TWIN BONANZA GOLD PROJECT

Biodiversity Management Plan

Prepared by: EcOz Environmental Services

Prepared for: ABM Resources NL.




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Project Manager:	Tom Reilly
Author(s):	Tom Reilly, Dane Trembath, Will Riddell
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EcOz Pty Ltd.
EcOz Environmental Services
ABN: 81 143 989 039
Winlow House, 3rd Floor
75 Woods Street
DARWIN NT 0800
PO Box 381, Darwin NT 0800

Telephone: +61 8 8981 1100
Facsimile: +61 8 8981 1102
Email: ecoz@ecoz.com.au
Internet: www.ecoz.com.au

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1 Introduction

This Biodiversity Management Plan (BMP) has been developed by EcOz Environmental Services (EcOz) for the Twin Bonanza project (project area) on behalf of ABM Resources NL (ABM).

This BMP describes the framework employed by ABM for management of biodiversity values including safeguards and controls developed to ensure environmental impacts are minimised and outlines effective monitoring and environmental management throughout the project.

Preparation of this BMP has been undertaken with reference to best practice environmental management standards in accordance with the draft EIS, and other statutory requirements. This BMP will be updated when the government (Commonwealth and N.T.) provides approval conditions within their formal EIS assessment report after their review of the draft EIS and EIS supplement.

This BMP is a working document subject to regular reviews made in consultation with key environmental stakeholders including the Department of Environment (DOE), Department of Mines and Energy (DME), Northern Territory Environment Protection Authority (N.T. EPA), and Department of Land Resource Management (DLRM). Compliance with this BMP is the responsibility of all project personnel (including ABM staff and their contractors).

The BMP will be reviewed and amended to incorporate any recommendations resulting from the EIS. The BMP will be reviewed annually to maintain relevance to all aspects of the project. Any updates to the BMP will also be included in the Mining Management Plan annual review.

In addition to the BMP, ABM also has an Environmental Management Plan (EMP – chapter 14 of the EIS) that describes fire and noise management for the site.

1.1 Objectives

This BMP has been prepared to cover all activities associated with the Twin Bonanza gold project that may impact biodiversity values of the local area and region. Methods developed within this BMP can be modified where necessary to assist with continuous improvement of management at the mine site through the MMP process. This BMP provides practical instruction for managing and controlling risks to biodiversity associated with the project and directs implementation of the Biodiversity Offsets Program described in the draft EIS. The objectives of this BMP are to:

- define the statutory obligations that must be fulfilled
- present a range of specific environmental management actions necessary to meet the requirements of the environmental assessment process
- provide a clear framework for effective environmental management during all phases of the project
- assign clear and appropriate responsibilities for the implementation of specific environmental undertakings
- specify monitoring regimes to enable assessment of environmental performance
- facilitate self-assessment to ensure that mitigation measures are implemented.

1.2 Project background

ABM is proposing to develop a gold mine in the northern Tanami Desert (Figure 1-1). The project is titled the Twin Bonanza Project (the project). The proposal includes establishment of open cut pits, waste rock dumps, tailings dam, sewerage ponds, and associated ancillary infrastructure (Figure 1-2).

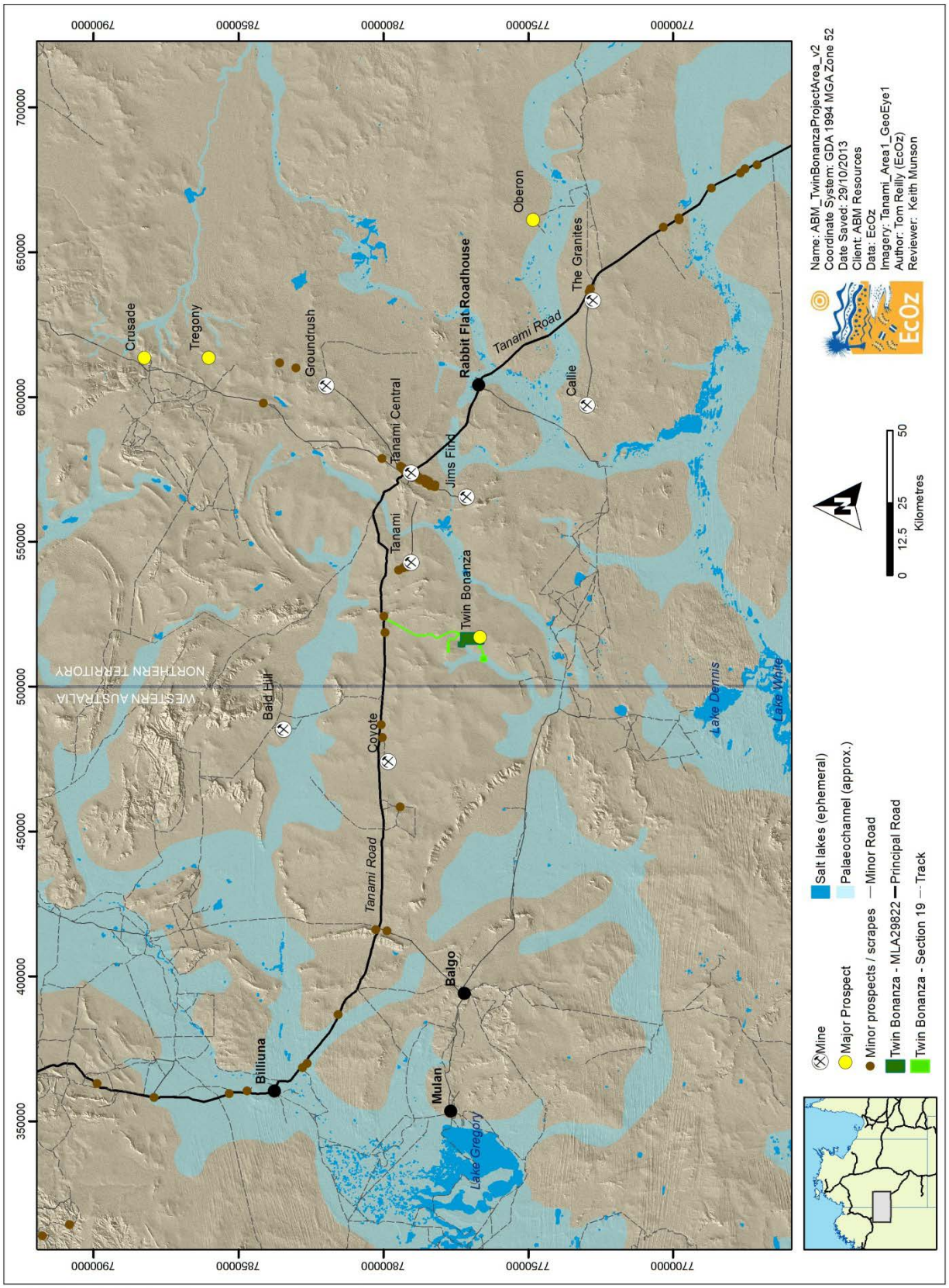


Figure 1-1. Twin Bonanza location map

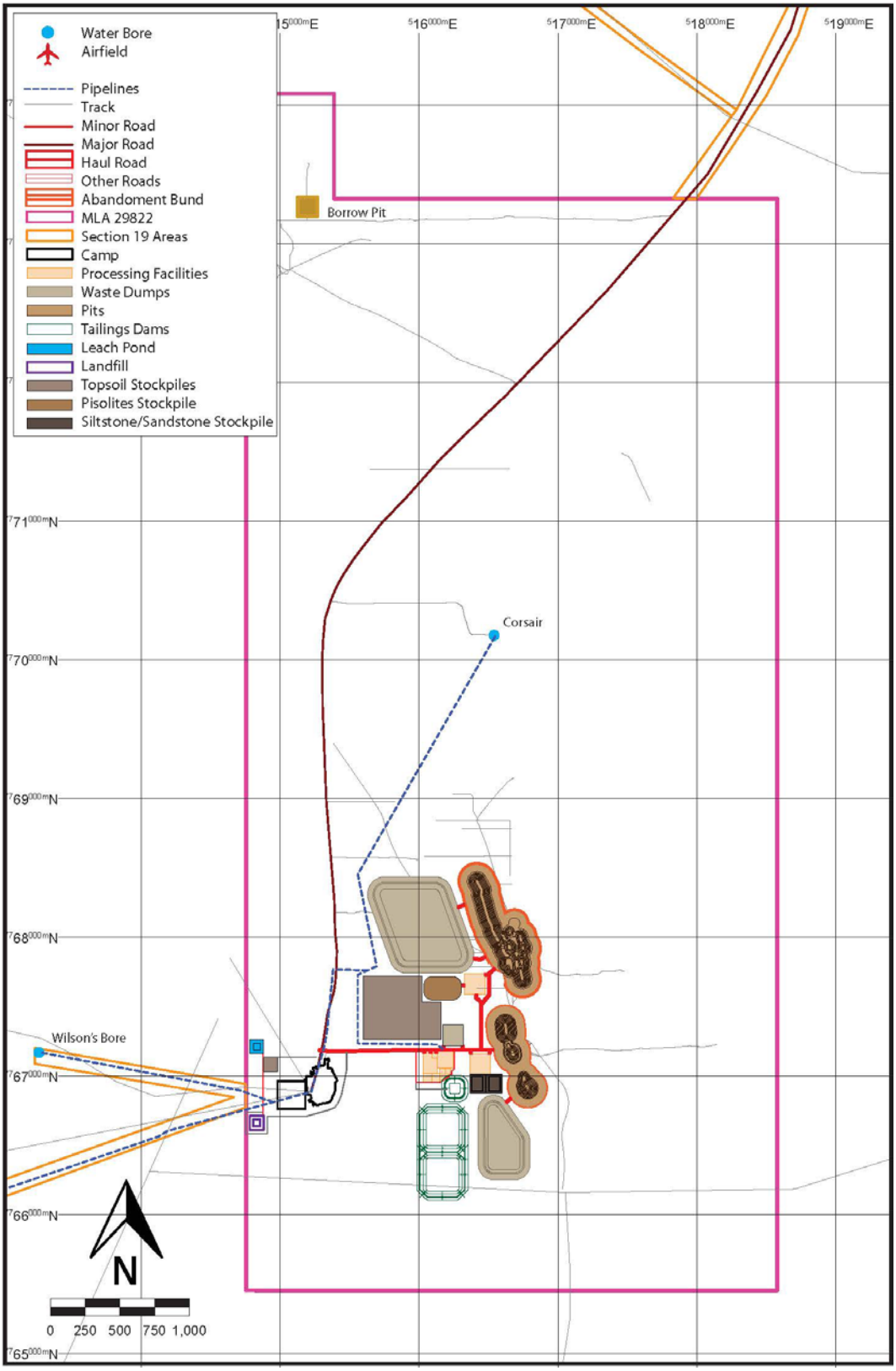


Figure 1-2. Proposed mine layout – Twin Bonanza gold project

2 Implementation plan

It is important to align organisational structure, including tasks, workflow, responsibility and authority, with the overall business and environmental objectives. The following section details the responsibilities of different levels of personnel and the tools that are used to support the management structure. This process is essential to ensure that management plans are in compliance.

2.1 Responsibilities

ABM and their contractors are responsible for implementation of, and compliance with, this BMP. Key personnel (i.e. site general manager or delegate, environmental manager and operations manager) are responsible for communicating environmental matters and ensuring management practices and procedures are being implemented.

ABMs management structure is illustrated in Figure 2-1.

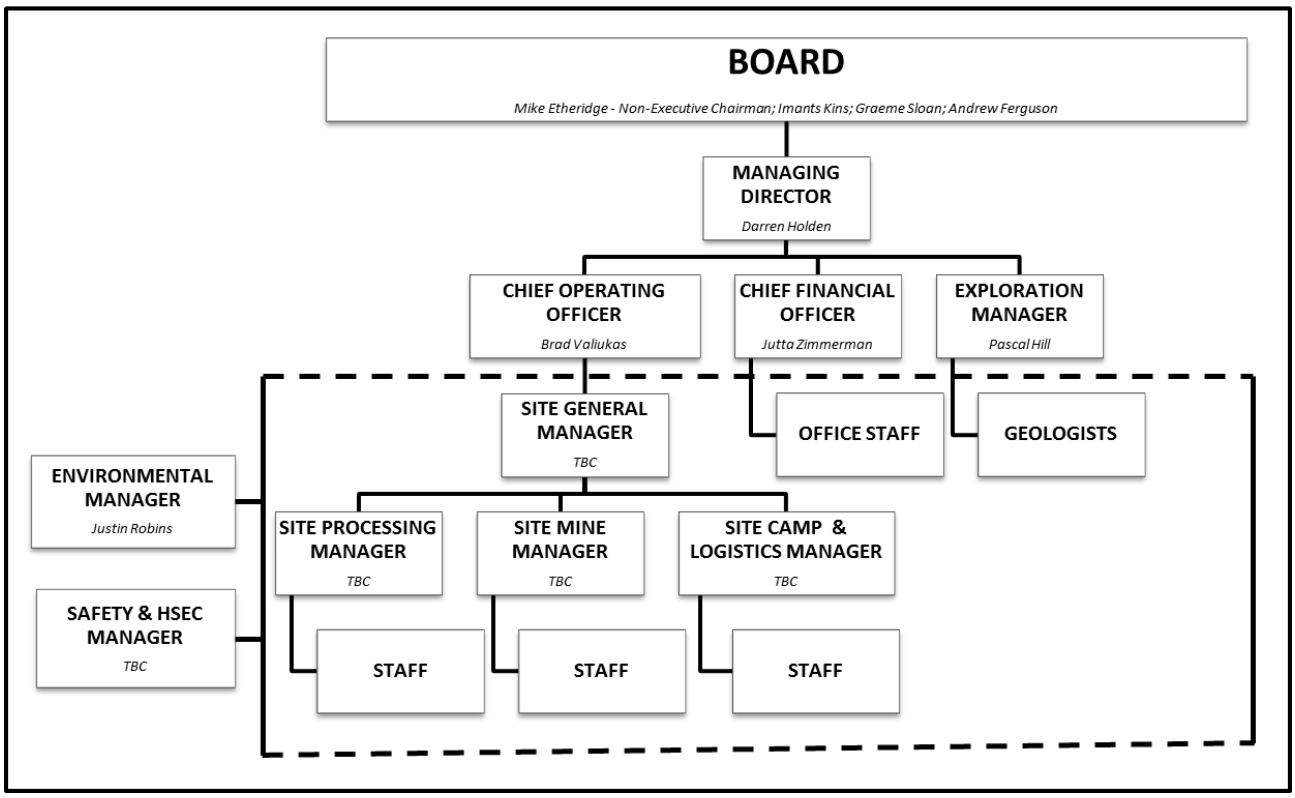


Figure 2-1. ABM's management structure

2.2 Environmental induction, training and awareness

All managers are responsible for identifying training and competency requirements for personnel under their control, and for ensuring that personnel have the requisite competencies, skills and training to carry out their assigned tasks. Managers are also responsible for ensuring training records are maintained.

2.2.1 Induction

All staff, contractors, and consultants will complete a comprehensive site induction. The induction will include safety requirements, site behaviour rules, access protocols and restrictions, cultural requirements and commitments, and a comprehensive review of environmental risks, responsibilities and standards.

All project managers will have an additional training session on the use and implementation of the BMP.

It is the responsibility of the managers to ensure records of the training of relevant personnel are maintained.

2.2.2 Toolbox meetings

The field supervisor will hold regular toolbox talks with staff and crews to discuss issues associated with the scheduled work. The toolbox meetings will involve highlighting and discussing relevant environmental and safety issues and monitoring results. Toolbox meeting agendas, attendance and outcomes will be recorded and maintained, as they will form the main stream of communication between the upper management and on-site staff.

2.2.3 In-house training

Regular training will be offered for personnel; this will include, but not be limited to, training in pollution/spill management and response, incident reporting, fire-fighting and weed identification.

2.3 Reporting requirements

It is important that records and reports are maintained to ensure that the objectives of the BMP are being achieved. The environmental and site general manager or delegate will be required, during audits and inspections, to record current performance against relevant BMP requirements.

All reports, reviews, and audits will be maintained by the site general manager or delegate and environmental manager, copied to the managing director, and made available to appropriate staff (environmental staff, geologists and area managers) and, when relevant, the regulatory authorities. Audit results will be used to review management practices.

2.3.1 Mining Management Plan

ABM will submit an updated MMP as required under section 41 (1) of the *Mining Management Act 2011* (NT). The MMP will include a revised version of the BMP.

The BMP is a working document and as such will be updated annually to ensure commitments remain effective and applicable. The Northern Territory Department of Mines and Energy (DME) will be notified of any significant changes to approved mining activities by amending the MMP, this may occur at any time, outside of the above commitment.

2.3.2 Audits

Annual audits of BMP compliance will be conducted and reported as part of the annual MMP review and renewal process. ABM operations will be annually audited against this BMP and the results provided to regulatory authorities, such as the DME, as requested.

Any reasonable environmental practices, procedures or standards recommended after an environmental audit or assessment will be implemented at the first available opportunity. ABM understands the importance of high environmental standards and is committed to achieving these.

2.3.3 Incident reporting and non-conformance

Incident reporting will be implemented to record any safety or environmental non-conformances or incidents. These shall be recorded on an incident report form and forwarded to the environmental manager and site general manager. Reporting of incidents externally will be undertaken in accordance with relevant legislation (e.g. Section 29 of the *Mining Management Act 2011*). Incidents will be investigated and followed up and,

where relevant, corrective actions nominated and implemented. The site general manager and environmental manager are responsible for ensuring all incidents are thoroughly investigated, managed accordingly and that these incidents are made available to auditors.

2.3.4 Complaints register

The appropriate area manager or delegate (area managers include the site processing manager, site mine manager, site camp and logistics manager) will be required to report and record any complaints from the public or specific project stakeholders to the environmental manager and site general manager. The environmental manager and site general manager will record any complaints received from the area manager and enter these on the ABM complaints register and will raise the complaints at daily toolbox meetings. The environmental manager and site general manager shall review each complaint upon receipt and with the appropriate area manager determine how the complaint will be addressed.

Corrective actions and other recommendations including, where applicable, modifications to practices and procedures shall be made and closed out under the direction of the environmental manager and site general manager. A summary of complaints and subsequent investigations, including monitoring results and corrective actions, will be prepared and reported within the MMP.

2.4 Monitoring

Monitoring will be undertaken to verify compliance with environmental conditions and commitments, satisfy regulatory and reporting requirements, track environmental performance and measure the effectiveness of environmental management measures. Results from any monitoring undertaken will be presented within the MMP, with an assessment of compliance against commitments made in the BMP.

Provision will be made for changes in monitoring requirements throughout the proposal, including those following the implementation of the Mine Closure Plan. Changes will be captured within the MMP.

2.5 Document management

The draft BMP shall be updated following comments received through the EIS process. Any further improvements identified during implementation of the plan will be incorporated into the BMP. The BMP will be reviewed annually and updated as required, and these changes summarised within the MMP. Both the MMP and BMP will be submitted as required for appropriate regulatory approval that may include DME, DOE and DLRM (Department of Land Resources Management).

