

CHAPTER 16- Additional environmental impacts

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16.1 Introduction

This chapter addresses additional environmental impacts not addressed in previous chapters but still relevant to the project. These include:

1. bushfires
2. noise and vibration
3. biting insect management
4. clearing and ground disturbance

16.2 Bushfire and fire management

Regular and widespread fires are a feature of the Tanami Desert. The intensity of fires relates both to the vegetation fuel load and the time of the year. Changes in wildfire intensity and burning patterns have the potential to detrimentally affect local biodiversity and land use (Desert Knowledge 2009). To minimise the potential for ABM's activities to contribute to a change in local fire regimes and burning patterns, a site specific Fire Management Plan (FMP) has been prepared. The plan outlines clear objectives and management/ mitigation strategies that staff and contractors are required to adhere to at all times (Appendix Z: Fire Management Plan). The aim of the FMP is twofold, firstly to inform employees and contractors of fire policies and procedures, and secondly to ensure that fire control practices are implemented on site to minimise the risk of bushfires from site operations.

From an operational perspective the six main objectives of the FMP are to:

1. ensure a comprehensive fire risk management process is applied across all work areas to ensure a high level of safety for persons, property and environment
2. reduce the occurrence, and minimise the impact, of bush fires on the Twin Bonanza area, thereby reducing the threat to life, property and the environment
3. document fire prevention requirements of the Twin Bonanza mine site
4. ensure that fire safety problems that arise are quickly and effectively contained and resolved
5. ensure that ABM complies fully with its legal obligations in relation to fire safety
6. ensure that appropriate training and information is provided on fire safety and fire control to all staff on site.

Responsibility for ensuring the site environmental requirements are met, including the FMP, will lie with the chief operating officer (COO), environmental manager and health and safety manager or their delegates.

16.2.1 Relevant legislation and codes of practice

The following fire safety legislation is applicable in the Northern Territory and to ABM:

- Bushfire Act 2009 (NT)
- Bushfire Regulations 2005 (NT)
- Environmental Assessment Act 1982 (NT)
- Fire and Emergency Act 1996 and relevant amendments (NT)
- Fire and Emergency Regulations 2011 (NT)
- Work Health and Safety (National Uniform Legislation) Act 2011 (NT)

Bushfires NT, a branch of the Department of Land Resource Management responsible for implementing the Bushfires Act, operates under a series of policy guidelines designed for the:

- protection of life, property and the environment from the effects of wildfires
- maintenance of natural resources, including native ecosystems and productive lands, by the use of appropriate fire regimes.

These policies stress the need for individual landholders, be they public or private, to have fire management plans in place which are in the main devoted to the pre-suppression of large and intense fires. Such plans should be set in the context of a broader regional strategy.

ABM will adhere to all relevant legislation, particularly the Bushfire Act 2009. ABM will specifically undertake seasonal maintenance of firebreaks around accommodation camp buildings and infrastructure in line with legislative requirements, and as part of an integrated fire management approach, to reduce the risk of fire.

16.2.1.1 Standards and guidance material

The following Australian Standards and Codes of Practice apply:

- AS 4665-2002, Guidelines for Fire Safety Audits for Buildings (Int)
- AS 3745-2002, Emergency Control Organisation and Procedures for Buildings, Structures and Workplaces
- Fire Engineering Guidelines 2001 (Canberra, A.C.T. : Australian Building Codes Board, 2001)
- ABM Emergency Response Management Plan (Appendix R).

16.2.1.2 Consultation

ABM consults with the traditional owners, through the Central Land Council (CLC), as they have specialist knowledge in fire management. Recommendations from the CLC have been incorporated into the FMP and include, but are not limited to:

- The requirement to ensure Traditional Owners are confident that the mine site is always well protected from fires that they might light near to the lease block (or even a long way away from the site, but that have the potential to travel to the site even under mild conditions) so that their traditional and landscape-scale burning activity is not hindered by the existence of the mine site and personnel.
- Fire risk in this country will always be higher in years following seasons of good rains when grasses respond to soil moisture. These are the times to expect large wildfires to threaten the mine and the times when preventative prescribed burning practices are most needed. This should form part of the training of the person responsible for fire monitoring.
- The CLC recommends that prescribed burning to maintain a reduced-fuel buffer of between 100-200m needs to be a feature of standard fire prevention. The location and timing of prescribed burning needs to be negotiated with Traditional Owners in order to minimise risks to any assets in the surrounding area, such as sacred sites. Another option is to establish a system of double breaks, which can be used where environmentally appropriate and endorsed by Traditional Owners. All firebreaks must be constructed under standard conservation earthworks principles; e.g. not altering the flow of surface water to ensure no windrows are created and erosion is not caused.
- The CLC recommends that ABM undertake reduced-fuel burning to prevent fuel build-up within 200m of the infrastructure. A reduced-fuel buffer (a burnt area of between 100-200m width) around the facility would be appropriate.
- The Basic Wildfire Awareness Course should be considered a minimum for site staff. The person controlling burning activities should have also completed a Fire Fighter NT course.

