of preferred seed producing grasses and degradation of water holes; and
- also to a lesser degree an air sac mite (*Sternostoma tracheacolum*) which is a disease agent.

Current knowledge of the Gouldian Finch suggest that one of the most critical threats to the persistence and recovery of this species is degradation or reduced availability of their food source. Unlike other finch species and generalist savanna granivores, Gouldian's appear to have a much more restricted diet of seed from a particular suite of grass species (O'Malley, 2006). These preferred grass species are patchily distributed in the landscape.

The wet season is a particularly hard time for the Gouldian. There can be periods of low seed availability prior to the first heavy rains of the wet season (November to January). The low water and seed availability occurs just after the Gouldian moults and develops a new complement of feathers and the same time which Gouldian's are moving to the low lands (NRETAS Gouldian Recovery Project, 2009, and O'Malley 2006).

Gouldians are most vulnerable to a decline in numbers if there is reduced availability of critical wet season grass seed resources due to changes in land use and consequent changes in grazing and fire regimes, as well as natural fluctuations in seasonal rainfall (NRETAS Gouldian Recovery Project, 2009). Climate change is likely to be potential threat to this species.

Species Status

Reason for listing – IUCN listing could be altered

Other species which can benefit from Gouldian finch management

Gouldian Finch within the Redbank Area

Population size and significance

The sightings of Gouldian Finches on the Redbank ERL in May 2009 represent the first records for an area within a 20km radius centred on ERL94. A total of 17 birds (black and red headed morphs) were sighted in five separate localities in habitat along the Wollogorang Road and Haul road which consists of: Lowlands with Low Open Woodlands featuring *Corymbia dicromophloia & Eucalyptus tretradonta* and an understorey of *Triodia.* Hilly areas with *Eucalyptus leucophloia*, typical of breeding habitat, were also situated nearby

The nearest significant Gouldian Finch population to Redbank is at Limmen Gate National Park in the Northern Territory, with a population estimated at less than 100 individuals.

Gouldian Finches were not sited during the 1990 EIA Survey of Redbank. However, the vegetation, topography and persistent water holes are typical of the habitat requirements of Gouldian Finch. It is assumed that significant population (50 individual or more) either exists on site or nearby. Monitoring of water holes in the late dry season (August) will be necessary to make better estimates of the population size.

Further monitoring (both on and off site) will be required to confirm:

- the likely size and home range of the population; and
- areas of the landscape mostly likely to be of value to a resident population.

Habitat Values for Redbank and the Surrounding Area

The Redbank ERL94 features Open Woodlands featuring *Eucalyptus leucophloia* and grass species preferred by the Gouldian on Lowlands and Hilly areas situated near permanent waters. Low Open Woodland with Snappy Gum *Eucalyptus leucophloia* sub sp *euroa* occupies 445 hectares of the Redbank ERL94. This equates to about 22% of the project area. Woodland featuring Snappy Gum is relatively common in the greater region with a more extensive area mapped 15km North East of the project area figure 3 (Wilson et al, xxxx)

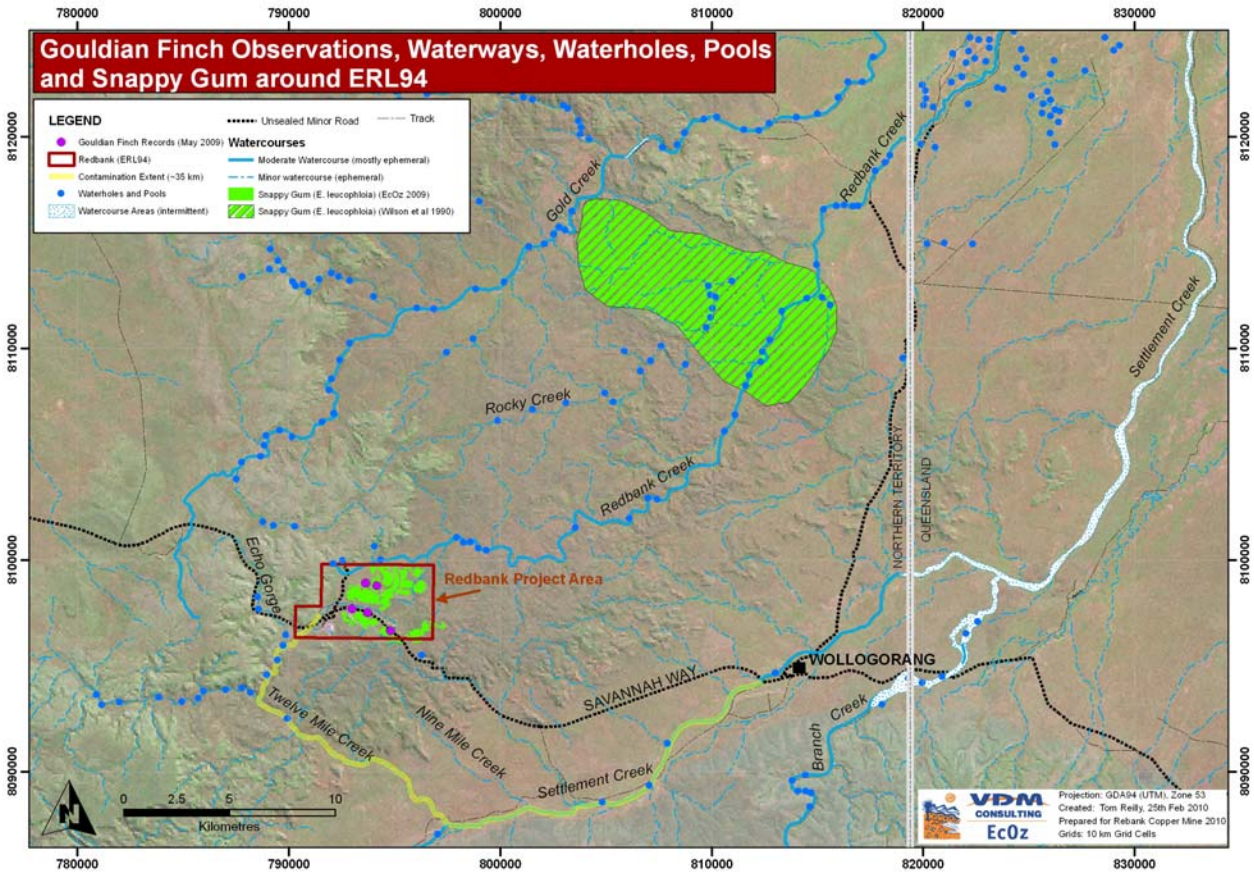


Figure 3 Known and mapped areas with Snappy Gum in proximity to permanent or near permanent waters together with Redbanks records for Gouldian Finch.