3 Biodiversity values at risk

The EIS guidelines identified biodiversity values at risk from the Twin Bonanza mining development. These biodiversity values are listed below along with relevant management plans that ABM will implement to minimise risk.

Greater bilby (Macrotis lagotis)

Threatened species known to occur within project area

- Greater Bilby Management Plan (Section 4.1)
- Pest Management Plan (Section 4.5)
- Land Clearing Procedure (BMP Appendix A)
- Fire Management Plan (EIS Appendix Z)
- Noise Management Plan (EIS Appendix Y)

Brush-tailed mulgara (Dasycercus blythi)

Threatened species known to occur within project area

- Brush-tailed Mulgara Management Plan (Section 4.2)
- Pest Management Plan (Section 4.5)
- Land Clearing Procedure (BMP Appendix A)
- Fire Management Plan (EIS Appendix Z)

Water bird and migratory species

No water bird habitat occurs within the project area but the tailings facility and sewerage ponds may attract water bird and migratory species, and therefore potentially impact birds that visit man-made water bodies.

- Water birds / migratory birds management plan (Section 4.3)

Palaeochannel habitat

Sensitive habitat that may be impacted by water supply operations

- Palaeochannel Management Plan (Section 4.4)
- Pest Management Plan (Section 4.5)
- Weed Management Plan (Section 4.6)
- Land Clearing Procedure (BMP Appendix A)
- Fire Management Plan (EIS Appendix Z)

If additional biodiversity values are identified (such as additional threatened species) ABM will develop management plans for those values to mitigate potential impacts.

4 Biodiversity management plans

4.1 Greater bilby management plan

It has been identified that the Twin Bonanza project may impact on the greater bilby, which is a species listed as vulnerable under *Environment Protection and Biodiversity Conservation Act 1999* (Cth) and the *Territory Parks and Wildlife Conservation Act 2000* (NT). Therefore, ABM has committed to managing their operations in a way that either avoids or minimises impact to the species.

This Greater Bilby Management Plan (GBMP) will address the conditions of approval that will be available following the formal assessment of the draft EIS and EIS supplement by Northern Territory and federal authorities.

4.1.1 Scope

This GBMP guides and informs the management of mining operations within MLA29822 so as to minimise the impacts on the greater bilby, which will contribute to the conservation of local populations in the vicinity of Twin Bonanza.

This GBMP aims to establish the management framework specifically for the conservation of the greater bilby which is known to occur within the Twin Bonanza project area (MLA29822) and the immediate surrounds. Specifically, this plan:

- provides background information on the Greater Bilby, its status, significant populations, life strategies and habitat requirements, key threats and management priorities.
- provides context for the local population and potential habitat within Twin Bonanza.
- provides an overview of potential impacts associated with the project.
- details management measures that will be implemented to mitigate impacts during the life of the project and beyond.
- provides a rigorous monitoring program, including performance objectives and criteria that will be implemented prior to mine development.

This GBMP aligns with the National Recovery Plan for greater bilby (Pavey 2006a), as well as a Northern Territory specific recovery plan that covered the period 1995-1999 (Parks & Wildlife Commission of the Northern Territory 1998).

4.1.2 Background Information

Description of species

The greater bilby is a medium sized charismatic omnivorous burrowing marsupial. Within the marsupials it belongs to a group of ground dwelling animals called bandicoots. Once common throughout Australia, there were historically two species; the greater bilby and the lesser bilby. The lesser bilby is thought to have gone extinct in the 1960's following a broad scale decline in the previous 50 years (Burbidge et al. 1988). The greater bilby has however been able to continue its existence within Australia, but has declined dramatically following European settlement.

Distribution

The greater bilby is known to inhabit the Tanami bioregion (Figure 4-1). Historically the greater bilby occupied a substantial area of arid and semi-arid Australia. Its range and population declined dramatically following European settlement and it currently occurs across about 20% of its former range (Southgate 1990). The species now occurs in two distinct geographic areas, one of which extends from the desert region of the Northern Territory and Western Australia north to the Pilbara and Kimberley regions. The Tanami Desert is considered as containing critical habitat for the species (Pavey 2006a).

Southgate (1987) has found that it is widespread but in relatively low numbers throughout the Tanami Desert, although no specific studies have been undertaken in the areas considered here for proposed developments (apart from recent efforts discussed in this report). Surveys in the Tanami Desert indicate that bilbies are most likely to be found in the Granites-Rabbit Flat region and west of Tennant Creek (Pavey 2006b). Greater bilby surveys in the N.T. in the 1990s indicated that that laterite and drainage line land units were occupied more frequently than sand plain and dune systems (Southgate et al 2005). However, when resources are plentiful they will forage in a variety of habitat types.

Habitat requirements

The greater bilby is found in a wide range of habitats including stony uplands, lateritic areas, hummock grassland sand plains, mulga scrub and woodlands, drainage depressions and palaeodrainage systems (Southgate 1990). They seem to be strongly associated with lateritic and some other stony areas with sandy soils (containing stone fragments) deep enough to allow burrows to be constructed, and often associated with palaeodrainage areas (Southgate 1987). Southgate (1990) identified three major vegetation types where greater bilby occurs:

- open tussock grassland (both grasses and forbs) growing on uplands and hills
- mulga woodland/shrubland (both pure mulga and mixed stands of mulga/witchetty bush) growing on ridges and rises
- hummock grassland growing on sand plains and dunes, drainage systems, salt lake systems and other alluvial areas.

The greater bilby tends to avoid densely vegetated areas. A patchwork of different post-fire ages of vegetation is preferred. Fire seems to maintain the sparse vegetation they prefer, and promotes the ephemeral plants used as secondary and primary food sources (Johnson 1989). The greater bilby is not a sedentary species, moving over a wide area according to changing food and vegetation cover conditions associated with seasons and fires (Johnson 1989).

Shelter

The greater bilby shelters in deep burrows, excavated in sand, that are 2 to 3 meters long, and 100 to 150 mm in diameter. The entrance is usually against a bush or surface irregularity, although they may be dug in flat, featureless locations (Johnson 1989) (as is the case for some observed in the Twin Bonanza region). The greater bilby appears to vacate burrows and reuse old burrows over time. A number of burrows, from a few up to more than 100 in an area several kilometres square (Southgate 1987; Johnson 1989) may be occupied by a number of animals at one time, colonies may be vacated and reused frequently and opportunistically, and the long-term seasonal home range of a group of bilbies may be large (up to hundreds of square kilometres) (Southgate 1987).

An individual may have over a dozen regularly used burrows within its home range and several different burrows may be visited in a single night (Sinclair, Knight, Merz 2012; Pavey 2006b). On consecutive nights, only from 2% to 27% of burrows have been observed to be used, and 14 of 35 burrows were not used on any one night.

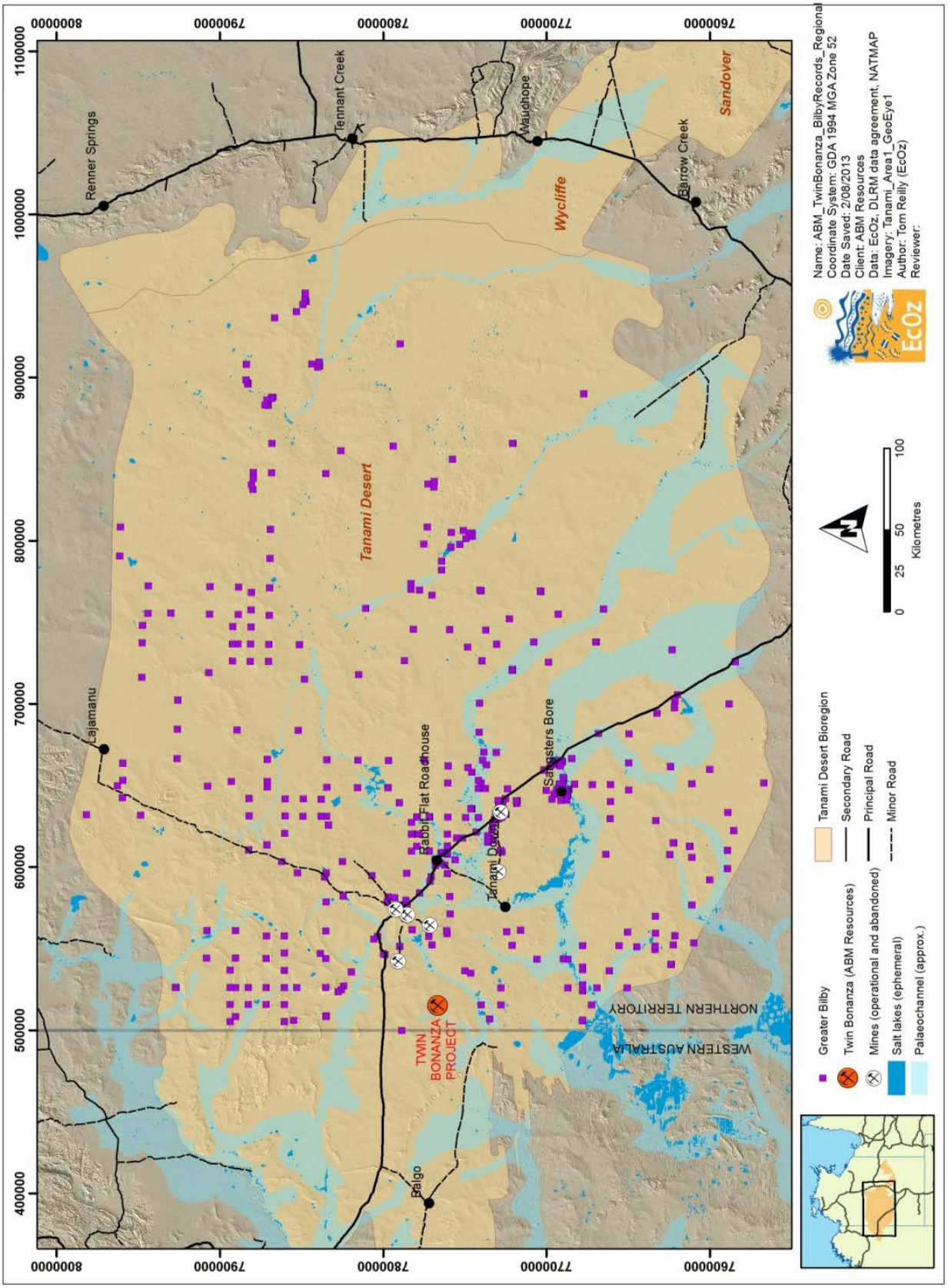


Figure 4-1. Greater bilby records in the Tanami Desert bioregion (NT Atlas 2013)

Some burrows appeared to be used regularly, while others were used only infrequently or transiently (Johnson 1989). Foraging distance from a burrow ranges from 200 to 600 m.

Diet

The greater bilby has an opportunistic foraging strategy and feeds on a wide range of plant and animal taxa with major dietary components varying across seasons and geographic range (Pavey 2006b). Most food is excavated from the soil and holes can be 250 mm in depth. In the Tanami Desert, seed and bulb plant foods are a major component of the diet, in particular the seed of *Yakirra australiense* and bulb form *Cyperus bulbosus*, and invertebrates are relied upon when plant food is scarce (Southgate & Carthew 2006).

Life history

In captivity the life expectancy of greater bilby regularly exceeds five years and has been recorded exceeding 10 years. A captive breeding colony of 19 individuals was found to have an average life expectancy of four years (Southgate et al 2000). Bilbies breed throughout the year (Pavey 2006a) with litter sizes of one to three young (Southgate 1987). In good conditions there is potential for four litters to be produced within a year (Southgate 1987).

Greater Bilbies aggregate in relatively high densities in areas where favoured plant food becomes abundant and easy to obtain. The greater bilby can reach a density of 12-16 individuals/km^2 in optimal habitat; however, a density of 1-2/km^2 is considered more typical (Pavey 2006a). Bilbies are known to periodically vacate an area for a new location, usually in response to depleted food resources. The nomadic nature of the species enables it to respond to patchy and uneven food availability (SKM 2012).

The greater bilby is not sedentary and an occupied area will be periodically vacated for a new location (Southgate 1987). Depleted food resources are the probable stimulus that results in a bilby vacating an area (Southgate 1987). This itinerant nature of the bilby enables it to respond to patchy and uneven food availability (Southgate 1987).

Threatening processes

Predation

Predation by European Fox (*Vulpes vulpes*) is a major threat to the greater bilby in the Northern Territory while feral cat (*Felis catus)* and Dingo (*Canis lupus dingo*) also predate on the species. There is considerable interaction between these species, as dingoes may protect the greater bilby by restricting fox and cat populations (Pavey 2006a).

Competition with rabbits (*Oryctolagus cuniculus*) is an additional threatening process faced by the greater bilby, though rabbits are unlikely to occur in the northern Tanami Desert. The increase in one-humped camel (*Camelus dromedaries*) numbers in western NT is also a potential threat to populations of the greater bilby. The large size of camels (up to 1000 kg), combined with their preference for dune systems and their tendency to consume a large portion of available plant species suggest that the species poses a significant threat to greater bilby habitat (Pavey 2006a).

Habitat degradation

Livestock are known to degrade greater bilby habitat, via mechanisms such as physical damage to soil structure, competition for preferred food species (grasses) and reduction in termite and ant abundance due to reduced grass seed biomass. Feral camels consume a wide variety of plant species and their hard hooves can seriously damage vegetation, posing a significant threat to bilby habitat (Pavey 2006a). An additional threat to bilbies and their habitat is competition with rabbits for food resources, and potentially burrow resources. Greater bilby distribution correlates to areas where rabbits are absent or present in low abundance (Pavey 2006a).

Parasites and disease

Mortality of greater bilbies found in south-western Australia in the 1920s and 1930s has been attributed to disease. This is supported by observations of native mammals travelling in circles, and coincides with the arrival of foxes in the area (Abbot 2001). However a conclusive link between disease and bilby declines at a national scale has not been established.

Mining

The greatest direct impact of mining operations is the destruction and degradation of greater bilby habitat (Pavey 2006a). The location of mines adjacent to palaeodrainage channels, which appear to be favoured bilby habitat, may have long term impact to the species at a regional level. The positioning of tailings dams on laterite substrates could deleteriously impact bilbies and other threatened marsupials (Pavey 2006a). Internal mine roads have the potential to cause greater bilby mortality at a local level if they are used at night. Collisions with vehicles on haul roads at night have been a cause of bilby mortality in the Tanami Desert (Pavey 2006a). However, it must be noted that bilbies are also known to reside adjacent to mining developments within the Tanami Desert, with relatively little impact on populations; for example bilby burrows at the Coyote mine site airstrip located 45 km to the west of Twin Bonanza remained active during airstrip operations over a number of years (pers. comm. Jeremy Shepherdson, Principal Ecotec WA 2013).

Fire

Changes in the pattern of fire regimes following European settlement has been hypothesised as a factor behind historic greater bilby decline, combined with the introduction of exotic predators (Southgate et al 1994). Fire temporarily modifies vegetation cover which may facilitate the presence of exotic predators within bilby habitat. High intensity uncontrolled fires are of particular concern; however, a link between specific fire histories and bilby abundance has yet to be established (Pavey 2006a).

Due to their burrowing abilities the greater bilby is not reliant on vegetation for shelter thus enabling the species to persist in recently burnt and sparsely vegetated areas. In the Tanami Desert, bilbies are known to be reasonably tolerant of fire, being able to inhabit both recently burnt and long unburnt sites. Studies within the region have demonstrated that fire-promoted plants constitute an important component of bilby diet in recently burnt areas, with termites and other invertebrates increasing in dietary composition when bulb foods become less readily available (Southgate & Carthew 2006).

Heterogeneity of fire intervals and size of patch burns are highest in the mid-latitudes of the Tanami Desert, coinciding with highest prevalence of greater bilby. Proximity to recently burnt habitat has been found to correlate significantly with bilby occurrence in the Tanami, where fire-promoted vegetation is also relatively heterogeneous. Fire and the promotion of key food plants are therefore likely to be an important determinant of bilby distribution (Southgate & Carthew 2006).

4.1.3 Greater bilby at Twin Bonanza

Greater bilby are confirmed to occur within the immediate project area through identification of active and inactive burrows, nocturnal sightings, camera trap footage, and fresh diggings during three fauna surveys at the site (GHD 2012; EcOz 2012; EcOz 2013) (Table 4-1 and Figure 4-2). Survey effort included searches for tracks, scats, burrows, and diggings at fauna sites, along exploration tracks, and targeted transects throughout the proposed mining footprint (Figure 4-2). Surveillance cameras were set at burrow entrances suspected to be “active” which resulted in several still shots and video footage of an adult greater bilby (see Table 4-1). Bilby habitat probability mapping was also conducted for the project area based on vegetation type preferences, existing fire scars, and regolith type preferences. This methodology aligned with *EPBC Act* Threatened Species Survey Guidelines.

To date, surveys and transect searches have identified 23 burrows plus 2 confirmed sightings. The majority of records occur within lateritic sand plain in a relatively distinct area (see Figure 4-2).

A threatened species database has been created that can be easily updated when new records become available. The database has been setup in Excel and is compatible for use in MAPINFO mapping software. The database includes sightings and burrow locations.