16.2.2 Management

The Twin Bonanza project is not in a fire protection zone, however seasonal fires are prone to sweep through the region. Vegetation is generally sparse, because of the arid climate and predominantly sandy soils. Fire risk in this country will always be higher in years following seasons of good rains, when grasses respond to soil moisture. These are the times to expect large wildfires to threaten the mine and the times when preventative prescribed burning practices are most needed. The majority of fires are thought to be generated from lightning strikes; additional fire sources include Traditional Owner practices and accidental fires through human activities. The main sources of fire are outlined below:

1. lightning generated natural wildfire
2. uncontrolled burns – not ABM
3. Traditional Owner controlled burns
4. accidental fires – community activities
5. accidental fires – ABM activities

The site will operate under the general principal of fire avoidance. There will be no central reticulated fire system or fire hoses at Twin Bonanza. Fire protection will be by use of hand held fire extinguishers within buildings and equipment. Around the site, fire breaks will be used to prevent naturally occurring fires from damaging buildings and infrastructure and prevent a fire within the infrastructure escaping to the general environment. Additionally, housekeeping will play a major part in ABM's fire management, which will include reducing waste and dry vegetation, not only in fire breaks but also around infrastructure on site.

ABM personnel are strictly banned from lighting fires except under controlled conditions. Fires are banned during the course of normal field work activities, with the exception of camp fires and barbecues during exploration programs, in designated areas and under controlled conditions.

The following guidelines are to be followed by all field personnel:

1. All staff will comply with fire ban days declared by BushFires NT, a delegated staff member will monitor the Bureau of Metrology website (BOM).
2. Open fires must be dug into the ground and/or surrounded by a low earthen or rock wall to prevent spreading of hot embers and burning wood.
3. Open fires must be sited on cleared ground which is barren of vegetation over a radius of at least five metres from the fireplace.
4. Fires are not to be lit under windy conditions, greater than 25 knots (46.3 km/hr).

5. A shovel and/or ready supply of water must be close at hand.
6. Only dead wood should be collected for fuel, and fire wood should be checked for inhabitants prior to use, e.g. lizards within hollow logs.

Under the bulk sampling program at the Twin Bonanza project, no employee of, or contractor to, the company is permitted to light fires for the purpose of clearing vegetation, with the exception of authorised personnel conducting planned fuel reduction activities within the fire break areas, or conducting emergency back burning. Back burning is only permitted in the case of a direct emergency where evacuation and/or infrastructure are compromised and no other form of fire protection is available. Back burning is discussed further in the following section.

16.2.2.1 Bushfire and wildfire threat

Vegetation consists mainly of spinifex with scattered low trees (mostly species of eucalyptus and acacia), shrubs and herbaceous plants. The growing period is generally directly after the wet season, which occurs from December through to March, with the amount of dry vegetation available as a fuel source depending on the amount of rain and the growth of vegetation for the season. In addition, the dominant wind direction is from the east during the dry season and northeast during the wet season, therefore bush fires from the east and northeast (respective of seasonal variations) will be of potential danger for ABM's staff and operations.

The risk of wildfire is predominantly from August through to November, where the frequency of storms and lightning strikes increase and a surplus of dry vegetation is present. If a wild fire is encountered, personnel are required to avoid the area and evacuate any downwind positions. For safety reasons, ABM personnel are not permitted to try to fight such fires as they can be highly unpredictable. Should a fire threaten the operation and it appears probable/highly likely that the fire will approach the site; back-burning to reduce the amount of vegetation (fuel) in the immediate vicinity of the site is permitted under the following circumstances:

1. Move portable plant and equipment to a safe location.
2. Preferably select small patches of vegetation to burn individually, one at a time. After each patch is burnt, extinguish remaining embers to avoid ember attack on nearby surrounds should the wind pick-up unexpectedly.
3. Fires are not to be lit under windy conditions. Back-burning is best done early in the morning or in the evening when the wind dies down.