Vegetation mapping for the Redbank ERL to date is relatively course for the purpose of identifying critical feeding and breeding areas for the Gouldian. Finer scale mapping is required to identify significant patches in the landscape which are supporting the presence of the Gouldian and other granivorous species. However, the combination of Snappy Gum, Sorghum or *Sarga* species and permanent or near permanent water holes of Redbank and Hanrahan's Creek on Redbank ERL94 as well as Echo Twelve Mile and Settlement Creek to the South, suggests several potential dry season breeding and wet season feeding areas.

Threatening Processes for Redbank Gouldians and Preferred Habitat

Threats on a Regional Scale

The greatest regional threats to Gouldian finch within the region (within a 50km radius of Redbank ERL) are likely to be fire regimes (either suppression or late dry season burns) and grazing which alter the presence and productivity of the small suite of grasses which the Gouldian depends upon.

Threats on a Local Scale

The fact that Gouldians were recorded on site in May 2009 suggests the habitat requirement s are favourable for at least some years. The Redbank site is currently highly disturbed through previous mining. The quality of water in Hanrahan's Creek is very low.

While a mining development will place some pressure on the species through loss or reduced quality of some critical habitat it will also diminish some threatening processes through the opportunity to introduce targeted management for the whole site which can benefit the Gouldian and other granivorous species.

A precautionary approach has been applied and it has been assumed that identified Gouldian Finches are resident and utilising the area for both breeding and critical wet season feeding. Based on this assumption the potential impacts on key values for sustaining a local population of Gouldian Finch are identified below.

Table 1. A Summary of Key Values, Potential Threatening Processes

Values	Potential Threatening Processes
Breeding and Feeding Habitat (Wet and Dry Season	Reduction of favoured habitat through clearing of individual trees (potentially favourable as breeding sites) and potential wet and dry season feeding habitat along the haul road and for the Azurite and Bluff open pits .
	Disturbance through noise, some dust and vibration for approximately xx ha accounting for a 320m zone either side of mine roads, infrastructure and open pits.
	Wildfires may reduce the condition of Snappy Gum trees with potential nesting hollows through lightening strikes.
	Wildfire intensity, frequency or suppression may reduce the presence and productivity of preferred grass species.
	Feral animals such as pigs and horses may reduce the presence of preferred grass species.
Water Sources	The volume of some permanent waters may reduce through draw down on underground aquifers
	Water quality for permanent or semi-permanent water holes (e.g. Hanrahan's Creek) may remain the same or reduce in quality
	Provision of artificial waters which contain toxic materials (e.g. tailings storage facility and Sandy Flat Pit)
Low Predation Rate	Rubbish disposal areas may attract cats and wild dogs and hence slightly increase predation pressure.

Threats, Consequences and Mitigation Measures

Impacts on breeding and feeding habitat

Threats

The most significant impacts to breeding habitat would be some removal of trees suitable for breeding as well as; and possibly more importantly; noise and vibration which may reduce the habitat quality for the life of the mine. The impact of noise, vibration and dust specifically for the Gouldian Finch is not known.

The area of Snappy gums targeted for clearing for a haul road is minimal (a total of 2.5 hectares) but it is located at least 1km of Redbank Creek and hence permanent waters (figure 4 & 5). This means the cleared area will fall within a potential breeding area. Studies at Yinberrie suggest that suitable nesting trees tend to be clumped.

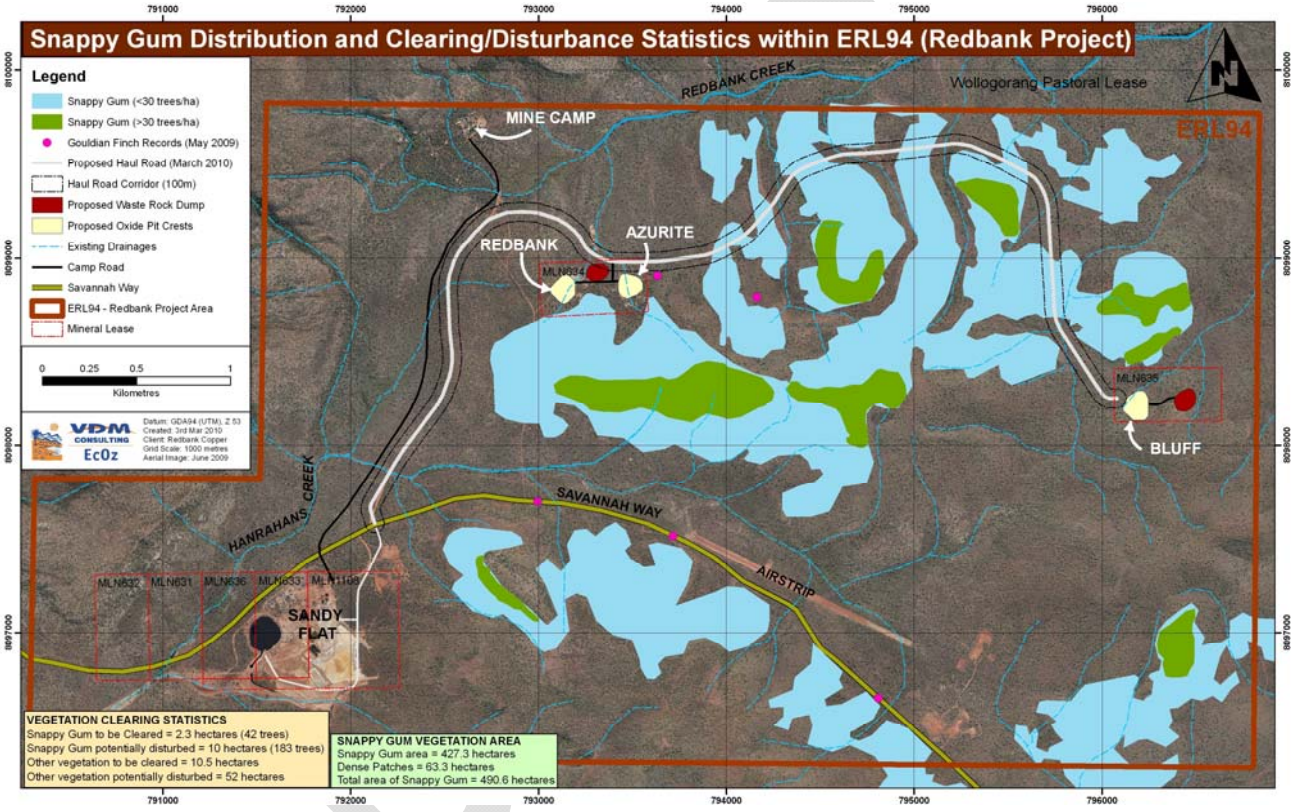


Figure 4 Distribution of Snappy Gum throughout the Redbank ERL area in relation to proposed infrastructure.