Table 4-1. Photos of Greater Bilby sightings, signs and habitat at Twin Bonanza

Camera trap image of a Greater Bilby (EcOz 2013)

Greater Bilby sighted in 2012 (GHD 2012)

Typical Greater Bilby habitat – open spinifex grassland on lateritic sand plain (EcOz 2013)

Greater Bilby Burrows found within the Twin Bonanza Project Area (EcOz 2013)

Signs of fresh Bilby activity, forage digging (EcOz 2013)

Signs of fresh Bilby activity, track (EcOz 2012)

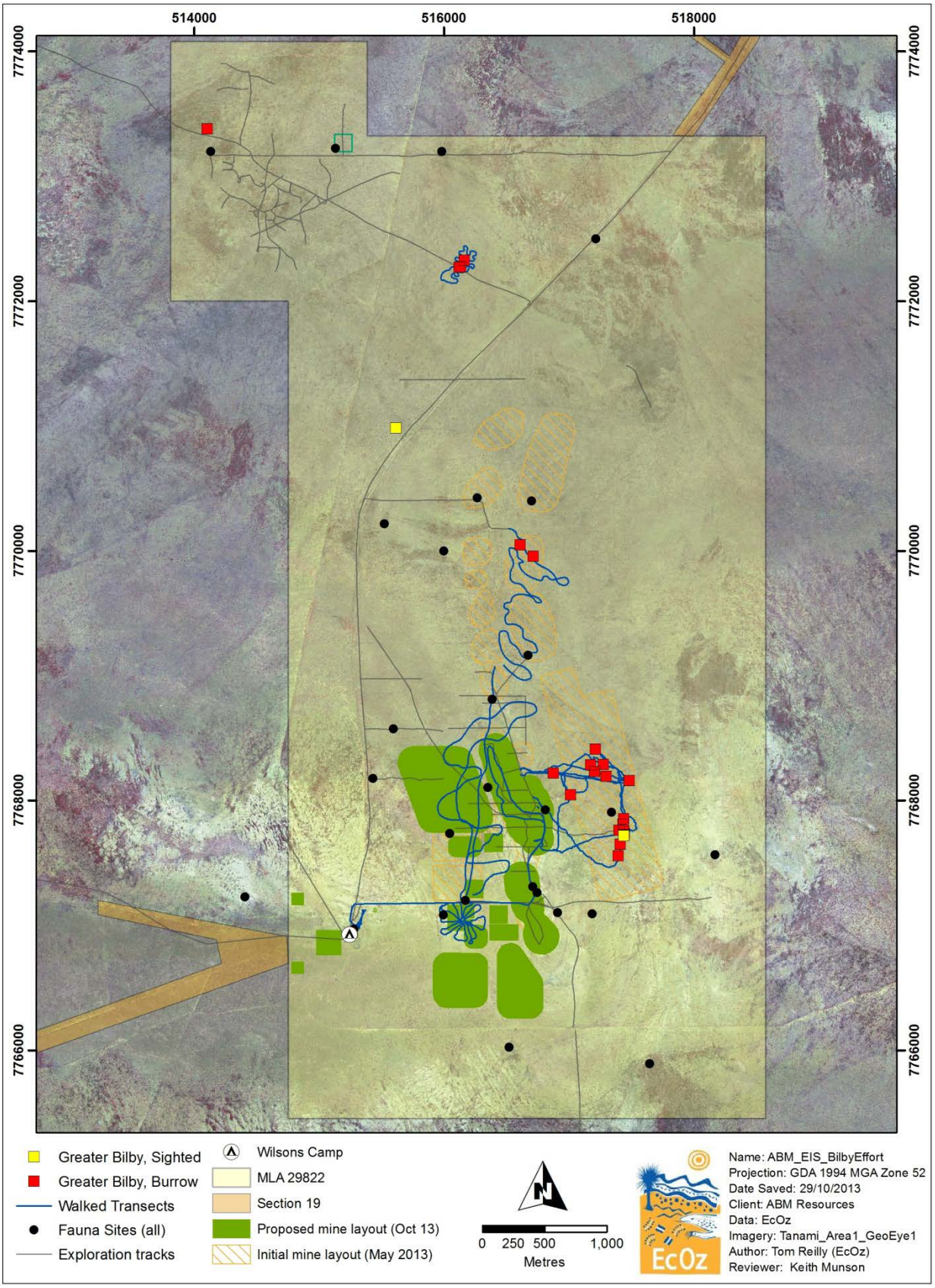


Figure 4-2. Greater Bilby reported sightings within Twin Bonanza proposed footprint

4.1.4 Hazards and potential impacts

Mining activities at Twin Bonanza have the potential to adversely impact on greater bilby, which is known to occur within the project area. These activities and associated potential impacts are listed below.

- Hazard - vegetation clearing as part of mine construction and operations may lead to:
  - accidental injury / mortality of individuals that persist at the site during land clearing activities
  - damage to existing burrow networks
  - loss and/or degradation of greater bilby foraging and burrowing habitat
  - displacement of existing populations, making them prone to predation by existing feral cat and dingo populations.
- Hazard – increased pest fauna due to poor environmental management of mine site may lead to:
  - increased predation pressure by pest species (such as feral cats and dingoes) on threatened species populations.
- Hazard - vehicle movements during construction and operations may lead to:
  - accidental injury / mortality of individuals through collisions
  - damage to burrows due to off-road driving.
- Hazard - increased noise and vibrations at the site may lead to:
  - populations of threatened species leaving the local area
  - displacement of existing populations, making them prone to predation.

4.1.5 Relevant legislation and standards

- *Environment Protection and Biodiversity Act 1999* (Cth)
- *Territory Parks and Wildlife Conservation Act 2006* (NT)
- A management program for Greater Bilby (*Macrotis lagotis*) in the NT (PWCNT 1998)
- National Recovery Plan for the Greater Bilby *Macrotis lagotis* (Pavey 2006)

4.1.6 Objectives

- To avoid adverse impacts on greater bilby by implementing appropriate management measures.
- To prevent impact on the local greater bilby population.
- To prevent impact on the greater bilby habitat that will not be cleared during mining operations.

4.1.7 Performance indicators

- No greater bilby deaths as a result of clearing.
- No greater bilby deaths as a result of mining activities.
- No significant decline in the quantity and quality of greater bilby habitat adjacent to mining operations.

4.1.8 Management actions

Burrow and activity avoidance when locating mining infrastructure

The most effective means of minimising (or ideally avoiding) impacts to greater bilby is to locate mining infrastructure in areas where no burrows or diggings occur. Therefore, survey evidence was mapped to

identify areas suitable for placement of mining infrastructure and exhibited little to no evidence of greater bilby activity (Figure 4-2).

In addition, ABM conducted bilby habitat probability mapping based on known locations, existing data, mapping files, and ecological assumptions of the bilby (referred to in this document and chapter 6 of the EIS). This was aimed to determine the possible extent of bilby habitat and was used in repositioning mining infrastructure to areas that were less likely to have bilby activity. This mapping exercise resulted in a moderate confidence assessment of potential areas of bilby activity in the project area.

Controlled burn and pre-clearance inspection prior to vegetation clearing

Controlled and restricted burning (in association with the Traditional Owners) will be undertaken within the proposed clearing areas immediately prior to land clearing activities. If bilbies are present, this may encourage individuals to move from the area as the potential food source has been removed. The burnt site will be inspected for bilby presence by an experienced ecologist, and if deemed clear (i.e. no evidence of bilby), the topsoil will be immediately removed and stockpiled. It is important to remove the topsoil component as soon as possible as vegetation clearing often promotes fresh growth, attracts insects and softens soils which could attract bilbies to the site (i.e. foraging for food), thereby increasing risk of impact to individuals. If evidence is detected within the proposed clearing area, this will trigger further investigation and a case by case plan as required to minimise potential harm to individuals.

Adherence to agreed clearing boundaries

All land clearing activities associated with the project will require completion and compliance of ABM's Land Clearing Procedure (Appendix A), which is based on existing Northern Territory Land Clearing Guidelines (LRM 2010).

This procedure includes a delineation of clearing boundaries to ensure that unanticipated clearing occurs. This form requires confirmation that regulatory approval for clearing has been given and that the area to be cleared is demarcated by cones or pegs. The importance of remaining within these boundaries will be clearly communicated to relevant field staff by senior ABM personnel. Disturbed areas will be rehabilitated as soon as practical to prevent weeds from colonising the area, thus maintaining the integrity of bilby habitat.

Furthermore, vegetation clearing will only occur when required (i.e. no wide scale clearing prior to building waste rock dumps) as clearing prior to immediate development exposes soils to wind and water erosion.

Site inductions are compulsory for all staff and contractors. The inductions detail the presence of bilbies and mulgara and employees are instructed of their duty to comply with ABM's environmental requirements.

Predator control

Predation by foxes and cats poses a serious threat to greater bilby and can lead to declines in abundance (Southgate et al. 1994). Various predator control methods have been carried out across the bilby range, including ground baiting, aerial baiting and hunting. Reintroduction of greater bilby in the southern Northern Territory provides an indication of predator densities at which the bilby can persist. Bilby populations were found to expand with fox and cat densities of 0.15 animals/km^2 and dingo densities of 0.11 animals/km^2, while declines occurred at fox and cat densities of 0.25 animals/km^2 and dingo densities of 0.16 animals/km^2 (Southgate et al. 1994).

A Pest Management Plan has been developed for the Twin Bonanza project to ensure that predation pressure on threatened species (such as the greater bilby) is not increased as a result of the mining operation. The Pest Management Plan is presented in Section 4.5 of this BMP and details management actions applicable to protecting threatened species from predation pressure from pest species.

Vehicle movement restrictions

Mining haul roads are a significant cause of bilby mortality at a local scale, especially when vehicles operate on these roads at night time. Bilby mortality due to night time vehicle collisions on haul roads have been documented in the Tanami Desert (Pavey 2006a). Night driving outside the mining area is to be avoided where possible, and should occur only when determined to be absolutely necessary. The implementation of night time speed restrictions can significantly lower the risk of road-killed bilbies. A night speed limit of 60 km/hour will be adopted and posted within areas of known bilby activity on haul roads and roads within the project area; this allows individual bilbies to avoid vehicles and vehicle drivers to make a safe adjustments to avoid a collision should a bilby be sighted. Night driving will be limited to essential activities.

Potential exists for greater bilby burrows to be damaged by vehicles undertaking off-road driving, especially considering the majority of the project area constitutes potential habitat for the species (i.e. sand plain). Identified areas of bilby activity will be demarcated on maps, with access restricted at these areas.

Fencing-off and signage of burrows is not suitable as bilbies may be disturbed by artificial structures close to their burrows.

Any greater bilbies spotted during driving are added to the fauna register and this information mapped and relayed to staff working in the area.

Non-specific but related management items

Other activities or occurrences related to the mining operation that require management to minimise impact to the greater bilby include accidental bush fire, noise disturbance and vibrations from blasting activities. These impacts will be mitigated via management plans that have been developed for the Twin Bonanza Environmental Management Plan, these include:

- fire only being used under controlled condition and there will be no intentional starting of bush fires without explicit approval from government authorities and the CLC (refer to Fire Management Plan)
- blasting (refer to Noise Management Plan).
- noise disturbance (refer to Noise Management Plan)

4.1.9 Monitoring and Inspections

Pre clearance inspections

Prior to land clearing in an area not already surveyed, an on ground pre-clearance survey will be conducted in order to determine if greater bilby is present.

Sand plot monitoring program

Sand plot monitoring will be used to estimate activity and population of greater bilby within the Twin Bonanza project area. This monitoring program will be based on methods developed by Colleen O'Malley and Rachel Paltridge (Pavey 2006a). It is a rapid site-based method used to identify a selection of relevant parameters within 200 m by 300 m plots over a period of 15 to 20 minutes. Parameters include:

- threatened species sign (i.e. tracks, scats, burrows, diggings)
- feral cats sign (i.e. tracks)
- dingo sign (i.e. tracks, scats)
- fire impact and fuel load estimates

- vegetation condition (i.e. photo point and basic habitat description based on customised field datasheet)

Monitoring and associated data analysis is proposed to occur on an approximately 6-monthly basis in order to capture seasonal variation and detect trends at a relatively early stage.

Sites will be selected adjacent to mining activity in areas where greater bilby has been identified during previous fauna surveys. Additionally, control sites will also be monitored in habitat outside of the determined zone of mining impact. This research will provide valuable information that could inform mitigation strategies for future mining projects, especially considering the current dearth of information on the impacts of mining to Greater Bilby.

The Draft Sand Plot Monitoring Program is included in Appendix B of this BMP.

Vegetation monitoring program

A vegetation monitoring program is proposed to occur within the project area. The objective of this program is to monitor vegetation condition across the site, and the program can be used to identify potential degradation of greater bilby habitat (which may or may not be attributed towards mining operations).

Methodology for vegetation monitoring will be based on techniques utilised by the regional biodiversity monitoring program (a long term program established by the Newmont Tanami Operations and the Central Land Council in the early 2000s). This approach collects data on flora diversity, plant height class, weeds, fire, and erosional features along a permanent 200 m transect. A description of methods for this monitoring program has not been finalised, however they will be completed prior to mine construction in order to collect appropriate baseline dataset.

Landfill and camp area inspections for pest species

Additional to data collected as part of the sand plot monitoring program, there will be weekly site inspections of land fill and camp area for pest fauna (such as feral cats and dingoes). Data collected will be reported to the environmental manager for collation into a pest species and management database.

4.1.10 Environmental triggers and corrective actions

Pre clearance inspections

If pre clearance surveys provide conclusive evidence that areas to be cleared are home to populations of the greater bilby, ABM will determine whether mining infrastructure can be relocated to areas which do not support populations of the greater bilby. If mining infrastructure cannot be relocated, ABM will liaise with both the DLRM and DOE, towards best practice management of this species.

Evidence of greater bilby habitat degradation

If monitoring provides conclusive evidence that greater bilby habitat is in decline because of ABM's activities, ABM will investigate and liaise with experts in the field to determine the best management measures to resolve the issue. ABM will take preventative measures if the cause of decline can be determined.

Vegetation boundaries compromised

Report unauthorised clearing to DME and propose re-vegetation strategy for the affected area.

Death or Injury to greater bilby

An injury or death of a greater bilby as a result of mining activities (i.e. vegetation clearing, haul trucks traffic, and light vehicle traffic) would be immediately reported to DME and DOE. This would trigger a response that reviews reasons why the incident occurred and how the risk of re-occurrence could be minimised. If

repeated incidents occur to greater bilby, this will trigger a further review in liaison with relevant experts in the field in conjunction with LRM, DME and DOE.

Identification of cats in mining area

If cats are detected during weekly site inspections of camp area and landfill site, this will trigger a control program using baits within the landfill compound that does not provide access to native species (Section 4.5).

4.1.11 Reporting and record keeping

Pre clearance inspections

The pre-clearance inspections will provide a summary report on the presence of greater bilby in the habitat to be cleared. These records will be reviewed prior to clearing by the environment manager.

Vegetation clearing

The vegetation clearing will be documented in the ABM Land Clearing Procedure. These records will be reviewed prior to clearing by the environment manager.

Sand plot reporting and record keeping

The sand plot monitoring program will include a database update after each monitoring event (approximately 6-monthly) and will also include an annual summary report that discusses and analyses results from the program, which will include a section on the greater bilby.

Vegetation condition reporting and record keeping

The vegetation condition monitoring program will include a database update after each monitoring event (approximately 6-monthly) and will also include an annual summary report that discusses and analyses results from the program. Assessment results from this program will be used to determine if greater bilby habitat quality is degrading as a result of mining operations.

Incident reporting and response strategy

An incident/hazard/near miss reporting policy and an incident/hazard/near miss reporting procedure will ensure the reporting of all incidents, hazards, and near misses. Upon notification, the environmental manager will investigate the event and coordinate the implementation of corrective or preventative action. The environmental manager is also responsible for reporting of significant incidents (i.e. greater bilby road kill) to DME and/or DOE and for ensuring that corrective action is taken to prevent recurrence. A copy of these records will be issued as required to DME and other statutory authorities on request. ABM will ensure that this procedure for incident reporting is being complied with and that the procedure allows for the timely reporting, investigation, and mitigation of incidents, hazards and near misses.

4.1.12 Roles and responsibilities

Position	Responsibility
Site general Manager	Ensure that this management plan is implemented. Provide access to training for operations manager.
Environment Manager	Ensure that this management plan is implemented. Ensure ongoing compliance with management plan.
Employees and contractors	Adherence to and implementation of management plan.
Ecologist (consultant)	Conduct pre-clearance surveys

4.2 Brush-tailed Mulgara Management Plan

It has been identified that the Twin Bonanza project may impact on the brush-tailed mulgara (*Dasycercus blythi*), which is a species listed as vulnerable under the *Territory Parks and Wildlife Conservation Act 2000* (Northern Territory). Therefore, ABM has committed to managing their operations in a way that either avoids or minimises impact to the species.

This Brush-tailed Mulgara Management Plan (BMMP) will address the conditions of approval that will be available following the formal assessment of the draft EIS and EIS supplement by Northern Territory and federal authorities.

4.2.1 Scope

This plan guides and informs the management of mining operations within MLA29822 so as to minimise the impacts on brush-tailed mulgara as much as possible, which will contribute to a net gain for the conservation of local populations on or in the vicinity of Twin Bonanza.

This plan aims to establish the management framework specifically for the conservation of the brush-tailed mulgara, which is known to occur within the Twin Bonanza Project Area (MLA29822).

The BMMP focuses on managing potential impacts to brush-tailed mulgara associated with the Twin Bonanza gold project. Specifically, this plan:

- provides background information on the Brush-tailed Mulgara, its status, significant populations, life strategies and habitat requirements, key threats and management priorities
- provides context for the local population and potential habitat within Twin Bonanza
- provides an overview of potential impacts associated with the project
- details management measures that will be implemented to mitigate impacts during the life of the project and beyond
- details a monitoring program, including performance objectives and criteria that will be implemented prior to mine development.

4.2.2 Background information

Description of species

The brush-tailed mulgara is a carnivorous marsupial species with a body mass of over 100 g. It can be differentiated from the closely related crest-tailed mulgara (*Dasycercus cristicauda*) by the presence of two pre-molar teeth (three in *D. cristicauda*), the brush-like appearance of the black hairs in the distal half of the tail (crest-like in *D. cristicauda*) and the female having six teats as opposed to eight teats in *D. cristicauda* (Pavey et al 2006).

Distribution

Brush-tailed mulgara is known to inhabit the Tanami bioregion (Figure 4-3) (Wooley et al 2013). The brush-tailed mulgara is believed to have once been widespread in the desert regions of central Australia. It began to decline in the 1930s and is believed to have a more fragmented distribution than in the past (Pavey et al. 2006). Historical records, however, do not distinguish between the two different mulgara species (crest-tailed mulgara and brush-tailed mulgara), hence there is some ambiguity regarding the distribution of each species. Recent assessments indicate that both *Dasycercus* species are more widely distributed than previously thought (Masters & Dickman 2012).