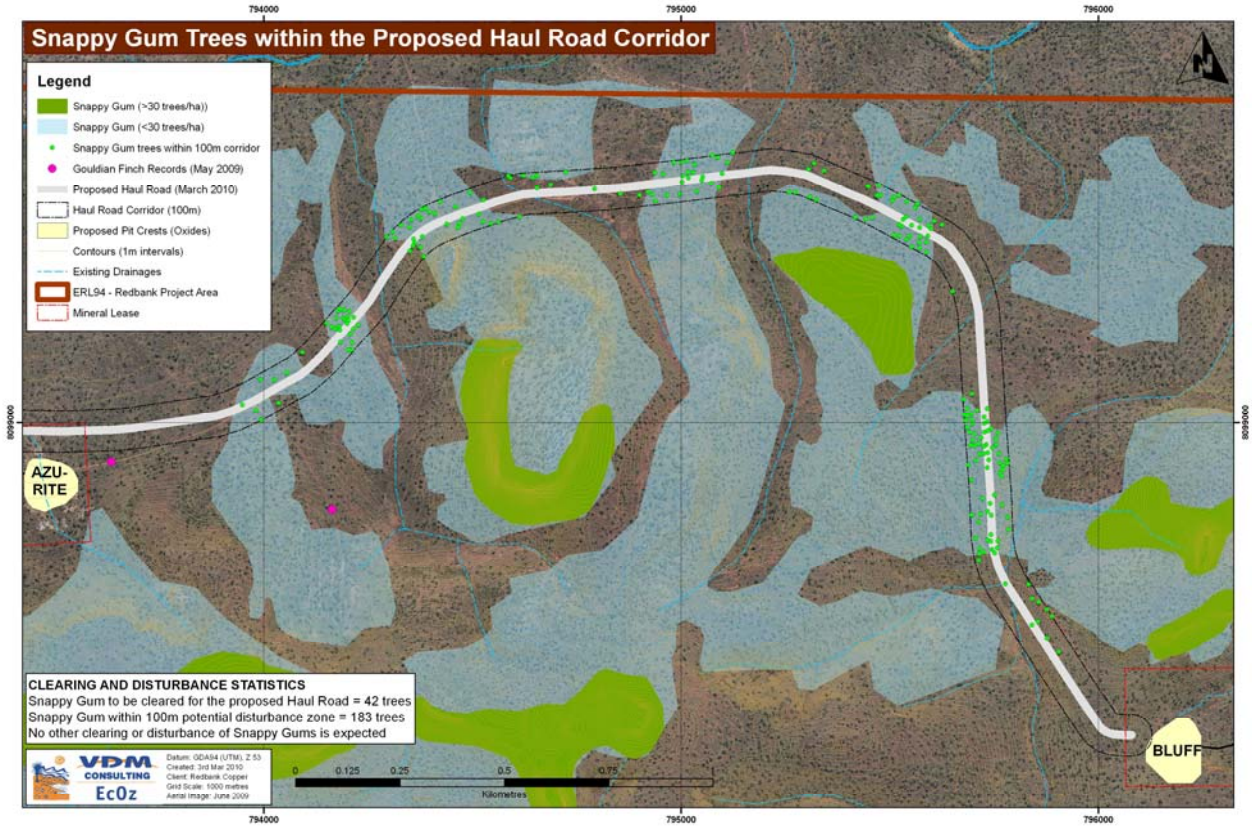


Figure 5 Individual Snappy Gums targeted for clearing or a moderate degree of impact through noise and vibration within a 100m impact zone centred on the main haul road and proposed open pits.

However, the scope to realign parts of the haul road is constrained by soil conservation requirements and the logistics for large heavy vehicles. There is little which can be done to restrict the noise and vibration disturbance.

A study by Parris *etal*, 2009 investigating the impact of traffic noise for two bird species, the Grey Shrike-Thrush and Grey Fantail, on roadside habitats; indicates that birds are adversely affected by traffic noise and particularly birds which have calls at the low frequency range. Traffic noise on Australian roads (mostly urban) generally have a frequency range of 2000Hz. Birds with a low call frequency are more likely to be masked by the traffic noise.

The two birds studied by Parris *etal* had a call frequency in low and high frequency range.

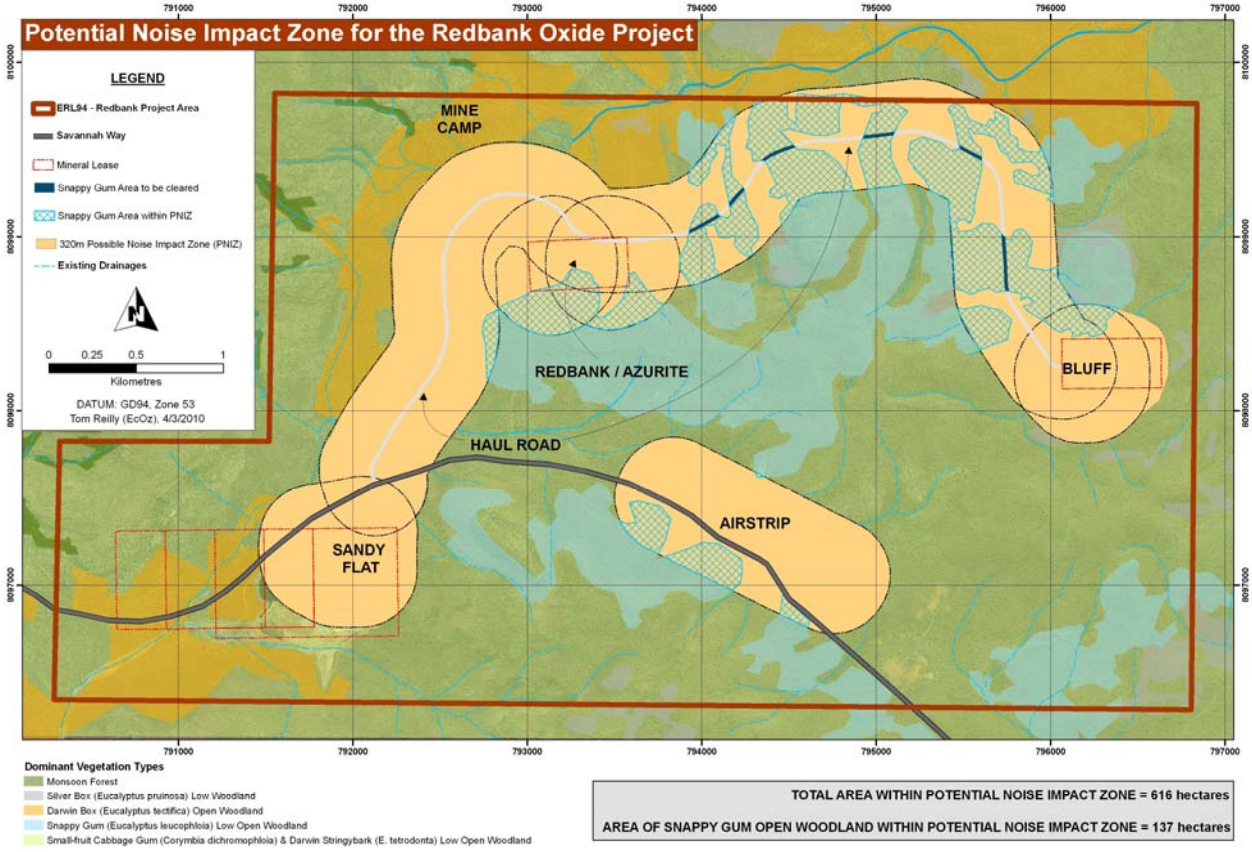
Grey Shrike-Thrush 1500 – 4000Hz

Grey Fantail 4000 – 7500Hz

Zebra finches have an average call frequency of 3000Hz and their calls have been shown to be masked by traffic noise in controlled experiments (Parris, et al, 2009).

Parris and Schneider's' study indicated that the presence (or lack of for the bird sp) is more strongly correlated with noise rather than traffic volume. They found that the chance of observing the Grey Shrike-Thrush reduced as the noise approached 60L10 18h dB(A) SPL and that they were not detected at all at 67L10 18h dB(A) SPL. The Grey Fantail, which a higher frequency of call than the Grey Shrike-Thrush, were not as affected by noise but were detected at all at 72.3L10 18h dB(A) SPL.

The average noise of traffic for roads in Aust is 63 L10 18h dB(A). The noise emission for haul trucks is understood to be 90dB(A) LEQ. To calculate the boundary of an impact zone beyond which negligible impact of noise is forecast an attenuation of 10 dBA for every 100m (assuming open conditions with no wind) suggests that a distance of 400m is necessary to achieve 50dB(A) LEQ. Based on these assumptions a total area of 616 hectares of road and airstrip areas are likely to exceed the tolerable auditory thresholds for the Gouldian finch.



What figure is this???

Mitigation Priorities

The haul road has been aligned so as to minimise the number of individual Snappy Gum trees cleared (55 in total), and particularly those with hollows

Individual trees will be targeted for conservation while not compromising the objectives for minimising soil erosion. The aim will be to conserve trees with breeding hollows so that they are maintained after the life of the mine.

Areas which appear to feature a number of trees with hollows will be avoided with a 50m buffer.

The remaining breeding habitat will be protected through appropriate fire management

Impacts on feeding habitat

Threats

The greatest concerns for impacts to a resident population of Gouldian finches are any impacts to valuable food sources as this is appears to be a critical factor influencing the range and recovery of the species.

The greatest impact of the proposed Redbank development will be clearing of Lowland with ground cover of grass species favoured by Gouldian and significant noise and vibration discouraging use of areas featuring these crucial grass species (figure 6).

Grazing and digging by feral horses and pigs can alter the presence and seed production of preferred grass species. Intensive grazing by wallabies is also known to reduce the presence of *Chrysopogon fallax* (Scott, 2006) which is one of the staple foods for Gouldian finches during the wet season.

Mitigation

Finer scale vegetation mapping and a more intensive survey prior to clearing is necessary to determine the extent of feeding habitat and minimise the loss and impact on these areas.

An appropriate fire management and feral animal control (namely pigs) will be established to improve the presence and likely productivity of grass species favoured by the Gouldian finch. Areas featuring Curly Spinifex (*Triodia* species), cockatoo grass (*Alloteropsis semialata)* and golden beard grass (*Chrysopogon fallax)* in the low lands will be targeted for particular attention.

Figure 6 The proposed zones to be either directly impacted upon through clearing or disturbed through noise, dust and vibration along the main Haul Road

Impacts on the quality of water sources

Threats

The Gouldian finch prefers small shallow but persistent water holes near their breeding site. The Redbank Camp site will source ground water from an aquifer which has a very small chance of connections to nearby spring fed water hole. Draw down on this aquifer could, although unlikely, adversely affect the volume of water and hence quality of water in the water holes utilised by significant species such as the Gouldian Finch and other species.

Any contamination of surrounding tributaries, particularly permanent waters will have a negative impact on the Gouldian finch as well as other species.

Mining at Redbank will result in artificial watering sites such as processing site and the tailing dam which will contain toxic materials that can kill Gouldian's should they drink from these waters regularly. Sandy Flat pit currently contains toxic waters and does not seem to be adversely affecting small granivorous birds, this could be that the waters are too exposed to raptors to be utilised.

Mitigation

The water quality of currently polluted waters (Hanrahan's Creek) and maintain the water quality for other tributaries will be improved through a range of pathways nominated and monitored under the water quality strategy

The potential danger of toxic artificial waters being visited by native birds will be minimised by keeping the vegetation cover surrounding these waters to a minimum and installing devises to scare birds (cannons, waving steamers etc) if necessary.