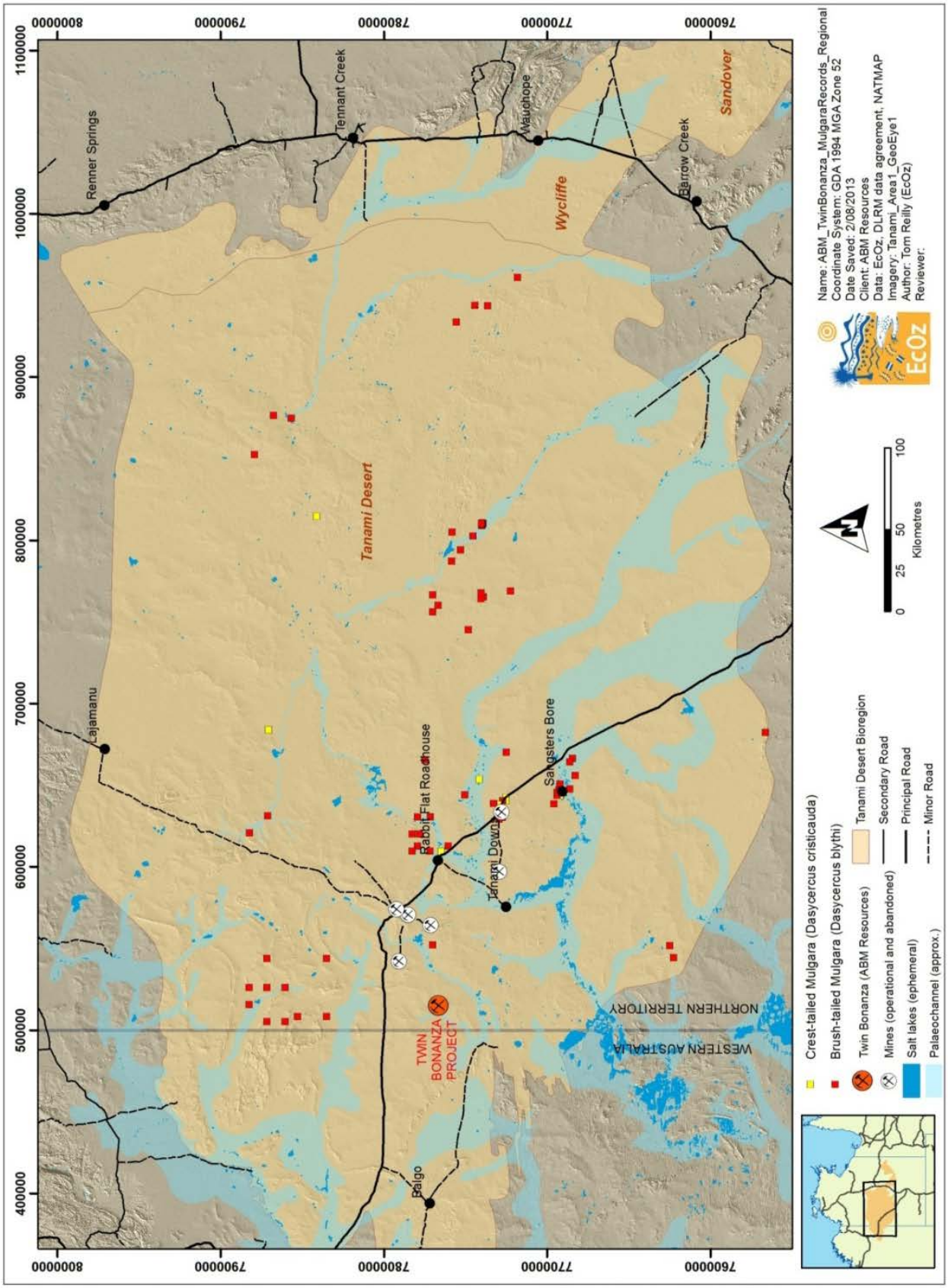


Figure 4-3. Brush-tailed mulgara records in the Tanami bioregion (NT Atlas 2013)

Habitat requirements

Typical habitat for the species consists of sand plains and drainage depressions that support mature hummock grasslands of spinifex, especially *Triodia basedowii* and *T. pungens* (Pavey et al 2006). Burrows located at Twin Bonanza project area were generally built at the base of mature Spinifex hummocks.

Shelter

Brush-tailed mulgara are predominantly nocturnal, sheltering by day in burrows that are about 0.5m deep. Burrows are fairly conspicuous and are generally 5 cm diameter and often have multiple entrances (but not always) (notes from field experience – Tom Reilly). The depth of brush-tailed mulgara burrows provides additional protection from environmental disturbances, including climatic extremes and intrusions from predators such as the feral cat (*Felis catus*) and red fox (*Vulpes vulpes*) (Masters and Dickman 2012).

Diet

Brush-tailed mulgara are both carnivorous and insectivorous, taking a range of prey including scorpions, centipedes, rodents, small marsupials and reptiles. Unlike smaller dasyurids, it is able to excavate prey from burrows (Masters & Dickman 2012).

Life history

Brush-tailed mulgara are able to survive periods of food shortage due to its dietary flexibility and aspects of its behaviour and physiology. The mulgara is able to reduce its energy expenditure in situ by entering daily torpor. During periods of drought, the brush-tailed mulgara is able to tolerate reduction in bodyweight and condition by drawing on substantial reserves of fat stored in its tail (Masters & Dickman 2012).

The brush-tailed mulgara breeds in late winter, producing a litter of up to six young. The young suckle for 12 to 15 weeks. Unlike other small dasyurids, males do not die after breeding (AWC 2013). Maximum life span for brush-tailed mulgara in the wild is estimated to be three years (Masters & Dickman 2012).

Threatening Processes

Predation

Red fox, feral cat and dingo are known to prey on brush-tailed mulgara (Paltridge 2002). Radio-tracking of individuals in Uluru- Kata Tjuta National Park revealed three of nine brush-tailed mulgara individuals falling victim to predation by exotic predators (two by cat and one by fox), representing a high portion of the study population (Körtner et al. 2007). Predation pressure is probably greatest in the years following heavy summer rainfall, when predators increase in numbers and rodent populations start to crash (Masters 2012). The low overall abundance of brush-tailed mulgara makes them vulnerable to the impacts of predation by cats and foxes, especially at a local scale.

Habitat degradation

Grazing by rabbit (*Oryctolagus cuniculus*), camel (*Camelus dromedarius*) and livestock is likely to degrade brush-tailed mulgara habitat and cause declines at certain thresholds. Research has shown crest-tailed mulgara to decline concurrent with increases in camel populations (Reid et al. 1993), and the brush-tailed mulgara is likely to be similarly affected. Cattle may also degrade habitat by damaging dunes and trampling vegetation (Masters 2012).

Parasites and disease

Parasite and diseases specific to the brush-tailed mulgara have not been documented, and are unlikely to pose a significant threat. The predominant parasites of dasyurids are ticks, fleas, mites and lice. Internal parasites include protozoans, cestodes, trematodes and nematodes (Morton et al 1989).

Mining

Efforts have been made in the WA goldfields to monitor the impacts of mining on crest-tailed mulgara. Unfortunately these studies were hindered by large fluctuations in the species abundance owing to variation in annual rainfall, making it difficult to discern mining impacts from natural changes due to resource pulses (Pearson 2003).

In 1994 biological surveys by Ecologia at the Jundee Gold Project (Wiluna WA) captured two adult females. These individuals were re-trapped the following two years and showed no signs of breeding, indicating that they may have become isolated from other mulgaras due to the proximity of mining (Pearson 2003).

Fire

Fire increases the risk of brush-tailed mulgara predation by reducing spinifex cover and resource availability. Dense spinifex provides increased protection from predators when mulgaras are actively foraging above ground. Radio-tracking of brush-tailed mulgara has revealed that individuals in burnt habitat have larger home ranges than those living in mature spinifex, indicating that fire reduces resource availability for the species. The additional foraging effort required in burnt habitat makes individuals more susceptible to predation (Körtner et al 2007).

4.2.3 Brush-tailed mulgara at Twin Bonanza

A total of five brush-tailed mulgara were captured or sighted during fauna surveys at Twin Bonanza, with an additional confirmation of two active burrows (Figure 4-4). One mulgara sighting occurred under the kitchen donga at Wilsons Camp (existing exploration camp), and the others were all Elliott trap captures. Surveys did not identify high densities of the species but they did determine that mulgara were relatively widespread across the Twin Bonanza project area (which makes it difficult for the mining operation to avoid suitable mulgara habitat).

Transects walked as part of the greater bilby surveys also checked for mulgara burrows, which are far less conspicuous than bilby burrows. No mulgara burrows were detected during these searches.

A threatened species database has been created that can be easily updated when new records are available. The database has been setup in Excel and is compatible for use in MAPINFO mapping software. The database includes sightings, burrows, and other signs.

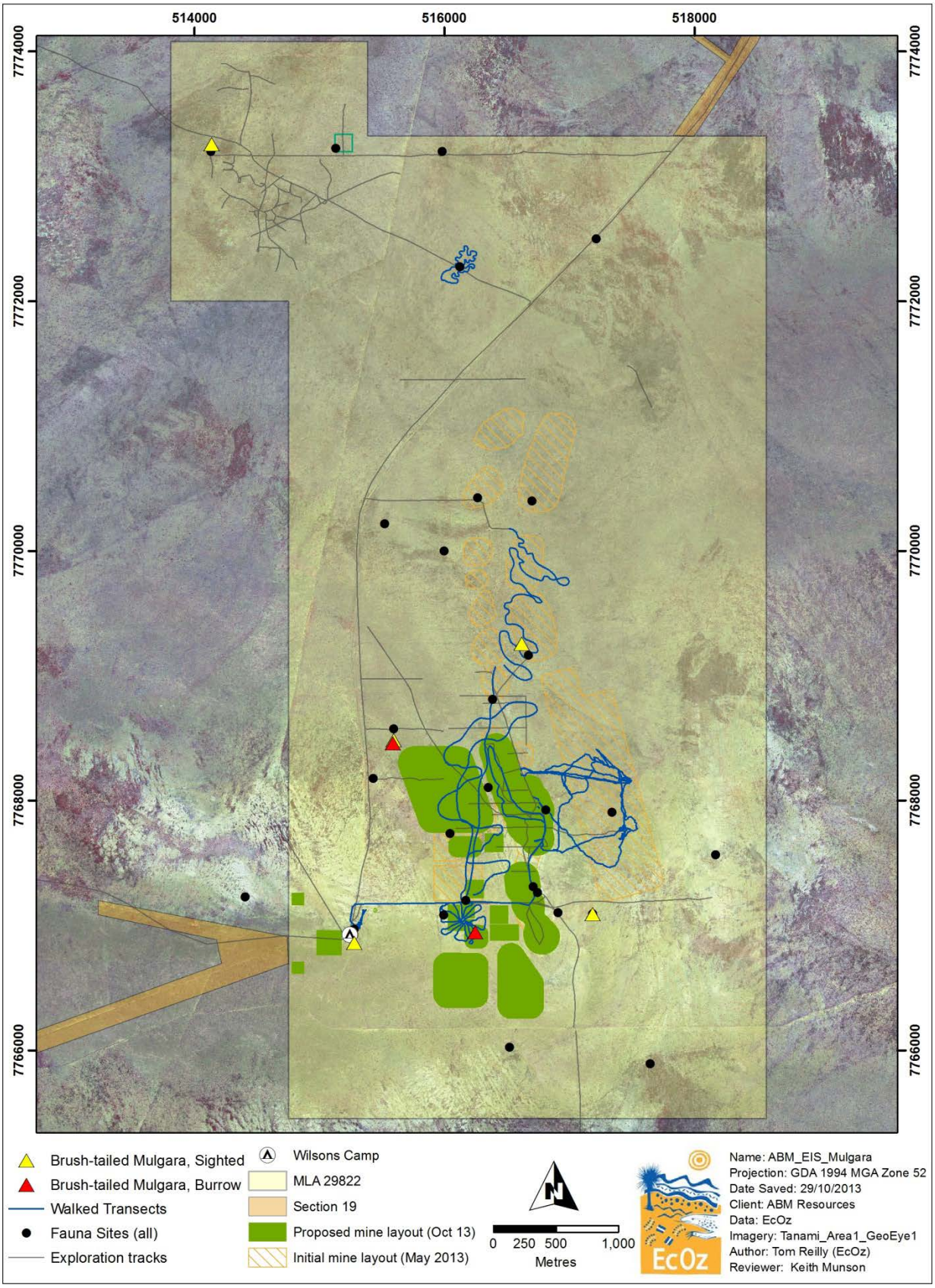


Figure 4-4. Brush-tailed mulgara reported sightings within Twin Bonanza proposed footprint

4.2.4 Hazards and potential impacts

Mining activities at Twin Bonanza have the potential to adversely impact on brush-tailed mulgara, which is known to occur within the project area. These activities and associated potential impacts are listed below.

- Mining activity - vegetation clearing as part of mine construction and operations may lead to:
  - accidental injury / mortality of individuals that persist at the site during land clearing activities
  - damage existing burrows
  - loss and/or degradation of foraging and burrowing habitat
  - displacement of existing populations, making them prone to predation by existing feral cat and dingo populations.
- Hazard – increased pest fauna due to poor environmental management of mine site may lead to:
  - increased predation pressure by pest species (such as feral cats and dingoes) on threatened species populations.
- Mining activity - vehicle movements during construction and operations may lead to:
  - accidental injury / mortality of individuals through collisions
  - damage to burrows due to off-road driving.
- Mining activity - increased noise and vibrations at the site may lead to:
  - populations of threatened species leaving the local area
  - displacement of existing populations, making them prone to predation.

The presence of the mine could also result in increased numbers of predatory species (such as feral cats, dingoes, and dogs), which will increase predation pressure on the brush-tailed mulgara.

4.2.5 Relevant legislation and standards

- *Territory Parks and Wildlife Conservation Act 2006* (NT)

4.2.6 Objectives

- To avoid adverse impacts on brush-tailed mulgara by implementing appropriate management measures.
- To prevent impact on the local brush-tailed mulgara population.
- To prevent impact on the brush-tailed mulgara habitat that will not be cleared during mining operations.

4.2.7 Performance indicators

- Minimise brush-tailed mulgara deaths as a result of clearing.
- No brush-tailed mulgara deaths as a result of mining activities.
- No significant decline in the quantity and quality of brush-tailed mulgara habitat adjacent to mining operations.

4.2.8 Management actions

Burrow avoidance when locating mining infrastructure

The most effective means of minimising (or ideally avoiding) impacts to brush-tailed mulgara is to locate mining infrastructure where the species does not occur, or where density of the species is regarded as low or unlikely. Data collected from recent fauna surveys (GHD 2012; EcOz 2012; EcOz 2013) indicate that brush-tailed mulgara occur at the site in low numbers but seem to occur in a variety of habitat across the project area (see Section 4.2.3). Walked transects that targeted greater bilby also searched for brush-tailed mulgara burrows, however identification of mulgara burrows is less conspicuous than bilby burrows and it is possible that results from the walked transects are not representative of mulgara distribution at the site.

In summary, the proposed layout for mining infrastructure at Twin Bonanza was firstly chosen based on avoiding greater bilby burrows, then selected based on existing evidence of brush-tailed mulgara from fauna surveys and transect surveys. This resulted in one mulgara burrow being disturbed by the mining footprint (based on existing survey information at the site).

Controlled burn and pre-clearance inspection prior to vegetation clearing

Controlled and restricted burning (in association with the Traditional Owners) will be undertaken within the proposed clearing areas immediately prior to land clearing activities. The burnt site will be inspected for possible brush-tailed mulgara presence (plus other threatened species) by an experienced ecologist, and if deemed clear (i.e. no evidence of threatened species), the topsoil will be immediately removed and stockpiled. If there is strong evidence that brush-tailed mulgara is present within the proposed clearing zones, if mining infrastructure cannot be relocated, ABM will liaise with DLRM, on measures to reduce/minimise the impacts.

Adherence to agreed clearing boundaries

All land clearing activities associated with the project will require completion and compliance of ABM's Land Clearing Procedure (Appendix A), which is based on existing Northern Territory Land Clearing Guidelines (LRM 2010).

This procedure includes a delineation of clearing boundaries to ensure that unanticipated clearing occurs. This form requires confirmation that regulatory approval for clearing has been given and that the area to be cleared is demarcated by cones or pegs. The importance of remaining within these boundaries will be clearly communicated to relevant field staff. Disturbed areas will be rehabilitated as soon as practical to prevent weeds from colonising the area.

Furthermore, vegetation clearing will only occur when required (i.e. no wide scale clearing prior to building waste rock dumps) as clearing prior to immediate development exposes soils to wind and water erosion.

Site inductions are compulsory for all staff and contractors. The inductions detail the presence of brush-tailed mulgara, and employees are instructed of their duty to comply with ABM's environmental requirements.

Predator control

A Pest Management Plan has been developed for the Twin Bonanza project to ensure that predation pressure on threatened species (such as the brush-tailed mulgara) is not increased due to the presence of the mining operation. The Pest Management Plan is presented in Section 4.5 of this BMP.

Vehicle movement restrictions

Brush-tailed mulgara are a nocturnal species and therefore are susceptible to collisions with vehicles at night. Night driving outside the mining area is to be avoided where possible, and occur only when determined to be absolutely necessary. A night speed limit of 60 km/hour will be adopted and posted within

areas of known brush-trailed mulgara activity on haul roads within the project area; this allows individual brush-trailed mulgara to avoid vehicles and vehicle drivers to make safe adjustments to avoid a collision should a brush-trailed mulgara be sighted.

Brush-tailed mulgara burrows may be damaged by vehicles when off-road driving. Identified areas of brush-tailed mulgara activity will be demarcated on maps, with access restricted from these areas.

Non-specific but related management items

Other activities or occurrences related to the mining operation that require management to minimise impact to the brush-tailed Mulgara include accidental bush fire, noise disturbance and vibrations from blasting activities. These impacts will be mitigated via management plans that have been developed for the Twin Bonanza, these include:

- fire only being used under controlled conditions, and there will be no intentional starting of bush fires without explicit approval from government authorities and the CLC (refer to Fire Management Plan).
- blasting (refer to Noise Management Plan)
- noise disturbance (refer to Noise Management Plan)

4.2.9 Monitoring

Pre clearance inspections

Prior to any land clearing in an area not already surveyed, an on ground pre-clearance survey will be conducted in order to determine ifb-tailed mulgara are present.

Sand plot monitoring program

Sand plot monitoring will be used to estimate activity and population of brush-tailed mulgara within the Twin Bonanza project area. This monitoring program will be based on methods developed by Colleen O'Malley and Rachel Paltridge (Pavey 2006a). It is a rapid site-based method used to identify a selection of relevant parameters within 200 m by 300 m plots over a period of 15 to 20 minutes. Parameters include:

- threatened species sign (i.e. tracks, scats, burrows, diggings)
- feral cats sign (i.e. tracks)
- dingo sign (i.e. tracks, scats)
- fire impact and fuel load estimates
- vegetation condition (i.e. photo point and basic habitat description based on customised field datasheet)

Monitoring and associated data analysis is proposed to occur on an approximately 6-monthly basis in order to capture seasonal variation and detect trends at a relatively early stage.

Sites will be selected within areas adjacent to mining activity, in areas where brush-tailed mulgara have been identified during previous fauna surveys. Additionally, control sites will also be monitored in habitat outside of the determined zone of mining impact. The control sites are important; discerning mining impacts from natural variations can be difficult as mulgara populations are known to fluctuate greatly due to resource pulses. Monitoring should occur annually, pre and post breeding season, to obtain an estimate of

recruitment. Monitoring will be conducted over the life of the mine so that data acquired is sufficient to make conclusions regarding the impacts of mining to brush-tailed mulgara.

The Draft Sand Plot Monitoring Program is included in Appendix B.

Vegetation monitoring program

A vegetation monitoring program is proposed to occur within the project area. The objective of this program is to monitor vegetation condition across the site, and can be used to identify potential degradation of brush-tailed mulgara habitat (which may or may not be attributed towards mining operations).

Methodology for vegetation monitoring will be based on techniques utilised by the regional biodiversity monitoring program (a long term program established by the Newmont Tanami Operations and the Central Land Council in early 2000s). This approach collects data on flora diversity, plant height class, weeds, fire, and erosional features along a permanent 200 m transect. A description of methods for this monitoring program has not been finalised, however they will be completed prior to mine construction in order to collect appropriate baseline dataset.

Landfill and camp area inspections for pest species

Additional to data collected as part of the sand plot monitoring program, there will be weekly site inspections of land fill and camp area for pest fauna (such as feral cats and dingoes). If cats are detected during these inspections, this will trigger a control program using baits within the landfill compound that does not provide access to native species (Section 4.5). Data collected will be reported to the environmental manager for collation into a pest species and management database.