Impacts on predators such as dingos, wild dogs, cats and quolls

For any small population an increase in predators will have a significant impact. The presence of landfill and waste disposal from a mine may attract dingos, wild dogs, cats and quolls periodically if food scraps are easily accessible.

Mitigation

Management of the camps landfill management will aim to avoid exposure of food wastes for more than half a day.

A program for trapping cats in the surrounds of the main camp will be put in place. Should the key predator species be observed around the camps landfill the need for further action will be investigated (including decreasing the accessibility of food scraps and population reduction if necessary).

Summary Risk Assessment and Mitigation

The following section outlines a risk assessment for possible impacts on the Redbank Gouldian population assuming that the identified mitigations are put in place.

Table x. A Summary of Key Values, Potential Threats or impacts and Assessment of Risk

Qualities critical to Maintaining Gouldian Finch Population	Threats or Impacts	Consequence	Likelihood of occurrence	Risk to the population & details
Breeding habitat				
Unburnt Snappy Gum trees with hollows 2-4km from permanent waters and adjacent to feeding habitat with Sorghum and spear grass	*Construction of the haul road and* Azurite and Bluff deposit will *result in clearing 55 individual tress an unknown number may feature hollows suitable for nesting*	**Moderate to Major**	**Almost Certain**	**High Risk** *It is assumed the Gouldian are using the area for breeding. Trees have not yet been assessed for hollows to quantify the loss of habitat.*
	Construction of roads and infrastructure may result in noise, dust and vibration which are in excess of the tolerances of Gouldian finch to utilise breeding sites within a 50 zone either side of the roads.	**Moderate to Major** *The impact of noise dust and vibration is not known*	**Almost Certain**	**High Risk** *It is assumed the Gouldian are using the area for breeding. Roads will result in a loss in habitat quality over the life of the mine*
	Burning of trees with potential nesting hollows – e.g. lightening strikes	**Moderate to Major**	**Unlikely**	**Low Risk** *The risk of unplanned fires in the dry season will be very small. Only a few trees may be lost at a time.*
Quality Feeding Habitat				
Quality patches of preferred species for both wet season and dry season feeding	*Construction of roads and infrastructure may result in clearing some preferred wet and dry season feeding habitat*	**Moderate to Major**	**Likely**	**High Risk** *Clearing will be minimal but targeted to the Lowlands where wet season feeding habitat may exist*
	Construction of roads and infrastructure may result in noise, dust and vibration in excess of the tolerance of the Gouldian finch	**Moderate to Major** *The impact of noise dust and vibration is not known-a 320m*	**Almost Certain**	**High Risk** *Although clearing will be minimal if disturbance deters the Gouldian from utilising key feeding areas the impact will be significant*

Qualities critical to Maintaining Gouldian Finch Population	Threats or Impacts	Consequence	Likelihood of occurrence	Risk to the population & details
		impact zone surrounding infrastructure is proposed		
	Wildfires Fire or fire suppression can reduce the seed production and presence of preferred grass species	**Moderate to Major**	**Moderate to Major**	**High - Medium Risk** *Fire suppression in the hills may be the greater concern over the long term*
	Grazing or digging by feral herbivores can reduce the seed production and presence of preferred grass species	**Moderate to Major**	**Moderate to Major**	**High - Medium Risk** *Presence of the mine will reduce the presence of grazing animals* *Grazing may be the greatest concern for significant habitat off -site.*
	Grazing by native wallabies may reduce the presence and productivity of preferred grass species	**Moderate to Major**	**Likely**	**High Risk**
Water Sources				
Water holes which persist throughout the dry season.	*Draw down from the camp water table could affect the water volume and hence quality of some connected permanent water holes.*	**Moderate to Major**	**Unlikely**	**Medium Risk** Permanent volumes of water will persist
	The condition of permanent waters in Hanrahan's Creek are very poor and the natural condition of Redbank is yet to be determined. Mining could potentially degrade the condition of permanent waters through unanticipated contamination with sediments or acid sulphides	**Moderate to Major**	**Moderate**	**High Risk** *The Gouldian appears to be either tolerating existing polluted waters or not utilising them. Further decline in water condition could have a significant impact.*

Qualities critical to Maintaining Gouldian Finch Population	Threats or Impacts	Consequence	Likelihood of occurrence	Risk to the population & details
	Mining will result in the establishment of artificial waters which are acidic and precipitate toxic heavy.	**Moderate to Major**	**Likely**	**High Risk** *Tailing Storage are intended to be benign and will be managed for deterring birds.*
Minimal Pressure from Predators				
Small populations require low predator pressure	*Mining will result in a land fill which may attract predators such as dingos, wild dogs, cats and quolls into the areas and increase pressure on a very small population of Gouldian finch*	**Moderate** Predation does not rate very highly in the 2006 Gouldian finch recovery plan.	**Moderate to Major**	**High - Medium Risk** Only slight increased in predator presence is predicated.

Off Set Implications

The greatest impact on the Gouldian finch is likely to be a reduction in amount and quality of the breeding and feeding habitat. Offsets to compensate for direct and indirect impacts to potential breeding habitat and feeding sites are required under the EPBC Act.

Given that feeding areas in the early wet season are thought to be a key bottle neck to Gouldian populations any off-setting for reduced habitat quality (either direct removal or disturbance by noise, dust and vibration) will target conserving feeding habitat of equivalent or better quality as a priority. Nearby areas (preferably within 20km) on Wollogorang station with prime wet season feeding habitat and nesting sites, of an area thought to be significant to supporting a resident population will be targeted for fire and grazing management. This area will be greater than the area disturbed through mining activity and will be managed to maximise the attributes critical to supporting Gouldian finches resulting in a net gain in quantity and quality.