4.2.10 Environmental triggers and corrective actions

Pre clearance inspections

If pre clearance surveys provide conclusive evidence that areas to be cleared are home to populations of the brush-tailed mulgara, ABM will determine whether mining infrastructure can be relocated to areas which do not support populations of the brush-tailed mulgara. If mining infrastructure cannot be relocated, ABM will liaise with the DLRM towards best practice management of this species.

Evidence of brush-tailed mulgara habitat degradation

If monitoring provides conclusive evidence that brush-tailed mulgara populations are being detrimentally impacted because of ABM's activities, ABM will investigate and liaise with experts in the field to determine the best management measures to resolve the issue. ABM will take preventative measures if the cause of decline can be determined.

Vegetation boundaries compromised

Report unauthorised clearing to DME and propose re-vegetation strategy for the affected area.

Death or injury to brush-tailed mulgara

An injury or death of a brush-tailed mulgara as a result of mining activities (i.e. vegetation clearing, haul trucks traffic, and light vehicle traffic) would be immediately reported to DME and DLRM. This would trigger a response that reviews reasons why the incident occurred and how the risk of re-occurrence could be minimised. If repeated incidents occur to brush-tailed mulgara, this will trigger an additional review in liaison with relevant experts in the field in conjunction with DME and DLRM.

Identification of cats in mining area

If cats are detected during weekly site inspections of camp area and landfill site, this will trigger a control program using baits within the landfill compound that does not provide access to native species.

4.2.11 Reporting and record keeping

Pre clearance inspections

The pre-clearance Inspections will provide a summary report on the presence of brush tailed mulgara in habitat to be cleared. These records will be reviewed prior to clearing by the environment manager.

Vegetation clearing

The vegetation clearing will be documented in the ABM Land Clearing Procedure. These records will be reviewed after clearing by the Environmental Manager.

Sand plot reporting and record keeping

The sand plot monitoring program will include a database update after each monitoring event (approximately 6-monthly) and will also include an annual summary report that discusses and analyses results from the program, which will include a section on the brush-tailed mulgara.

Vegetation condition reporting and record keeping

The vegetation condition monitoring program will include a database update after each monitoring event (approximately 6-monthly) and will also include an annual summary report that discusses and analyses results from the program. Assessment results from this program will be used to determine if brush-tailed mulgara habitat quality is degrading as a result of mining operations.

Incident reporting and response strategy

An incident/hazard/near miss reporting policy and an incident/hazard/near miss reporting procedure will ensure the reporting of all incidents, hazards, and near misses. Upon notification, the environmental manager will investigate the event and coordinate the implementation of corrective or preventative action. The environmental manager is also responsible for reporting of significant incidents (i.e. brush-tailed mulgara road kill) to DME and/or DOE and for ensuring that corrective action is taken to prevent recurrence. ABM will ensure that this procedure for incident reporting is being complied with and that the procedure allows for the timely reporting, investigation, and mitigation of incidents, hazards and near misses.

4.2.12 Roles and responsibilities

Position	Responsibility
Site general manager	Ensure that this management plan is implemented. Provide access to training for operations manager.
Environment Manager	Ensure that this management plan is implemented. Ensure ongoing compliance with management plan.
Employees and contractors	Adherence to and implementation of management plan.
Ecologist (consultant)	Conduct Pre-clearance surveys

4.3 Water Birds / Migratory Birds Management Plan

This section identifies hazards that the mining operation may introduce to the project area and how they may impact migratory species (and other water birds) that may visit the site in preferred seasons.

Typical natural habitat features in the Tanami Desert that may attract water birds and migratory birds are salt lakes and palaeochannels. After heavy rainfall these features provide plentiful food supplies of aquatic macro-invertebrates and suitable water qualities. Tailings dams and other man made water holding structures, such as sewage ponds, are also well known to attract a diversity of bird life, including migratory species.

The proposed mining operation may lead to adverse impact on migratory species visiting the site. These hazards and impacts are listed below and described in the following sections.

4.3.1 Scope

This plan guides and informs the management of mining operations within MLA29822 so as to minimise the impacts on water birds and migratory birds at Twin Bonanza.

This plan provides:

- background information on water birds and migratory birds in the Tanami bioregion, including key threats and management priorities
- description of water birds/ migratory birds at Twin Bonanza
- how the mining development may impact on water bird or migratory species
- objectives, performance indicators, management actions, monitoring, reporting, and corrective actions.

At the present time there is no national or state recognised plan for the conservation of the water birds in the Tanami Desert.

4.3.2 Background information on water/migratory birds

Seventy-two species of water birds and migratory birds are known to visit the Tanami Desert after periods of high rainfall (Reid et al 2006). Six migratory species are predicted to occur within the vicinity of the project area according to the EPBC matter search tool. These species are:

- fork-tailed swift (*Apus pacificus*)
- great egret (*Ardea alba*)
- cattle egret (*Ardea ibis*)
- oriental plover (*Charadrius veredus*)
- rainbow bee-eater (*Merops ornatus*)
- painted snipe (*Rostratula benghalensis*)

Other mines in the area that have these facilities have a history of migratory species attraction, therefore it is likely that migratory species will visit similar facilities built at Twin Bonanza.

The majority of the ore to be processed on site is via a gravity circuit with minimal/no chemical input. These tailings will report to tailings cells 2A and 2B. On a daily basis approximately one to two tonnes of tailings concentrate are to be intensely cyanide leached through an Acacia Reactor. Prior to discharging the leached concentrates to a dedicated Concentrate Residual Dam the material will have the cyanide removed. In 1996 several Northern Territory gold mining operations and the Northern Territory Department of Mines and Energy initiated a study to “identify the impacts on wildlife caused by toxic tailings” (Bird Usage of Tailings

Storage Facilities Coordinating Group, 1998). Birds that use tailing storage facilities and other impounded water bodies at mine sites are predominantly non-passerines. The study found that 90% of all bird mortalities on mining leases belong to the following families:

- *Accipitridae* (kites)
- *Anatidae* (ducks)
- *Charadriidae* and *Recurvirostridae* (waders)
- *Glareolidae (pratincoles)*
- *Laridae* (terns)

4.3.3 Water/migratory birds at Twin Bonanza

Of the 58 bird species recorded at Twin Bonanza one species can be considered as a water bird:

- grey teal (*Anas gracilis*) – which was attracted to surface water at Wilsons Camp.

Natural habitat features important for migratory species were not identified during surveys; therefore the proposed mining will not have an impact on an existing migratory population. However, the proposal does include establishment of tailings and sewerage dams that have potential to attract migratory species on route to destinations in Southern Australian and Northern Hemispheres. These types of facilities have the potential to contain water qualities that can be detrimental to birds if consumed, and as these facilities often contain "permanent" water, they may end up being "constant" sites that are visited by a variety of water bird species.

4.3.4 Hazards and potential impacts

Mining activities/hazards at Twin Bonanza have the potential to adversely impact water/migratory bird species that may visit the tailings and sewage facilities once constructed and contain water. The main impact of concern is bird mortality or sickness due to consumption of poor quality water from tailings facility.

4.3.5 Relevant legislation and standards

Legislation

- *Environment Protection and Biodiversity Conservation Act* (Cth)
- *Territory Parks and Wildlife Conservation Act 2006* (NT)
- *Water Act 1992* (NT)
- *Waste Management and Pollution Control Act 1998* (NT)

International Treaties

- The China–Australia Migratory Bird Agreement (CAMBA)
- Japan–Australia Migratory Bird Agreement (JAMBA)
- Bonn Convention (Conservation of Migratory Species)

Standards and plans

- The Australian Water Quality Guidelines for Fresh and Marine Waters (ANZECC 2000) nominates criteria for a range of environmental values. The environmental values include:
    - Protection of aquatic ecosystems- Protection of wildlife

Guidelines

- *Best Practice Environmental management in Mining: Cyanide Management* (Environment Australia 1998)

4.3.6 Objectives

- To maintain water quality levels at sewerage pond to prevent bird mortality/sickness

- To minimise birds from aggregating at tailings dam and sewage pond

4.3.7 Performance Indicators

- No bird mortalities

4.3.8 Management Actions

Design of tailings storage facilities

Birds most susceptible to mortality are those attracted to supernatant on tailings storage facilities. The removal or reduction of supernatant and slurry will reduce visitation by these species and their exposure to poorer quality water. Active decanting of supernatant to screened or netted ponds will significantly reduce supernatant size and deny bird access (DME 1998). During operations, active recovery of supernatant water will occur from the tailings dam and high levels of evaporation from the concentrate residual dam will minimise available water on the dam surfaces and reduce water extraction from the bores. On a daily basis around two tonnes of material will be deposited in the concentrate residual dam; as such limited water will be available to form a pond.

Tailings cells will be designed to be as small as practicably possible. Large tailing cells are likely to attract large aggregations of birds and allow birds to find safe roosting spots on large expanses of supernatant. In designing the tailings dam, the size of the tailings surface was minimised as far as practicable to reduce the volume of rehabilitation capping material required but also to control tailings spigotting to better manage the water supernatant pond.

Based on the operation requirements, the design of tailings dam and concentrate residual dam has included the following measures (as detailed in DME 1998) to manage water birds:

- Construction of the tailings dam will not create an uneven floor thus forming islands for migratory and water bird roosting.
- During operations supernatant water resting against dam walls will be minimised to prevent additional habitat for waders and drinking access for granivorous birds.
- Where practical, removal of nearby vegetation will occur to restrict roosting options for birds.
- The concentrate residual dam has been located close to mining infrastructure to discourage bird presence.

Metallurgical test work

Only a small volume of tailings material will be processed using cyanide. The Acacia Reactor used to process these tailings will have a cyanide removal and neutralisation module that ensures no cyanide is discharged. Tailings characterisation of the gravity separated tailings which is the bulk of tailings has highlighted that it is unlikely to generate acid mine drainage, with water leachates characterised by elevated levels of arsenic with the majority of samples being below the Australian Water Quality Guidelines for Fresh and Marine Waters. Discharge and supernatant water will be monitored monthly to detect the potential loading of arsenic and other elements.

Other management strategies

If significant mortalities are being experienced, the use of gas cannons or other alternatives will be investigated. If mortalities do occur carcasses will be removed as soon as possible so as not to attract raptors or other carnivores (DME 1998).

4.3.9 Monitoring

Bird monitoring at tailings facility and sewerage dam

As part of regular monitoring of the tailings dams and sewerage dam, the presence of water bird/migratory species and evidence of illness or fatalities will be recorded.

An identification guide will be made available that describes common susceptible species of birds likely to occur at the tailings dam and sewerage treatment facilities. Personnel, who patrol the facilities as part of their normal duties, ideally first thing in the morning, will be made aware of the identification guide. Personnel will report mortalities and visitations during their regular patrols. All mine staff will be encouraged to report incidental sightings of water birds and migratory birds.

Analysis of supernatant water

Supernatant water will be sampled and analysed for arsenic and a number of elements on a monthly basis.

4.3.10 Environmental triggers and corrective actions

- If large bird aggregations are occurring at tailings dams then bird deterrent activities, such as use of bird scarers, can be introduced.

- If bird mortality/sickness is more than one a day, the incidents will be investigated and suitable measures implemented based on consultation with experts in the field and relevant regulators.

4.3.11 Reporting

Bird monitoring data

Information of bird mortalities will be saved in a document filing system. Data will also be entered into a custom made database for long term data accessibility and analysis.

Incident reporting

If a number of bird mortalities occur at the dams an incident report under section 29 of the *Mining Management Act* may require submission based on a review of the reporting criteria. All other bird sightings and recordings will be submitted within the MMP. An annual review of the impacts to migratory and water birds and the relative success of management strategies will be undertaken. This will help to improve avian management around site.

Water analysis reporting

Analysis results from water sampling activities will be stored on a database and examined to detect possible trends and patterns.

4.3.12 Roles and responsibilities

Position	Responsibility
Site general manager	Ensure that this management plan is implemented. Provide access to training for operations manager.
Environment manager	Ensure that this management plan is implemented. Ensure ongoing compliance with management plan.
Employees and contractors	Adherence to and implementation of management plan

4.4 Palaeochannel Management Plan

Palaeochannels are known for their importance in supporting a diversity of native species (including threatened species) and providing general refugia during dry periods. ABM proposes to construct water supply bores (and associated infrastructure) within a palaeochannel for the purpose of supplying water for mining operations (i.e. process water, dust mitigation etc.).

ABM have proposed a number of management and monitoring measures to avoid impact to the local palaeochannel environment.

4.4.1 Scope

This plan guides and informs the management of mining operations within MLA29822 so as to minimise the impacts on the palaeochannel environment located at Twin Bonanza.

This plan is an initial step in developing a management approach based on the limited knowledge of groundwater influence on surface vegetation, namely deep rooted trees such as *Eucalyptus vitrix, E. brevifolia, Corymbia opaca,* and *Acacia sericophylla*.

This plan provides:

- background information on palaeochannels in the Tanami bioregion, including key threats and management prioritie
- description of palaeochannels at Twin Bonanza
- potential impacts on palaeochannels from the mining development
- objectives, performance indicators, management actions, monitoring, reporting, and corrective actions.

4.4.2 Background information on palaeochannels

Palaeochannels (or palaeodrainage systems) are characterised by being the surface expressions of ancient river systems. There are two distinctive types. Type 1 is the saline system associated with salt lakes, and soils affected by various salts including sodium chloride and gypsum and others. Type 2 is the drainage depressions where the salinity has been masked by overlying sediments such as aeolian or alluvial sands. Vegetation and habitat surveys of the palaeochannels within the Twin Bonanza project area fit the description of Type 2 palaeochannel system.

The first type (Type 1), described by Lundie-Jenkins (1989) as *caliche* areas, are characterised by a distinctive vegetation of shrubs (mostly *Melaleuca* tea tree) and several grasses including *Triodia pungens* and *Plectrachne schinzii*. The physical features are low sandy rises in linear dune formations, juxtaposed with flat playas (sometimes known or identified as salt lakes) with vegetation very different from the dunes. The soils are often highly gypseous and may contain a large clay fraction. These areas are considered nutrient rich by comparison with the sandy areas of the desert. There are often large termite mounds (>2 m) in these areas.

The other type (Type 2) is characterised by buried valleys covered with deeper sands in usually more elevated situations (if only slightly) than the saline areas of Type 1. These are often the courses of ancient watercourses (as are Type 1), and are characterised by vegetation types more similar to the surrounding sandplains. Tall (>10m) trees are commonly found in these systems. They are characterised by narrow to broad drainage depressions of usually diffuse drainage with sandy red-brown earths. The soils are richer and better watered than the surrounding adjacent country, and there may be higher clay content.

Representative photographs of Type 1 and Type 2 palaeochannel are provided in Figure 4-5. Photo of a flooded palaeochannel south of Rabbit Flat in March 2006 is provided in Figure 4-6. Palaeochannel boundaries are most obvious when in full flood, which is not a common occurrence. One of the last major widespread rainfall events of the Tanami occurred in 2007, which resulted in Type 1 and Type 2 palaeochannels being clearly visible by air (Figure 4-7).

Additionally, palaeochannels hold several cultural values as they typically provide a concentration of food resources, surface water (for short periods after rainfall), shade trees, and orientation features important for travel.

Figure 4-5 Photos of Type 1 and Type 2 palaeochannels near Rabbit Flat.

Figure 4-6 Photos of Type 2 palaeochannels in flood after Feb 2006 rains (south of Rabbit Flat).

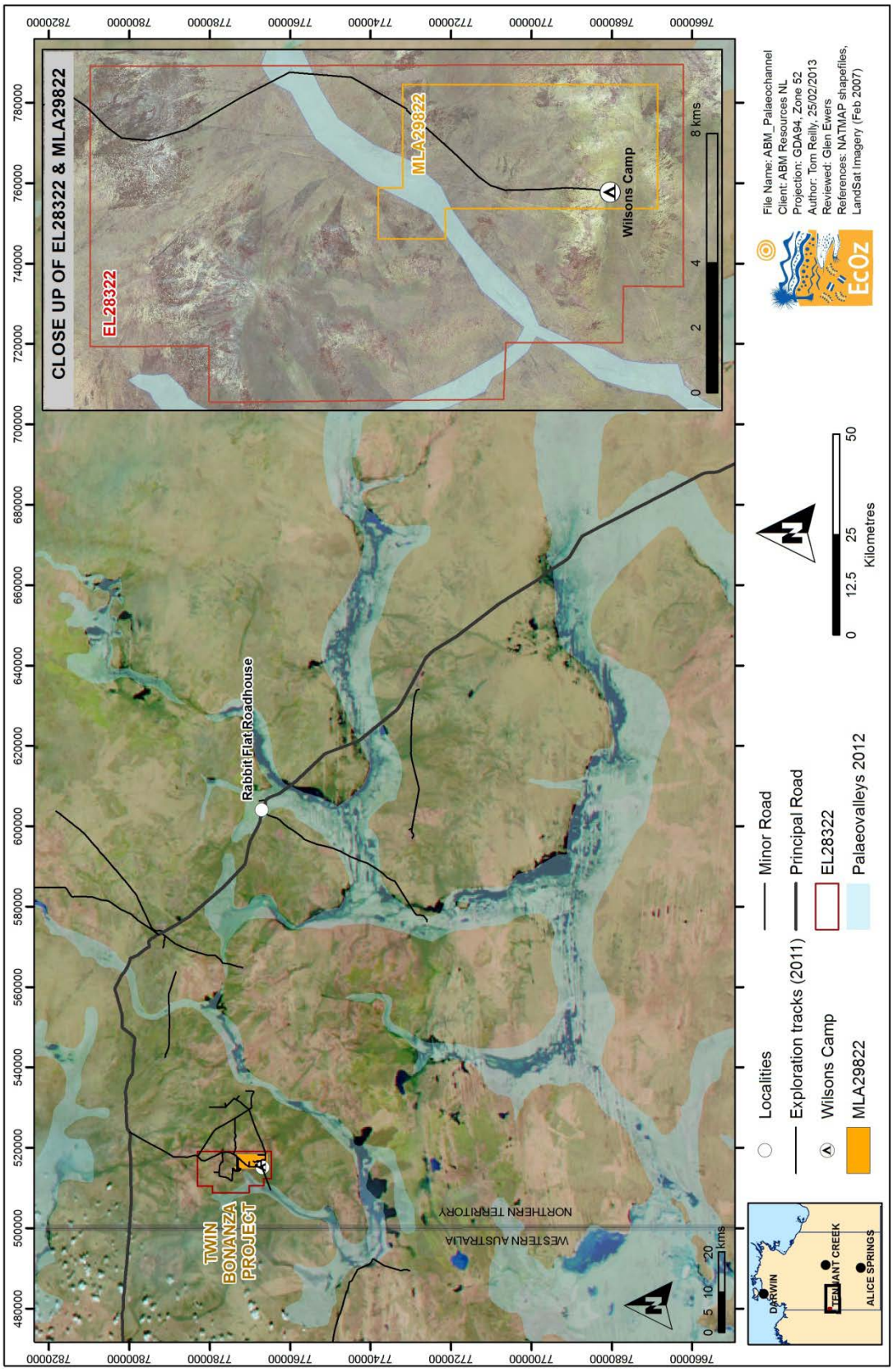


Figure 4-7. Satellite image (Landsat) of palaeochannels in full flood (Feb 2007)

4.4.3 Palaeochannels at Twin Bonanza

Palaeochannels occur within the Twin Bonanza project area and there are plans to construct water supply bores within the palaeochannel to supply water for mining operations (Figure 4-7).