Metrics for Calculating Off sets

Values to be impacted upon	Offset	Details
137 Hectares will disturbed through noise within a range of approximately $90L_{10}$ 18h dB(A) to $40L_{10}$ 18h dB(A) as well as some dust and vibration. This area includes 42 Snappy Gum trees within a 2.5 Hectare road corridor which is targeted to be cleared.	274 Hectares with a minimum of 325 trees with hollows for potential breeding to be protected from disturbance.	Ratio = 1: 2
479 Hectares of potential wet season feeding habitat will be disturbed through noise ranging from approximately $90L_{10}$ 18h dB(A) - $40L_{10}$ 18h dB(A) as well as some dust and vibration. X Hectares of potential wet season feeding habitat to be cleared for roads and infrastructure	958 Hectares to be managed with small scale mosaic fires 15 years	Ratio = 1:2
Total area of Gouldian habitat to be disturbed = 616 hectares	1232 hectares	Ratio = 1:2

Securing Long Term Benefits

Securing offsets on the nearby land tenure will be dependent on successful negotiations with the Pastoral lease holders. A commitment to long term management (beyond the life of the mine) will be facilitated through engagement and building capacity with traditional owners and the pastoral lessee. The aim is to assist traditional owners establish long term management in perpetuity. Initially this can be demonstrated via capacity building of traditional owners.

The Management Framework

Environmental management is a cyclical process. Environmental strategies or plans, goals and best practice management actions are not static but are adjusted with performance reviews and new knowledge from regular monitoring, and periodic evaluations or biophysical assessments to judge whether goals are being met and also appropriate (ref to appendix 1 for a glossary of terminology). While the management plan provides guidance there is a need to accommodate flexibility in response to the natural variation in the environment as well as deliberately aiming to gain a greater understanding of how the landscape and species function.

Long Term Objectives - Outcomes

Resource Condition

OGf1. Trends in population indicated by late dry season water hole monitoring indicate that local populations of Gouldian Finches are stable or fluctuating no more than would be anticipated compared to other key populations.

OGf2. Impacts of mining on the Gouldian finch and their preferred habitat are minimized and where impacts cannot be avoided offsets will ensure the Gouldian is benefited through management off-site.

OGf3. Specific fire and grazing regimes on and off-site will maintain or preferably improve the productivity of perennial and annual grass species which are preferred by Gouldian Finch.

Management Capacity

OGf4. Implementation of the Management Plan facilitates long term management of the Gouldian and other vulnerable species in key locations through engagement and capacity building with the indigenous rangers associated with Redbank.

OGf5. The knowledge base for the Local Redbank Gouldian Finch population will improve to enable targeted management and mechanisms for tracking response.

Key Management Strategies

- Where direct impact is unavoidable, minimise impact to the Gouldian Finch and its habitat on Redbank ERL during construction and operation.
- Manage the ERL site through fire and feral grazers to maintain existing trees with hollows and enhance the productivity of preferred grass species
- Invest in further assessment or knowledge gathering to fill key information gaps for future management.
- Offset impact of the development through establishing an appropriate management regime for Gouldians off-site.

Management Priorities

Linkage with high level objectives	**Strategy:** Where direct impact is unavoidable, minimise impact to the Gouldian Finch and its habitat on Redbank ERL during construction and operation.		
	Management Actions	**Time Frames**	**Responsibility**
OGf1 &OGf2.	***Minimise impact to potential breeding habitat*** • The road corridors will be aligned to minimise removal of individual Snappy Gum. • All trees will be checked for hollows prior to clearing and identified with flagging tap. • For clusters of trees with potential breeding hollows a buffer will be checked for hollows prior to clearing and identified with flagging tap. A 50m buffer demarking "no go zone" will be established for these sites where possible (*in some instances this may not be possible and offsetting will be required*).	Prior to construction	Environmental Consultants in collaboration with road engineers
	Minimise impact to Feeding habitat • Road corridors and infrastructure will be aligned to minimise removal of significant patches of preferred grass species. • Significant patches of grasses preferred in the wet season will be flagged and designated a no go zone with a 100m buffer if possible.	Prior to construction	Environmental Consultants in collaboration with infrastructure engineers
	Minimise impact to water sources • Water will not be drawn from any water holes • Water drawn from ground water near the camp site will be monitored for any impacts on the spring fed permanent water hole. • Water quality of water holes will be monitored regularly for the purpose of improving water quality for the site overall.	Prior to construction & during operation	Environmental Consultants in collaboration with infrastructure engineers
Means of Tracking Performance	Impacts on: • critical breeding ; • feeding habitat and • water sources do not exceed the level predicted		

Linkage with high level objectives	**Strategy:** Manage the ERL site through fire and feral grazers to maintain existing trees with hollows and enhance the productivity of preferred grass species		
	Management Actions	**Time Frames**	**Responsibility**
OGf3	***Maintain potential breeding habitat*** • Fire management will ensure individual and clusters of trees with hollows are protected from hot dry season fires. • Clusters of trees with potential breeding hollows a buffer will be checked for evidence of breeding on an annual basis	During operation	Environmental Consultants in collaboration mine managers
OGf3	***Maintain Feeding habitat*** • Fire management will ensure areas of *Sarga* and *Triodia* are burnt at least every 4-5 years to maintain their presence. • Fire management in the lowlands will instate a fine scale mosaic pattern of burning to favour the productivity of the preferred perennials. • Significant areas of preferred grasses will be monitored for condition annually.	During operation	Environmental Consultants in collaboration with indigenous rangers
OGf3	**Reduce grazing and disturbance by introduced species** • Removed feral pigs within at least a 26km^2 area to 0 density within 2 years of commencing development	During operation	Environmental Consultants in collaboration with indigenous rangers
OGf3	**Improve water quality for water holes** • Improve the water quality in Redbank and Hanrahan's Creek in particular through remedial works proposed under the water quality management framework	During operation	Environmental Consultants
Means of Tracking Performance	• Remaining trees with hollows are protected from fire. • Clusters of Snappy Gum with hollows with a buffer of 50m will be maintained as a no go zone. • Condition of remaining feeding habitat is maintained or improved. • Feral pigs are reduced to zero density within the ERL • Water quantity is maintained improved from 2009 baseline levels		

Linkage with high level objectives	**Strategy:** Invest in further assessment or knowledge gathering to fill key information gaps for future management		
	Management Actions	**Time Frames**	**Responsibility**
OGf5	***Finer scale vegetation mapping*** • Produce a finer scale vegetation map Identifying significant areas (these can be small clumps near water) of preferred grass species map and their condition. • Extend mapping of potential breeding habitat and dry season preferred grasses both on and off-site	Within 1 year of commencing construction	Environmental Consultants in collaboration with indigenous rangers
OGf5 & OGf4	***Assessment of populations*** • Scope the status of Gouldian populations on and off-site through early wet season survey and late dry season observations at a selection of water holes.	Within 1 year of construction	Environmental Consultants in collaboration with indigenous rangers
OGf5	***Monitor response of grasses to fire and grazing*** • Improve understanding of responses of key grass species to different fire and grazing regimes Link with existing research: The effect of fire regime on grass species: recruitment and community composition. Setterfield, Douglas, Scott (CDU), in collaboration with CSIRO and Bushfires CRC.	Within 2 years Post construction	Consultants to Liaise with research agencies (e.g CDU)
Means of Tracking Performance	• Finer scale vegetation map is informing management priorities • Annual status reports for Gouldian finch based on dry season water hole counts • Incorporation of an improved understanding of preferred grasses in the management framework		Environmental Consultants

Assessment to fill Key information Gaps

Priorities for future assessments include more targeted vegetation survey and mapping to effectively define the actual habitat requirements of the Gouldian finch on Redbank and in the near vicinity particularly with regard to breeding and wet season feeding habitat.