As described above, there are two types of palaeochannels (Type 1 and Type 2). Vegetation and habitat surveys of the palaeochannels within the Twin Bonanza project area fit the description of Type 2 palaeochannel system, as they do not appear to be affected by salinity, or the salinity has been masked by overlying aeolian and/or alluvial sands.

When flood events occur, the palaeochannel at Twin Bonanza flows in a south-westerly direction. The receiving salt lake environment is approximately 50 km from the project area and does not appear to be clearly linked along a distinct channel.

4.4.4 Hazards and potential impacts

Mining activities/hazards at Twin Bonanza have the potential to adversely impact palaeochannels in the area as a result of the following activities:

- Mining activity – groundwater extraction to support operational activities (i.e. processing, dust suppression etc) may lead to:
  - lowering of water availability to deep rooted trees.
- Mining activity – vegetation clearing for water bore pads and access tracks may lead to:
  - unnecessary removal of deep rooted species
  - fragmentation of habitat.
- General habitat modifications (i.e. weeds, fire, noise etc.) may lead to:
  - reduced ecological function of local palaeochannel environment.

4.4.5 Relevantl and standards

Legislation

- *Dangerous Goods Act 1998* (NT)
- *Water Act 1992* (NT)
- *Waste Management and Pollution Control Act 1998* (NT)

Standards and plans

- AS 1940:2004 - Storage and handling of flammable and combustible liquids.
- AS/NZS 5667.11: Water quality—sampling—guidance on sampling of groundwater.
- SAA/SNZ HB76 Dangerous Goods – Initial Emergency Response Guide.

Guidelines

- Minimum Construction Requirements for Water Bores in Australia, Edition 3
- Construction and Rehabilitation of Exploration Drill Sites (DME 2011)
- Ground Water Sampling Methodology (DME 2009)

4.4.6 Objectives

- To prevent adverse impact on the palaeochannel environment.

4.4.7 Performance indicators

- Demonstrate that the rate of tree mortality is comparable to the surrounding environment.

4.4.8 Management actions

Drilling

Construct and decommission all production and monitoring bores in accordance to the document titled "Minimum Construction Requirements for Water Bores in Australia, Edition 3". If deeper aquifers are targeted then management measures will ensure cross aquifer contamination does not occur (i.e. sealing of the aquifer by concreting).

Water extraction

Comply with all requirements of the DLRM and Department of Health (DOH).

Hydrocarbons

Hazardous materials and wastes will be stored within appropriately labelled containers within bunded dangerous goods storage areas. The areas will be self-bunded, ventilated and compliant with *AS1940:2004 Storage and Handling of Flammable and Combustible Liquids*. Fuel sources for diesel gensets and any small quantities of hydrocarbons will be stored in bunded areas onsite. Spill trays will be used when re-fueling.

4.4.9 Monitoring and inspections

Palaeochannel monitoring program

The palaeochannel monitoring program is to provide possible warning signs that water extraction operations are having an adverse impact on deep rooted trees within the palaeochannel environment. A management response will be triggered if an impact is detected.

There are two components to this monitoring program to determine impacts on palaeochannel vegetation from groundwater extraction activities, these include:

1) Visual tree health assessment, which aims to determine a health score for each tree based on visual parameters.
2) Monitoring of standing water level, which measures standing water levels from purpose built monitoring bores.

Currently, extraction bores are planned to be located within the palaeochannel at Twin Bonanza, and therefore monitoring will be focused at that location. A control site will also be selected within the same palaeochannel, but will be located at least 500 m from extraction bore to be outside of the possible zone of impact. The control site will replicate the water bore site in terms of site layout and methodology.

Three visual tree health transects are proposed to monitor possible impacts from the water extraction activities. Each transect will measure approximately 200 m, with the start point at the bore and end point 200 m from the bore. Tree's will be selected along each transect and will be permanent monitoring sites for this program. On-ground tree selection has not yet occurred, but it is anticipated that 10 trees will be selected for each transect. Methods for estimating visual tree health are described below.

In order to improve results interpretation, ABM proposed to measure standing water level from monitoring bores to determine the "actual" zone of drawdown (i.e. cone of depression) from the point source. Two bores will be installed along one visual tree health transect. Methods for measuring standing water levels are described in Appendix C.

Methods selected for the visual tree health assessment are based on tree crown condition techniques developed for determining harvest viability in silviculture industry (Grimes 1978; Stone et al 2003a; Stone et al. 2003b) and are summarised in Appendix C.

Water analysis

Sampling of ground water for typical suite of parameters (including EC, salinity, TDS etc) will be undertaken every six months.

Site inspections

Fuel and chemical storage locations will be inspected every 3 months to check spill containment structures are in working condition and compliant with Australian Standards.

4.4.10 Environmental triggers and corrective actions

Reduction in tree health

If monitoring provides conclusive evidence that ground water extraction is impacting tree health, water extraction activities will be moved to alternative groundwater sources to allow water levels to recharge.

Issues with hydrocarbon storage and procedure

Repair/upgrade storage practices/infrastructure as required.

4.4.11 Reporting

Palaeochannel monitoring program

The palaeochannel monitoring program will include a database update after each monitoring event (6-monthly) and will also include an annual summary report that discusses and analyses results from the program. Annual summary of results will be included in annual MMP revisions.

Incident reporting and response strategy

The main incidents that may impact the palaeochannel environment include hydrocarbon spill from the water bore generator and leaking/spillage of bore water (which may be moderately saline). See Section 2.3.3 for incident reporting procedures.

4.4.12 Roles and responsibilities

Position	Responsibility
Site General manager	Ensure that this management plan is implemented. Provide access to training for operations manager.
Environment manager	Ensure that this management plan is implemented. Ensure ongoing compliance with management plan.
Employees and contractors	Adherence to and implementation of management plan.
Ecologist (consultant)	Conduct monitoring of tree health.

4.5 Pest Management Plan

The Pest Management Plan identifies parts of the mining operation that may introduce new pest species, and/or benefit local pest species to the project area.

4.5.1 Scope

This plan guides and informs the management of mining operations within MLA29822 so as to minimise the impacts of pest species at Twin Bonanza.

This plan provides:

- background information on pest species in the Tanami Bioregion, including key threats and management priorities
- description of pest species at Twin Bonanza
- potential ways for introduction of new pest species, or benefits to existing pest species at the site from the mining development
- objectives, performance indicators, management actions, monitoring, reporting, and corrective actions.

4.5.2 Background information on pest species

A large range of introduced species have been previously recorded from this bioregion (Baker et al. 2005) (Table 4-2).

Table 4-2. NT Pest species records for the Tanami bioregion

Introduced fauna	Regional Status	Recorded impacts
Feral cat *Felis catus*	Widespread	Known to prey on many species on native animals (Denny 2007). Key threatening process under the *EPBC Act*.
One-humped camel *Camelus dromedaries*	Widespread	Known to cause an impact to native vegetation (Dorges & Heucke 2007).
House mouse *Mus musculus*	Widespread	Vector for some diseases (Singleton 2007) but there does not appear to be any documented threats to biodiversity from this species
Dog *Canis lupus*	Widespread	Known to prey on many native species (Corbett 2007)
European red fox *Vulpes vulpes*	Present	Known to prey upon a range of native species (Catling & Coman 2007). Key threatening process under the *EPBC Act*.

Feral cat

Ecology and distribution

Feral cats occur throughout the Australian mainland in a variety of different habitats including deserts, forests and grasslands. Total population estimates vary; however, a figure of 18 million was cited in the Threat Abatement Plan (DEWHA 2008). Feral cats are predominantly solitary and nocturnal. They are carnivorous and can survive with limited access to water, relying upon moisture from their prey. Each feral cat is estimated to kill between 5-30 native wildlife per day (AWC 2012).

Impacts

Cats play a significant role in the decline of native fauna and have been recognised as contributing to the decline of several ground-nesting birds and small to medium-sized mammals in the arid zone, including the greater bilby. As a consequence 'predation by feral cats' is listed as a key threatening process under the *EPBC Act* and the Threat Abatement Plan for predation by feral cats (DEWHA 2008) has been developed.

Control methods

Feral cat populations are difficult to control. The only successful eradication programs in Australia have been carried out on islands or within mainland areas enclosed by feral-proof fences (AWC 2012). The Feral Cat Abatement Plan states that 'although total mainland eradication may be the ideal goal (Threat Abatement Plan), it is not feasible with current resources and techniques' (DEWHA 2008). Techniques that have proved successful on islands and mainland enclosures, such as baiting, trapping and shooting, are less effective at a landscape scale. Cats are extremely wary and difficult to locate, making trapping and shooting resource-intensive and impractical. The removal of cats from a local area is likely to be offset by immigration from adjacent areas (AWC 2012).

The Threat Abatement Plan identifies a major obstacle to the control of feral cats as the lack of a suitable bait-toxin that is attractive to cats. Part of the difficulties lies in developing a bait that is palatable to cats and unattractive or inaccessible to non-target species such as goannas and birds (DEWHA 2008).

Evidence suggests that dingoes (*Canis lupus dingo*) may restrict feral cat numbers by both direct predation and competition. The presence of dingoes within an area is likely to supress the density of feral cats. The maintenance of a stable dingo population may play a significant role in limiting the impact of feral cats on native animals such as the greater bilby (AWC 2012). The presence of greater bilby within the project area may owe to the presence of a healthy population of dingo.

Dingo

Ecology and distribution

The dingo originated in southern Asia and arrived in Australia approximately 4000 years ago. At the time of European settlement dingoes occurred throughout the mainland, though numbers were thought to have been low. Domestic dogs arrived with European settlers and hybridization between the two sub-species has led to a smaller proportion of pure dingoes in Australia (Major 2009). Today dingos and their hybrids occur throughout most of the Australian mainland, with small areas of absence in southern Australia.

Dingos are opportunistic hunters, eating almost anything they can overcome and kill. They prey on native species such as kangaroos, bandicoots and wombats as well as introduced species such as rabbit, sheep, goats and pigs. Animals can hunt alone as well as cooperatively in packs to bring down larger animals. Dingoes usually concentrate on the most abundant prey available before switching to the next most common prey as their previous prey declines (Greer 2009). They are efficient scavengers, feeding on carrion and human waste when prey numbers are low, and also eat fruit and flowers. Such a flexible diet serves the species well in the variable Australian climate (Greer 2009).

Dingos breed once per year, usually during April to June (DEEDI 2010). A typical litter is 4-6 pups, which remain dependant on the adults for 6-8 months. In packs a dominant breeding female will kill the offspring of other females (National Geographic 2013). Home ranges vary according to the productivity of the country, from 300 km^2 in the Nullarbor Plain to 9 km^2 in rainforest areas (DEEDI 2010).

Impacts

Recent evidence indicates that dingos perform an important ecological function in maintaining species diversity in some ecosystems (Major 2009). Following the extinction of the Thylacine (*Thylacinus cynocephalus*), dingoes have become the top mammal predator of the Australian landscape. As apex predators they regulate the numbers of smaller predators and generalist herbivores, thus alleviating the pressure that these groups exert on their own prey and competitors and on the vegetation (Greer 2009). Some research has indicated that they protect native species numbers by controlling densities of foxes, cats and goats (Major 2009).

The extent to which feral dogs and hybrids have replaced dingo's as apex predators is uncertain (Major 2009). Predation by wild dogs can impact on remnant populations of threatened species, with endangered species with small populations being particularly vulnerable. The dingo has long been regarded as a serious predator of domestic stock and wild dogs impact farming communities in a similar manner (DPI Victoria, 2013a).

Dingoes and wild dogs may pose a threat to threatened species. Control methods for dingoes and feral dogs vary from baiting trapping, shooting and exclusion fencing. Care must be taken in regards to baiting and trapping as potential exists for harm to non-target native species (DPI Victoria 2013a).

House mouse

Ecology and distribution

In Australia the house mouse can be found wherever people occur as well as several areas where they do not. The house mouse is widespread in the Northern Territory (LRM 2012).

House mice breed throughout the year, though there is a pronounced burst of breeding activity in spring-early summer. Mice generally do not breed in winter. House mice litters vary between 4 and 8 offspring, though larger litters have been recorded. Sexual maturity is reached at about eight weeks of age (DPI Victoria 2010).

Mouse plagues occur where quality food and water is readily available, environmental temperatures are not extreme, nesting conditions are favourable (moist soil) and predation levels are low (DPI Victoria 2011). In Australia such plagues are limited to the southern and eastern grain belts of Australia (CSIRO 2003).

Impacts

The house mouse is not considered to be a great threat to biodiversity. There have been some concerns about their impact to native vegetation due to seed predation and in some areas they are known to prey on small birds (LRM 2012).

House mice can be of nuisance in urban areas because they spoil food and food packaging, carry and spread diseases, and chew insulation, electrical wiring, vehicle parts and all manner of infrastructure (DPI Victoria 2010). It is likely that this will be the main issue concerning house mice at Twin Bonanza.

One-humped camel

Ecology and distribution

The estimated population of camels in Australia is approximately one million at an overall density of 0.29/km^2 (Edwards et al 2008). Camels are capable of using almost all available habitat types within the arid and semi-arid areas of Australia (SEWPAC 2010). They have the ability to move over areas of thousands to tens of thousands of square kilometres. Edwards et al (2001) found that camels in the northern Tanami Desert use an area of approximately 450 km^2.

Camels use almost all food sources available to them within their habitat; however, the majority of their food intake is limited to a small suite of species. The conservation status of three plant species, *Erythrina vespertilio*, *Acacia sessiliceps*, and *Santalum acuminatum*, have been identified as being impacted by camel browsing (Dörges and Heucke 2003). All of which have not been recorded in the Tanami bioregion (according to DLRM records held in the N.T. Atlas).

Impacts

Negative environmental impacts from feral camels include damage to vegetation through foraging behaviour and trampling, suppression of recruitment of some plant species, and competition with native animals for food and shelter (Edwards et al 2008). The increase in one-humped camel numbers in western NT is also a potential threat to populations of the greater bilby. The large size of camels (up to 1000 kg) combined with their preference for dune systems and their tendency to consume a large portion of available plant species suggest that the species poses a significant threat to greater bilby habitat (Pavey 2006a).

Camels are also known to negatively impact on wetlands through fouling, trampling and sedimentation. They not only damage the ecology and hydrology of wetlands but remove free-standing water and even impair the ability of some wetland types to hold water (Edwards et al 2008).

European red fox

Ecology and distribution

The fox was introduced into southern Australia in 1855 and has since spread across much of the mainland, following the spread of its favourite prey, the rabbit (SEWPaC 2010; DPI Victoria 2012). Foxes are absent from the tropical climates of northern Australia with heat and humidity being a limiting factor for the species (DPI Victoria 2012).

The European red fox is a primarily nocturnal hunter, being most active in the evenings and early mornings. During the day the fox sleeps in dens, logs and other shelter. The fox eats almost anything, preying and scavenging on all available food resources. Its main food source is small animals weighing between 35-500g, including mammals, reptiles and ground nesting birds (DPI Victoria 2013a).

Fox territories range from 2 to 5 km^2 depending on habitat type and availability of food. Individuals usually move within their own territory but may travel up to 25 km when food is scarce. Male and female foxes are sexually mature at one year and produce an average litter of four cubs. The breeding season is August to September (DPI Victoria 2012).

Impacts

The European red fox is of significant conservation threat to Australian Wildlife (Parks and Wildlife Commission 2012). Predation by the European red fox is listed as a key threatening process under the Commonwealth *EPBC Act 1999*. The species is understood to be a threat to many species of native wildlife including black-footed rock-wallabies (*Petrogale lateralis*), brush-tailed bettong (*Bettongia penicillata*), numbats (*Myrmecobius fasciatus*), tammar wallabies (*Macropus eugenii*) and malleefowl (*Leipoa ocellata*) to

name a few. In the Northern Territory, one of the two last known wild populations of the rufous hare-wallaby (*Lagorchestes hirsutus*) was exterminated by a single fox (Parks and Wildlife Commission 2012). Remaining wild populations of the bilby (*Macrotis lagotis*) may be at risk of extinction if fox numbers in Northern Australia continue to rise (Parks and Wildlife Commission 2012).

European red fox may pose a threat to conservation of significant fauna in the ABM project area. Control methods for foxes include baiting, shooting, trapping, den fumigation or destruction, and exclusion fencing. Apart from broad scale baiting, the methods are expensive, labour intensive, long term and of limited effectiveness. Individual identification of foxes by scat genotyping has potential for monitoring abundance before and after control programs (DEWHA 2008).

4.5.3 Pest species at Twin Bonanza

Pest species that are known or are likely to occur at Twin Bonanza include feral cats, dingo, house mouse, one-humped camel, and European red fox.

- Feral cats were recorded at Twin Bonanza during fauna surveys. Population numbers did not appear to be high, however it is likely that cats avoided surveyors during nocturnal activity.
- Dingo was recorded at the Old Pirate prospect during the most recent survey, and was recorded in the project area during the two previous surveys.
- House mouse was recorded at Wilsons Camp during the October 2012 survey, but was not recorded during the most recent survey or April 2012 surveys. None were trapped or observed away from the camp site.
- Feral camels were not observed in the project area; however, fresh camel tracks were recorded in the Old Pirate and Buccaneer prospects.
- European red fox was not observed in the project area. The species was not recorded during the two previous fauna surveys in the project area. The species distribution may still be expanding northwards, having reached the Tanami Desert in the 1970's and becoming relatively common as far north as Tennant Creek, there is a possibility that established populations occur in the region of the project. Records of foxes will be immediately reported to the Northern Territory Government (DLRM) as they will likely be the northern most records for this part of the Tanami Desert.

4.5.4 Hazards and potential impacts

Mining activities/hazards at Twin Bonanza have the potential to introduce pests and/or increase existing pest populations. The potential impact that these pest species may have on the project area include

- Hazard - increased predation pressure on threatened species.

  The project area supports threatened mammals (greater bilby and brush-tailed mulgara) that are prone to predation by pest species, such as feral cats and dingo. Therefore it is essential that mining operations do not promote pest establishment at the site.

- Hazard - Attraction of large herbivores.

  It is possible that water sources created by mining operations may attract camels to the site which could lead to degradation of the surrounding vegetation (i.e. grazing pressure and trampling).

- Hazard - nuisance species (and possibly human hygiene) at site accommodation.

  House mice are prone to boom in desert environments when there is ample food, water, and shelter. This species is unlikely to result in an environmental impact; however they can cause issues in kitchens and living areas.