This management plan will refer to seek information from other key research and management projects.

Linkage with high level objectives	**Strategy:** Offset impact of the development through establishing an appropriate long term management regime for Gouldians off-site.		
	Management Actions	**Time Frames**	**Responsibility**

OGf1 OGf4.	***Assess the value and condition of nearby areas as a potential offset*** • Survey off –site on the Wollogorang Station to identify the best locations for offsetting against the identified impacts.	Within 1 year of construction	Environmental Consultants in collaboration with indigenous rangers
OGf1 OGf3 & OGf4	***Offset loss of breeding and feeding habitat*** • An area of twice as large as the area of potential breeding and feeding habitat (Snappy Gums with hollows) which is to be removed or disturbed through noise, dust and vibration will be identified; preferably nearby to accommodate local movements of the Gouldian finch; and managed through fire and feral animal control to maintain or improve habitat values (e.g trees with hollows and preferred grass species).	Within 1 year of construction	Environmental Consultants in collaboration with indigenous rangers and pastoral leasee
OGf4 OGf5	***Monitoring habitat values*** • Habitat values will be monitored to gauge response to management actions and improve the knowledge of critical attributes necessary for sustaining a Gouldian finch population and other granivorous species.	Within 1.5 years of construction	Environmental Consultants in collaboration with indigenous rangers and pastoral leasee
OGf4.	***Facilitate management discussions between key stakeholders and expertise*** • Facilitate communications and agreements between key stakeholders in identifying and securing the long term management of a nearby area	Within 1 years of construction	Environmental Consultants in collaboration with indigenous rangers and pastoral leasee
OGf4.	***Contribute to Building the Expertise of Indigenous rangers to take over the management of Gouldian habitat*** • Facilitate two way learning and skills transfer through addressing priority management measures.	Within 2 years of construction	Environmental Consultants in collaboration with indigenous rangers
Means of Tracking Performance	• An area at least twice the size of that proposed to be disturbed which is inclusive of breeding and wet season feeding habitat will be identified for long term management. • An agreement between the key stakeholders (indigenous custodians and the pastoral leasee) is established to manage a key area for predominantly conservation outcomes. • Regular on-ground management and monitoring involving indigenous custodians. • Condition of significant patches of preferred grasses feeding is maintained or improved. • Condition of key potential breeding areas is maintained or improved.		

Ongoing Monitoring

Ongoing monitoring will aim to assess the adequacy of management actions and contribute to building the local knowledge or this population.

Note the monitoring program will be refined when the population status and habits are better understood.

What is to be Monitored & Why	Monitoring Method, Frequency & Analysis
Climate patterns in key drivers such as rainfall (*To assist with assessing changes in populations or habitat associated with climate patterns*)	**Method:** Daily mm of rainfall recorded according to xxxx standards **Frequency:** Rainfall data will be collected on a daily basis on the ERL site. **Analysis:** Annually presented as xxxxxx
Indicator of Population size (*To determine if population fluctuates in size and range and whether these changes may be significant to warrant changes in management*)	**Method:** At this stage, the only method of monitoring population trend at the local scale that produces statistically analysable results involves annual dry season counts at 12 waterholes. (The Standard Operating Procedure for monitoring Gouldian finch in the Northern Territory by Carol Palmer NRETAS will be adhered to.....) **Frequency:** Annual (August to September) for one week **Analysis:** Annually in the species status report, indicating fluctuation in juveniles and adults.
Estimated area of occupancy and extent of occurrence (*To determine if population fluctuates in range and use of an area over time*)	**Method:** Opportunistic sightings during management of identified preferred habitat together with periodic extended surveys covering a greater region radiating out form a central core. **Frequency:** Predominantly during dry season breeding and the early wet season. **Analysis:** Annually in a species status report
Condition and use of **wet season feeding areas** (*To determine if these areas are changing in condition due to season or management*)	**Method:** A selection of areas which represent a range of the preferred species providing seed through the wet season will be assessed for species composition, sp abundance and seed production. These sites will be monitored for at least 3 years. Methods will follow..... **Frequency:** Annual for one week in the early wet season when the grasses are seeding (November) **Analysis:** Annually in a species status report
Status of potential **breeding areas** (to determine if these areas are changing in condition or use due to impacts such as noise or management)	**Method:** Clusters of Snappy Gums with hollows will be flagged and monitored for condition and use by Gouldians. **Frequency:** Annual (for one week) early to mid dry season (April-May). **Analysis:** Annually in a species status report
Condition and use of potential **dry season feeding areas** (to determine if these areas are changing in condition due to season or management)	**Method:** Areas which met the parameters for prime dry season feeding within 2-4km of breeding sites will be mapped and assessed for species composition, sp abundance and seed production and monitored for at least 2 years to determine whether these areas are being used. **Frequency:** Annual for one week in the early dry season (April- May)

What is to be Monitored & Why	Monitoring Method, Frequency & Analysis
	Analysis: Annually in a species status report
Monitoring for a range of purposes but will compliment management for Gouldian Finch	
Water Sources - quantity	**Method:** potential watering point for Gouldian through the dry season will mapped and a selection of prime sites will be inspected mid and end of the dry season for sustainability. **Frequency:** twice annually mid and end of the dry season **Analysis:** include in the annual species status report estimated volume for prime water bodies.
Water Sources - quality	**Method:** the quality of significant water holes will be monitored as a component of the Water quality management plan. **Frequency:** Pre wet season, first flush and mid dry season as a minimum **Analysis:** Quarterly
Predators	**Method:** number of feral cats removed through trapping will be recorded in relation to trapping effort **Frequency:** Dry season **Analysis:** Annually in management progress report
Wildfire	**Method:** The efficacy of fire management and incidence of wildfire will be monitored and responded to through the fire management plan **Frequency:** **Analysis:** Annually in management progress report
Feral Herbivores	**Method:** Density of feral pigs and horses will be estimated annually during November when planted mango trees shed their fruit **Frequency:** annually in November **Analysis:** Annually in management progress report

Triggers for Corrective Actions

The following presents some key thresholds which will provide as a guide to reviewing management actions.