4.5.5 Relevant legislation and standards

- *Environment Protection and Biodiversity Act 1999* (Cth)
- *Territory Parks and Wildlife Conservation Act 2006* (NT)
- A management program for Greater Bilby (*Macrotis lagotis*) in the NT (PWCNT 1998)
- National Recovery Plan for the Greater Bilby *Macrotis lagotis* (Pavey 2006)

4.5.6 Objectives

- To prevent the introduction of new pest species to the site.
- To prevent species from increasing in numbers due to mine works.

4.5.7 Performance indicators

- No new pest species introduced to the site.
- No increase in the existing populations of known pest species.

4.5.8 Management actions

The primary approach to predator management at Twin Bonanza will be to ensure that populations are not increased or introduced as a result of mining operations. This will incorporate management decisions in relation to land fill design, water source minimisation, and camp design (i.e. they may live and/or shelter under dongas during the day). Specific measures include:

- Site cleanliness will be maintained at a high level to avoid attracting introduced fauna species by making sure rubbish around the camp; mining and processing area is managed.
- Waste from covered bins will be collected regularly and transfered to landfill.
- Fences are to be erected around landfill.
- Pests will be baited and/or trapped.
- Putrescible wastes will be burned.
- As far as practicable the effects and availability of man-made water sources on terrestrial fauna will be reduced (namely one-humped camels, dingoes, cats).
- Machinery and equipment arriving at site will be inspected for signs of stowaway pests.
- Trapping and/or hunting will be implemented across the project area for feral predators that have the potential to adversely affect threatened species (namely greater bilby and brush-tailed mulgara which are known to persist at Twin Bonanza).

Additional to the general pest management listed above, the follow management actions will be implemented for feral cat occurrences at Twin Bonanza:

- Localised trapping and shooting program will be conducted around potential attraction sources.

- Professional hunters or Traditional Owners will undertake periodic culling.
- The landfill will be fenced to exclude native species including dingoes,
- If feral cats are seen to be accessing the landfill, baiting and trapping within the landfill compound will be undertaken.

A suitable trapping device for feral cats is leg hold traps, specifically Victor No. 1 (or No. 1.5) Soft-Catch leg-hold traps (Forsyth et al. 2005). Due to the occurrence of native marsupials, these traps are preferable as they are designed to only hold the animals without causing injury to any non-targeted species, such as greater bilbies.

Baiting for pest species outside of the landfill area is not proposed at Twin Bonanza, as this may result in accidental deaths of native fauna and also it is potentially harmful to humans.

4.5.9 Monitoring and inspections

Sand plot monitoring program

Sand plot monitoring will be used to estimate activity and population of pest fauna within the Twin Bonanza project area. This monitoring program is a rapid site-based method used to identify a selection of relevant parameters (i.e. tracks, scats, and other evidence of pest fauna) within 200 m by 300 m plots over a period of 15 to 20 minutes. Monitoring and associated data analysis is proposed to occur on an approximately 6-monthly basis in order to capture seasonal variation and detect trends at a relatively early stage. The Draft Sand Plot Monitoring Program is provided in Appendix B.

Landfill inspections

The land fill site and camp area will be inspected each week as part of regular site inspections for several parameters, and attraction of pest fauna is one of those parameters. If cats are detected during these inspections, this will trigger a control program using baits within the landfill compound that does not provide access to native species.

Incidental sightings

Any incidental sightings of pest fauna are regarded as important information to ABM pest management strategies. Therefore, staff will be encouraged to report any incidental sightings to the environmental manager for collation into the database located onsite and in central office.

4.5.10 Environmental triggers and corrective actions

Identification of feral cats visiting the landfill

- Implement baiting program within the land fill site.

Increased feral cats observations at the site

- Implement shooting program.

Identification of foxes at the site

- The ABM environment manager will begin discussions with experts in the field and the NT Government about possible control measures.

Increased camel observations at the site

- Investigate reasons why and implement response actions based on results (i.e. block access to man-made water bodies if that is the reason).

4.5.11 Reporting

Sand plot reporting and record keeping

The sand plot monitoring program will include a database update after each monitoring event (approximately 6-monthly) and will also include an annual summary report that discusses and analyses results from the program, which will include a section on pest species.

Pest database

Data collected from site inspections will be entered into a pest database that has been specifically developed for Twin Bonanza. The database will include pest map, pest location data (in a format compatible with MAPINFO), status of infestations (e.g. eradicated, current, or undergoing management), and pest management actions implemented. The database will be updated at least on a 6-monthly basis following pest inspections of the site.

Pest summary report

A pest summary report will be produced for inclusion in the annual MMP reporting. This report will summarise data collected from site inspections and list pest management activities that have occurred or are proposed to occur.

Reporting to DLRM

Any recording of a new pest species will be reported to the DLRM.

4.5.12 Roles and responsibilities

Position	Responsibility
Site general manager	Ensure that this management plan is implemented. Provide access to training for operations manager.
Environment manager	Ensure that this management plan is implemented. Ensure ongoing compliance with management plan.
Employees and contractors	Adherence to and implementation of management plan.
Ecologist (consultant)	Conduct monitoring of feral animal activity.
Indigenous ranger	Undertaking feral animal shooting campaigns

4.6 Weed Management Plan

As part of on-going operations, equipment and freight moves between project areas. If not managed, the introduction and spread of weeds across the project areas can threaten natural ecosystems by out competing native species, changing water quality and changing fire regimes. To prevent these risks and other potential effects of weeds on the environment ABM is committed to:

- preventing the introduction of weeds
- controlling any weed occurrences/infestations that may result from mining activities.

4.6.1 Scope

This plan guides and informs the management of mining operations within MLA29822 so as to minimise the impacts of weed species at Twin Bonanza. The aim of this plan is comply with *Weeds Management Act* 2001 (NT) Mining Management Plan commitments, reduce the risk of weeds and guide the management of weeds at Twin Bonanza.

This plan provides:

- background information on weed species in the Tanami bioregion, including key threats and management priorities
- description of weed species at Twin Bonanza
- potential ways for introduction of new weed species, or benefit existing pest species at the site from the mining development
- objectives, performance indicators, management actions, monitoring, reporting, and corrective actions.

4.6.2 Background information on weed species

NT Atlas records for the Tanami bioregion indicate that 6 declared weed species (Table 4-3) and 46 naturalised weed species occur in the Tanami Bioregion, which includes one Weed of National Significance (WONS). The declared weeds are all listed as "B Class" under the *Northern Territory Weeds Management Act*, which means that growth and spread for these species are to be controlled. Species listed as WONS mean that they have been identified by the Australian government as invasive and have the potential to cause infestations that may lead to environmental, social and economic impacts. Land owners and land managers are responsible for managing WONS, and the governments are responsible for overall legislation and administration. Naturalised weeds are species that have colonised ecosystems in which they did not previously exist, or they are exotic plants introduced into Australia that have formed naturalised populations.

Table 4-3. NT Atlas weed records for the Tanami bioregion

Family	Scientific name	Common name	Listing classification
FABACEAE	*Parkinsonia aculeata*	Parkinsonia	B Class; WONS
FABACEAE	*Senna obtusifolia*	Sicklepod	B Class
LAMIACEAE	*Hyptis suaveolens*	Hyptis	B Class
MALVACEAE	*Sida acuta*	Sida	B Class
POACEAE	*Cenchrus echinatus*	Mossman Grass	B Class

ZYGOPHYLLACEAE	*Tribulus terrestris*	Bindii	B Class

4.6.3 Weeds at Twin Bonanza

No declared weed species were recorded at Twin Bonanza, however, flora surveys identified three buffel grass (*Cenchrus ciliaris*) infestations (Figure 4-8), all related to previous land clearing practices (a legacy issue adopted by ABM).

Buffel grass infestations were identified at following sites:

- Wilsons Camp. Several small buffel grass patches located in disturbed areas across the camp area. Minor amount of purple-topped rhodes grass (*Chloris barbata*). There is no evidence that weeds have spread outside of the camp area at this stage (see Figure 4-9 for point locations).

- Wilsons Bore. Buffel grass infestation surrounding the cleared bore pad. Most probably spread by machinery used to clear the camp area.

- Junction of Tanami Road and Wilson Camp access road. It occurs on each side of the access track, and also on the northern side of Tanami road. It is evident that earthworks associated with the establishment of Wilsons Camp access track are responsible for introduction of buffel grass at this site. We are unsure whether this falls within jurisdiction of ABM land management requirement, but figured it was important to highlight, as this area may be a source of weed issues for the local region.

No weeds were identified along exploration tracks, drill pads, water bores, general roads, airstrip, or other areas within the Twin Bonanza project area. Purple-top rhodes grass is present in low numbers at Wilsons Camp but is not generally regarded as a threat to native biodiversity (therefore has low priority of control).

Buffel grass is responsible for significantly changing the ecological function of landscapes in central Australia (such as changing fire regimes, displacement of native flora, and altering habitat availability for fauna) (CRC 2008). This species also poses a fire threat to camp infrastructure if infestations are not appropriately controlled.

4.6.4 Hazards and potential impacts

Mining activities/hazards at Twin Bonanza have the potential to introduce weeds and/or increase existing pest populations. The potential impact that these pest species may have on the project area include

- Hazard – unmanaged weed establishment during mine construction and operations may lead to:

  - degradation of threatened species habitat
  - altered fire regime (i.e. increase frequencies and intensities.

- Mining activity - vehicle movements during construction and operations may lead to:

  - spread of existing or new weeds to the area.

4.6.5 Legislation and standards

- *Weed Management Act 2001* (NT)

- Revised National Weeds Strategy 1999

4.6.6 Objectives

- To prevent spread of established weeds within project area.

- To prevent introduction of additional weed species to the project area and other areas within the Tanami.
- To manage any weed populations adjacent to major camps.

4.6.7 Performance indicators

- No new weed species introduced to the site.
- No increase in the existing populations of known weed species.

4.6.8 Management actions

Staff education

- Educate staff during inductions of the potential to introduce new weeds.
- Make weed identification information and control handbooks available to all staff and encourage reporting of weed sightings.

Weed hygiene

- Equipment/vehicles are to be washed down prior to entering and moving between sites and if moving from an area of known weed infestation to a weed free area.
- Equipment entering site are inspected and a Weed and Pest Hygiene sheet is completed and filed.
- Equipment/vehicles that are identified as requiring a clean will be cleaned in the designated wash down area and inspected.
- If equipment moves from an area of known weed infestation to another area it is required to be inspected and undergo thorough cleaning if required. If insufficient water available for washing equipment mud and vegetation should be removed by hand using brushes sticks and/or air hoses.
- Check clothing, hats, socks, cuffs and shoes for seeds and burrs after working in a weed infested area. If required remove seeds and burrs.
- Ensure construction material (including sand and gravel) is sourced from a supplier that is weed free or treat material to prevent seed germination.

Avoid existing infestations

- Where possible, machinery and personnel will avoid areas that have existing weed infestations. This will limit the spread of weeds.

Minimise site disturbance

- Soil disturbance must be minimised by only clearing the area required and progressively clearing footprints ahead of operations/activities. By minimising disturbance the opportunity for weed establishment is reduced.

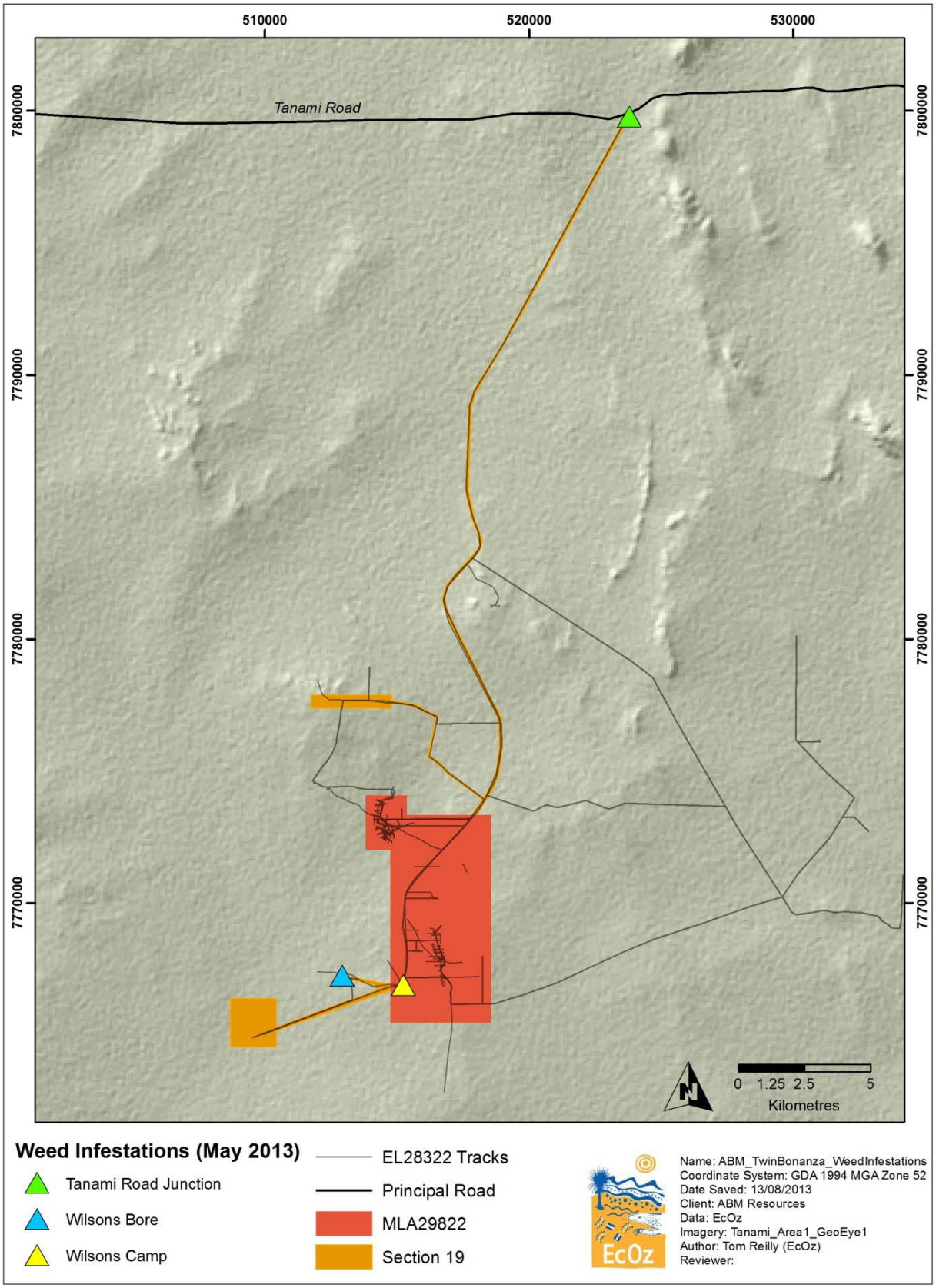
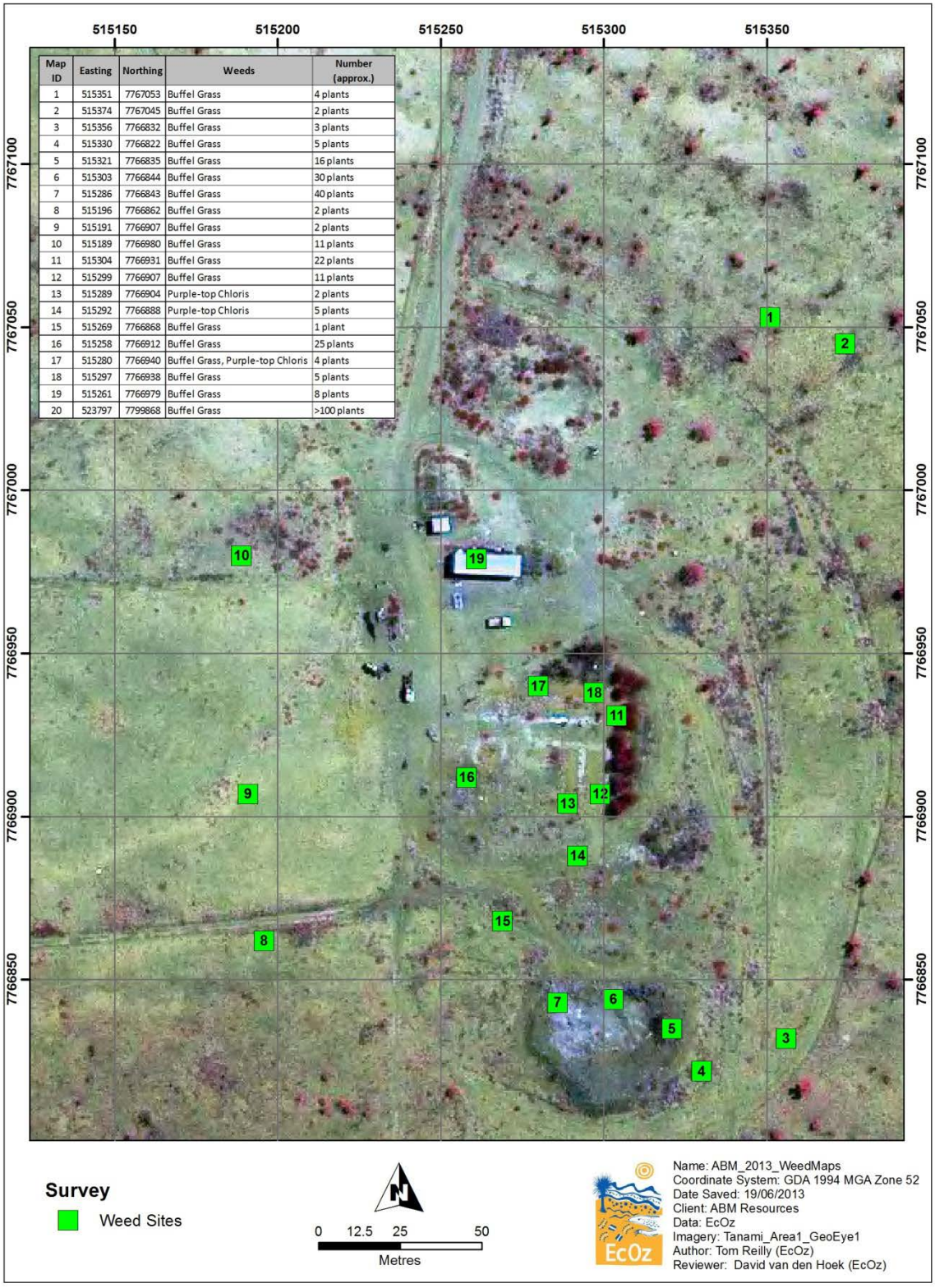


Figure 4-8. Weed infestations in the vicinity of the Twin Bonanza project area.



Map ID	Easting	Northing	Weeds	Number (approx.)
1	515351	7767053	Buffel Grass	4 plants
2	515374	7767045	Buffel Grass	2 plants
3	515356	7766832	Buffel Grass	3 plants
4	515330	7766822	Buffel Grass	5 plants
5	515321	7766835	Buffel Grass	16 plants
6	515303	7766844	Buffel Grass	30 plants
7	515286	7766843	Buffel Grass	40 plants
8	515196	7766862	Buffel Grass	2 plants
9	515191	7766907	Buffel Grass	2 plants
10	515189	7766980	Buffel Grass	11 plants
11	515304	7766931	Buffel Grass	22 plants
12	515299	7766907	Buffel Grass	11 plants
13	515289	7766904	Purple-top Chloris	2 plants
14	515292	7766888	Purple-top Chloris	5 plants
15	515269	7766868	Buffel Grass	1 plant
16	515258	7766912	Buffel Grass	25 plants
17	515280	7766940	Buffel Grass, Purple-top Chloris	4 plants
18	515297	7766938	Buffel Grass	5 plants
19	515261	7766979	Buffel Grass	8 plants
20	523797	7799868	Buffel Grass	>100 plants

Figure 4-9. Weed locations in the vicinity of Wilsons Camp.

4.6.9 Monitoring and inspections

All road sides and disturbed areas will be inspected for weeds on an approximately 6-monthly basis and will ideally be conducted following suitable rainfall events. These inspections will be conducted by environment staff that have been trained in Tanami Desert weed identification. The focus areas of these inspections include:

- designated wash down bays
- areas where earthen materials have been transported from off-site sources (even if they are marked as "free of weeds")
- areas of known weed infestation that are undergoing (or require) weed management will be monitored to detect re-growth distribution
- designated car parks.

4.6.10 Environmental triggers and corrective actions

If weeds are identified at an area that is the result of ABM activities the following steps will be completed.

Define and map

- Define the area of extent of the weed occurrence and associated control program.
- Record the GPS locations (MGA 94) of the weed occurrences, weed name, size of infestation and density (i.e. number of the plants).
- Send data to environmental personnel, or delegate, to record within the weed register.

Planning weed control

Choose the method of treatment, either chemical or mechanical, for each identified weed species. If weeds can be isolated and removed by hand and disposed of this should be done. A number of common weeds can be controlled by Glyphosate (i.e. Roundup Bioactive). For further details on chemical control either consult the *"Northern Territory Weed Management Handbook"* located at www.nt.gov.au/weeds that provides control options for a number of weed species or consult with Weed Management Branch, DLRM.

Chemical control

1. Read the Safe Work Procedure.
2. Use the most appropriate herbicide.
3. Read instructions to ensure appropriate application rates and protective clothing is worn.
4. Apply the chemical during suitable weather conditions (i.e. do not spray during rain)
5. MSDS sheets are kept for chemicals and they are stored and transported in the recommended manner.
6. Ensure only the weeds are sprayed and not surrounding vegetation.
7. If possible, plant material should be removed and placed in a sealed double plastic bag. The plastic bag requires burial or encapsulation.

Mechanical control

1. In cases where plants can be removed by hand, plant material should be placed in a sealed double plastic bag.
2. All plant material placed in a plastic bag needs to be either buried to a depth of at least 0.5 metres or encapsulated deep in a waste rock dump (WRD)
3. If tools (e.g. shovels) are used to remove the weeds check for the presence of seeds and clean if required.

4.6.11 Reporting and record keeping

Weed database

Data collected from site inspections will be entered into a weed database that has been specifically developed for Twin Bonanza. The database will include weed map, weed location data (in a format compatible with MAPINFO), status of infestations (e.g. eradicated, current, or undergoing management), and weed management actions implemented. The database will be updated at least on a 6-monthly basis following weed inspections of the site.

Weed summary report

A weed summary will be produced for inclusion in the annual MMP reporting. This summary will summarise data collected from site inspections and list weed management activities that have occurred or are proposed to occur.

Reporting to DLRM

Any recording of a Declared Weed, Class A, B, C within EL28322 will be reported to the DLRM – Weeds Branch as soon as practicable following recording.

4.6.12 Roles and responsibilities

Position	Responsibility
Site general manager	Ensure that this management plan is implemented. Provide access to training for operations manager.
Environment manager	Ensure that this management plan is implemented. Ensure ongoing compliance with management plan.
Employees and contractors	Adherence to and implementation of management plan. Conduct monitoring of weeds

5 Acronyms

5.1 Acronyms

AWC	Australian Wildlife Conservancy
BMP	Biodiversity Management Plan
DOE	Department of the Environment
DOH	Department of Health
DLRM	Department of Land Resource Management
DME	Department of Mines and Energy
DPI	Department of Planning and Infrastructure (Victoria)
EIS	Environmental Impact Statement
EL	Exploration Lease
EPBC	Environment Protection and Biodiversity Conservation Act
IUCN	International Union for the Conservation of Nature
MLA	Mineral Lease Application
MMP	Mining Management Plan
N.T.	Northern Territory
N.T. EPA	Northern Territory Environment Protection Agency
RMCP	Rehabilitation and Mine Closure Plan
SEWPAC	Department of the Environment, Water, Heritage and the Arts
SOP	Standard Operating Procedure
TPWC	Territory Parks and Wildlife Conservation Act
TD	Tailings Dam
WRD	Waste Rock Dumps
WONS	Weeds of National Significance

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Appendices

Appendix A – Land Clearing Procedure

ABM	**Land Clearing Procedure**	**ABM Twin Bonanza 1 Gold Mine**

Contractor	
Type of Equipment	
Area of Land Disturbed	

Clearing Checklist	**Yes**	**No**
Confirmed extent of clearing area has all required approvals (If approvals not granted clearing should not be undertaken)		
Checked for Aboriginal Heritage sites		
Confirm clearing area and stockpile areas are delineation based on clearly marked out scale maps and/or set of co-ordinates consistent with approvals		
Land to be cleared is demarcated by cones/flagging/pegs (note if large area no more than 50m between markers. If markers not visible from one to the next then markers need to be closer).		
Clearing supervised		
Check for the presence of Bilby or Mulgara (if present avoid habitat if possible. If unable ensure individuals are appropriately managed)		
Check for the presence of Desert Walnut Trees (Avoid if practicable. If unable to avoid provide details of the number of plants removed in the box below)		
Check for the presence of Bloodwood Trees (Avoid if practicable. If unable to avoid provide details of the number of plants removed in the box below)		
Check for the presence of Mature Trees >2m (Avoid if practicable. If unable to avoid provide details of the number of plants removed in the box below)		
Clearing is progressive to avoid the potential for soil erosion and dust generation		
Stockpiling of cleared vegetation within defined areas		
Stockpiling of salvaged topsoil (topsoil removal to a depth of 10cm) within defined areas		
Topsoil stockpiles do not exceed 2 metres in height		
Once clearing is completed a survey/GPS pickup is complete and the shape and coordinates provided in the box below		

Desert Walnut/Bloodwood/Mature trees removed	
Number	Species removed

Post Clearing Survey/GPS Pickup

Land Clearing Supervisor:	
Name	**Position**
Signature	**Date**

Please place signed copy in the Land Clearing Folder located in the Bulk Sample Office.

Appendix B – Sand Plot Monitoring Program (Draft)

6.1 Purpose

Sand plot monitoring will be used to estimate activity and population of threatened and pest species within the Twin Bonanza project area, with the main objective of the monitoring program to determine if threatened species and their habitat is degrading.

6.2 Description

The Sand Plot Monitoring Program is a rapid site-based method used to identify a selection of relevant parameters within 200 m by 300 m plots over a period of 15 to 20 minutes, which is based on methods developed by Colleen O'Malley and Rachel Paltridge (Pavey 2006a). Parameters include:

- Threatened species sign (i.e. tracks, scats, burrows, diggings)
- Feral cats sign (i.e. tracks)
- Dingo sign (i.e. tracks, scats)
- Fire impact and fuel load estimates
- Vegetation condition (i.e. photo point and basic habitat description based on customised field datasheet)

Track counts are widely used in Australia to monitor changes in abundance of native and feral animals. Track counts can be either 'passive 'or 'active', with the latter method using a lure (food) to attract cats to the tracking device (Forsyth et al. 2005). Forsyth et al. (2005) suggests that most efficient method for estimating the relative abundance of feral cats is a passive track count. Track counts have the additional benefit of potentially detecting other species of interest, namely Greater Bilby, Brush-tailed Mulgara, fox and Dingo. Passive track counts will involve adopting the same plots as the Bilby (described above) with additional plots surrounding or adjacent to landfills and water dams. This method is used to monitor temporal and spatial changes in abundance. An underlying assumption is that the number of tracks counted is linearly proportional to the true abundance of animals. Sand plot surveys are more effective at detecting feral cats than spotlight counts (Forsyth et al. 2005).

6.3 Frequency

Monitoring and associated data analysis is proposed to occur on a 6-monthly basis in order to capture seasonal variation and detect trends at a relatively early stage.

6.4 Site Selection

Sites will be selected within and adjacent to mining activity in areas where Greater Bilby has been identified during previous fauna surveys. Additionally, control sites will also be monitored in habitat outside of the determined zone of mining impact. This research will provide valuable information that could inform mitigation strategies for future mining projects, especially considering the current dearth of information on the impacts of mining to Greater Bilby.

6.5 Data collection, analysis and reporting

All signs of fauna, burrowing's/diggings, the age and frequency of the tracks, and also any scats will be recorded.

A datasheet based upon the one provided in Southgate and Moseby (2008) (Figure 1) will enable the data obtained at ABM to be compared against other projects in the desert and rangelands of Australia.

At the completion of each survey all data sheets will be scanned and saved in document filing system. Data will also be entered into a custom made database for long term data accessibility and analysis.

Figure 10. Draft Sand Plot Monitoring Datasheets taken from Southgate and Moseby (2008).

Name

Contact details (Phone and email)

Date Time started Time finished

DATUM Easting Northing Map grid

Location: distance and direction from nearest named place

Distance from freestanding water

Habitat (please circle): Sand dune Sand plain Creek line Other (please specify)

Main long-lived veg. type (if known)

Time since strong wind/rain Time since fire

- Visibility (circle one)

Distinct shadow Slight shadow No shadow

Length of shadow (as a % of your own actual height) = %

Hint: Stand with your back to the sun and look at your own shadow

- How good is the tracking surface? (circle one)

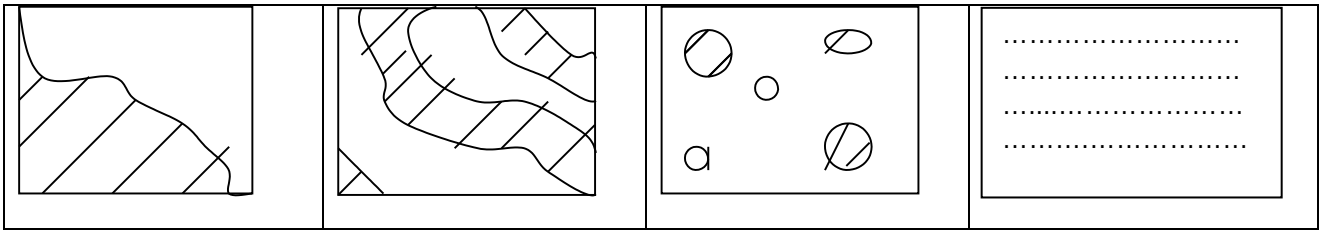
1 - (if present you would be able to distinguish camel, human, dingo, emu, kangaroo tracks only)

2 - (if present you would be able to distinguish all of the above plus fox, cat, rabbit, echidna, large reptiles, goannas etc)

3- (if present you would be able to distinguish all of the above plus hopping mice, rodent, small bird, insect etc)

Hint: only look at the parts of the substrate where you would be able to see tracks.

- What percentage of the quadrat is actually suitable for tracking ? (Areas not suitable include rock, bushes, lichen, green pick etc) %
- What is the continuity of the tracking surface like (circle one below- the hatched area is unsuitable substrate)



1	3	3	4

Species	Tracks	Animal (or skeletal remains)	Burrows/ Diggings	Scats	Abundance of all sign (1,2,3)	Age of most recent sign (1,2,3)	Comments (gait length and width, juvenile sign etc.
NATIVE							
Echidna							
Bilby							
Bandicoot							
Mulgara							
Kangaroo							
Rodent/dasyurid <35g							
Hopping mouse							
Emu							
Bustard							
Corvids							
Other birds							
Dragons							
Large skinks							
Pythons/ large elapids							
Other reptiles							
Dingo							
INTRODUCED							
Fox							
Cat							
Camel							
Cow							
Horse							
Donkey							
Goat/sheep							
Rabbit							
Other							

Abundance

1= sign in all four quarters and super abundant

2= sign in half to ¾ of quarters of quadrat

3= one individual only or sign only found in ¼,

1/4	

Age of sign

1= fresh 1-2 days old

2=older, 3 days to 1 week

3= imprinted in mud or hard substrate, older than 1 week (scats- white and crumbly, no smell)

Appendix C – Palaeochannel Monitoring Program (Draft)

6.6 Purpose

The palaeochannel monitoring program is to provide possible warning signs that water extraction operations are having an adverse impact on deep roots trees within the palaeochannel environment. A management response will be triggered if an impact is detected.

6.7 Description

There are two components to this monitoring program to determine impacts on palaeochannel vegetation from groundwater extraction activities, these include:

Visual tree health assessment, which aims to determine a health score for each tree based on visual parameters.

Monitoring of standing water level, which measures standing water levels from purpose built monitoring bores.

Currently, extraction bores is planned to be located with the palaeochannel at Twin Bonanza, and therefore monitoring will be focused at that location. A control site will also be selected within the same palaeochannel, but will be located at the most upstream monitoring bore from extraction bore to be outside of possible zone of impact. The control site will replicate the water bore site in terms of site layout and methodology.

Three visual tree health transects are proposed to monitor possible impacts from the water extraction activities. Each transect will measure approximately 200 m, with the start point at the bore and end point 200 m from the bore. Tree's will be selected along each transect and will be permanent monitoring sites for this program. On-ground tree selection has not yet occurred but it is anticipated that 10 trees will be selected for each transect. Methods for estimating visual tree health are described below.

In order to improve results interpretation, ABM proposed to measure standing water level monitoring bore to determine "actual" zone of drawdown (i.e. cone of depression) from the point source. Two bores will be installed along one visual tree health transect.

6.8 Visual tree health assessment method

Methods selected for the visual tree health assessment are based on tree crown condition techniques developed for determining harvest viability in silviculture industry (Grimes 1978; Stone et al 2003a; Stone et al. 2003b); however, some parameters have been omitted from this assessment as they are more relevant to economic harvest quality of trees. For the purpose of detecting water stress related to groundwater extraction, the following visual parameters have been selected:

- Canopy density
- Dead branch presence
- Epicormic growth

Scoring criteria for the above parameters is described in Table 1. The higher the score suggests the tree is in better condition. Scores will be analysed based on their distance to the extraction bore, and also compared against what is occurring at the control site. This data will be used to determine if there is a clear trend of reduced tree condition in areas close to the water extraction bore.

During site establishment, an identification tag made of non-corrosive stainless steel will be stamped with a unique code.

One permanent photo point will also be established at each site (i.e. tree) and a photo taken during each monitoring event. Ideally, a photo of the identification tag will occur prior to the photopoint to confirm site. Additionally, the digital camera photo number will be entered into the field datasheet.

General notes on surface impacts will also be collected at each tree site (i.e. leaf damage from herbivores, fire, flooding, mistletoe, lighting strike etc.) as these may also impact on overall tree health and condition, which may be useful for future data analysis purposes.

Example of field data sheet is provided in the Table 2. The initial site establishment will collect more detailed information about each site (i.e. tree), such as species, height, and distance from start of transect.

6.9 Standing water level measurements

ABM proposes to establish standing water level bores along one monitoring transect. The standing water level should be recorded to the closest centimetre using a standing water level dipper (or equivalent). Enter this measurement into the field datasheet Table 1.The casing height of the bore will be collected during the first monitoring event and should not be required at following events as that measurement will be entered into the database for future calculations.

6.10 Monitoring frequency

Monitoring events will occur on a 6-monthly basis. One baseline measurement will occur prior to water extraction in order to determine site specific data for future health comparisons.

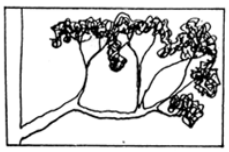
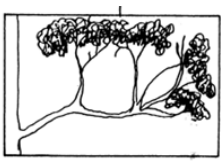
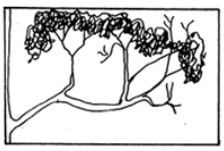
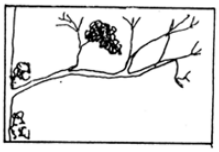
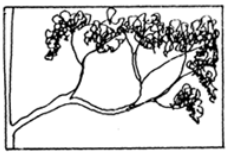
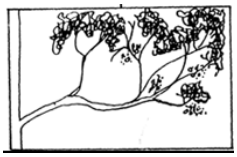
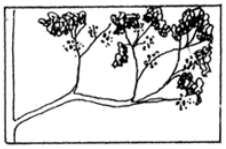
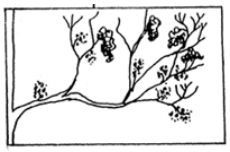
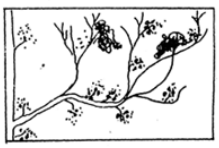
6.11 Data storage and analysis

At the completion of each survey all data sheets will be scanned and saved in document filing system. Data will also be entered into a custom made database for long term data accessibility and analysis.

Table 4. Example of palaeochannel monitoring field datasheet

Twin Bonanza Project – Palaeochannel Monitoring Field Datasheet						
Transect:		Date:		Recorder:		Event:
Visual Tree Health Measurements						
Tree ID	Photo number	Crown Assessment (use key provided in methodology)				Surface Impact Notes
		Crown density	Dead branch	Epicormic growth	CA total	(i.e. leaf damage, fire, flooding, mistletoe, lightning)
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
Standing Water Level Measurements						
Extraction Bore:		50 m Bore:			150 m Bore:	
General Notes						

Table 5. Parameters for determining tree health score

Crown density				
9 Very dense  **Very dense** clumps over entire crown	**7** Dense  **Dense** leaf clumps **unevenly** distributed over crown.	**5** Average  Clumps of **average** density **equally distributed** OR **dense** clumps **unevenly distributed.**	**3** Sparse  Clumps **sparse** and **poorly** spread	**1** Very sparse  **Very few** leaves **anywhere** on crown.
Dead Branch counts				
5 Nil  **No** visible dead branches or branchlets except thin twigs inside new lead dev.	**4** Branchlets dead  Dead branchlets evident on close inspection. Not all over Crown.	**3** Small growing branches dead  Small branches dead, all over crown. Easily observed but not affecting tree health	**2** Main growing branches dead  Large and/ or small branches dead over part of crown. Serious	**1** Main growing branches dead and epicormic growth too  Large and small branches dead over most of the crown.
Epicormic Growth				
5 Nil  Nil Epicormic growth. Normal foliar growth at branch tips.	**4** Slight  In part of crown only	**3** Moderate  Moderate over most of crown	**2** Severe on crown **OR** steam  Sever on crown OR steam	**1** Sever on crown **AND** stem  Sever on crown AND steam