Due to the lack of local knowledge of the Gouldian in the area of Redbank in some situations these thresholds and triggers are estimated and will be need to be improved with further monitoring and information.

Vital Attribute	Thresholds of concern	Triggers for corrective action	Alternative Actions	Responsibility & Time Frames for response
Population size and range	Total number of adults and juveniles observed for 12 select water holes varies within a range anticipated by other studies at other locations.	Sightings at the 12 select water holes on Redbank ERL and Wollogorang Station demonstrate a significant drop overall all sites (e.g. more than a 1/3) compared to the first years baseline figures	Utilise a search and monitoring of water holes further afield to determine if the population has moved or a greater area needs to be managed.	Environmental consultants and indigenous rangers–to implement additional searches either in the early wet season or late dry season

Vital Attribute	Thresholds of concern	Triggers for corrective action	Alternative Actions	Responsibility & Time Frames for response
Breeding habitat	Number and condition of Snappy Gums with hollows remains stable year to year.	A 20% reduction in number of trees with potential hollows	Increase protection measures to protect Snappy Gums from wildfire in a larger area. Utilise a search further afield to determine if the population has opportunity to move to alternative locations	Environmental consultants and indigenous rangers–to implement additional fire protection in the early wet season and Undertake further searches for breeding habitat either in the early wet season or late dry season
Dry Season Feeding habitat	Presence and productivity of preferred species on the hills (*Sarga* sp) for typical wet season rainfall events remains stable throughout the dry season.	A 20% reduction in the presence or productivity of preferred species for the established dry season feeding monitoring sites	Increase protection measures to protect patches of preferred grasses from wildfire or grazing in a larger area. Consider seeding areas with preferred species.	Environmental consultants and indigenous rangers–to implement additional measures to protect preferred grass species prior to or during the following wet season (Dec – April).
Wet season feeding habitat	Presence and productivity of preferred species on the low lands (particularly *A. Semialata & Chrrysopogon fallax)* for typical wet season rainfall events remains stable throughout the wet season.	A 20% reduction in the presence or productivity of preferred species for the established wet season monitoring sites	Seek to rehabilitate the area with favoured grasses through seeding and or protect a larger area within the offset area	Environmental consultants and Redbank –to implement prior to during the following wet season (Dec – April)
Water sources - quantity	Water sources persist throughout the dry season	A 20% reduction in the presence water points suitable for the Gouldian finch	Consider temporary artificial water points. Investigate the likely reason for a reduction	Environmental consultants and Redbank – to implement actions prior to the end of the dry season.
Water sources - quality	Water quality as indicated by pH	Water quality as indicated by pH and	Consider temporary artificial water	Environmental consultants and Redbank

Vital Attribute	Thresholds of concern	Triggers for corrective action	Alternative Actions	Responsibility & Time Frames for response
	and Cu concentration exceed ANZECC recommended thresholds. The aim is to demonstrate an annual decrease in these values.	Cu concentration, particularly in the mid dry season, increases beyond the pattern recorded for 2009 baseline.	points. Review the hydrogeological assumptions and water management plan.	– to undertake a full review of the water management plan within one month of detecting aberrant changes in water quality.

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Appendix 1. Glossary of Terminology

Abundance
Accuracy
Baseline
Biophysical assessment
Best Practice
Density
Extent
Goal
Inventory
Key Stone Process
Monitoring
Performance Report
Precision
Outcome
Objective
Range
Repeatability
Research
Rigor
Statically Significant
Target
Threshold
Trigger

Appendix 2

Principles on Biodiversity Offsets
Supported by the BBOP Advisory Committee

1. **No net loss**: A biodiversity offset should be designed and implemented to achieve in situ, measurable conservation outcomes that can reasonably be expected to result in no net loss and preferably a net gain of biodiversity.
2. **Additional conservation outcomes**: A biodiversity offset should achieve conservation outcomes above and beyond results that would have occurred if the offset had not taken place. Offset design and implementation should avoid displacing activities harmful to biodiversity to other locations.
3. **Adherence to the mitigation hierarchy**: A biodiversity offset is a commitment to compensate for significant residual adverse impacts on biodiversity identified after appropriate avoidance, minimization and on-site rehabilitation measures have been taken according to the mitigation hierarchy.
4. **Limits to what can be offset**: There are situations where residual impacts cannot be fully compensated for by a biodiversity offset because of the irreplaceability or vulnerability of the biodiversity affected.
5. **Landscape Context**: A biodiversity offset should be designed and implemented in a landscape context to achieve the expected measurable conservation outcomes taking into account available information on the full range of biological, social and cultural values of biodiversity and supporting an ecosystem approach.
6. **Stakeholder participation**: In areas affected by the project and by the biodiversity offset, the effective participation of stakeholders should be ensured in decision-making about biodiversity offsets, including their evaluation, selection, design, implementation and monitoring.
7. **Equity**: A biodiversity offset should be designed and implemented in an equitable manner, which means the sharing among stakeholders of the rights and responsibilities, risks and rewards associated with a project and offset in a fair and balanced way, respecting legal and customary arrangements. Special consideration should be given to respecting both internationally and nationally recognized rights of indigenous peoples and local communities.
8. **Long-term outcomes**: The design and implementation of a biodiversity offset should be based on an adaptive management approach, incorporating monitoring and evaluation, with the objective of securing outcomes that last at least as long as the project's impacts and preferably in perpetuity.
9. **Transparency**: The design and implementation of a biodiversity offset, and communication of its results to the public, should be undertaken in a transparent and timely manner.
10. **Science and traditional knowledge**: The design and implementation of a biodiversity offset should be a documented process informed by sound science, including an appropriate consideration of traditional knowledge.