4. Always burn up-wind, i.e. alight vegetation only where a fire break exists in the down-wind direction. The intention is to burn the vegetation (and thereby eliminate the fuel) in the zone between the site and the wild fire.
5. A shovel and/or ready supply of water must be close at hand for extinguishing embers.
6. Ensure a line of retreat away from the fire to safe ground (i.e. where no fuel exists).
7. Never attempt to back-burn alone - only do so with another team member present.
8. If in any doubt, do not attempt back-burning - EVACUATE THE AREA.

16.2.3 Mitigation strategies and hazard management

The site induction, which covers environmental and safety aspects, will inform all personnel about fire awareness, the requirement to obtain a hot work permit before undertaking welding, cutting or grinding activities, emergency contact numbers, and procedures in case of a fire.

All employees and contractors will be required to attend a site induction, with attendance documented on the Induction/Training Record Form and Induction/Training Register.

16.2.3.1 Monitoring wildfires

Monitoring of local bushfires/wildfires will focus on those to the north and northeast, particularly those that will restrict access to and from the site of operations. Regular monitoring will be necessary on a daily basis from August through to November and observations of fuel loads and rainfall will be required regularly throughout the year. If a bushfire is approaching the project area, actions will be taken to preserve infrastructure. Further details are available in Appendix Z – Fire Management Plan.

16.2.3.2 Fire breaks

Strategic fire breaks will be constructed around all buildings and operating plant. The aim of the firebreaks will be to enable vehicle access to fight fires (approximately 6m wide), to stop a fire under mild conditions, and to act as control lines from which planned, or emergency, back burning may be undertaken to stop wildfires in extreme conditions. Planned back burning and/or controlled burning will only be undertaken with a permit under the Bushfire Act that is currently administered by Bushfires NT (where applicable) and in consultation with the Traditional Owners.

All operational areas, including accommodation and power generators, will be placed in cleared areas and surrounded by a 6m fire break cleared completely of vegetation and

debris. Hydrocarbons and hazardous materials are to be stored in accordance with AS1940-2004, appropriate hazard separation zones will be established to reduce the potential fire risk in respect to fuel and hazardous chemical storage facilities. In the event of a fire, fire fighting equipment will include a mobile water tank with associated pump that will be used to extinguish the fire.

16.2.3.3 Hot work permit – NT Worksafe

Heat generating processes including welding, soldering, grinding, cutting and brazing are a fire hazard both during the process and for some time after, particularly where flammable materials are in close proximity. A hot work permit is required for hot work that is not part of the day to day production processes. The hot work permit ensures that; all welding, cutting and grinding activities that are undertaken on site require the issue of a hot work permit. The permit will specify fire control practices to ensure no fires are started from conducting these activities. The control measures will include ensuring:

- potential fire hazards are identified, isolated, removed, protected or disconnected as appropriate
- the operator is trained to perform the work safely
- appropriate warning and fire fighting equipment is on hand.

A hot work permit will be issued by the responsible person on site and should also be issued for a specific task that is undertaken in a clearly identified area. The hot work permit will require a final fire-check to confirm that there is no potential for a fire ignition. This will normally be at least one hour after the time of expiry of the hot work permit, when work must be complete. Additionally, ABM will align itself with the control measures outlined in Safe Work Australia's Welding Processes Code of Practice, specifically for welding and other hot works activities. These include:

1. Isolate fuel sources from ignition sources.
2. Purge all traces of flammable or combustible materials from drums, vessels and tanks prior to welding, vessels should preferably be filled with an inert substance such as nitrogen gas or water.
3. Use fire resistant barriers to prevent welding sparks accidentally reaching flammable and combustible materials.
4. Check work areas are well ventilated to prevent accumulation of flammable vapours in the work area.
5. Check work area is free from rubbish, paper or dust that could be potential fuel sources or produce dust explosions.

6. Use flash back arrestors on gas hoses to prevent the flames travelling back and igniting the gas in the cylinder.
7. Drain and purge equipment, such as gas hoses, and lock the gas off at the valve immediately after use.
8. Do not store flammable and combustible materials near welding area.
9. Keep and maintain fire fighting equipment near welding area.

16.2.3.4 Incineration of wastes

ABM proposes to incinerate solid wastes, i.e. cardboard and food scraps, to reduce the solid and putrescible wastes around camp. ABM will incinerate material in a bunded pit or a turbo burner, only on days where wind is low and the fire risk is low to moderate. Fires must be supervised at all times, and can only be lit following authorisation from the site general manager or their delegate. A fire break must be constructed around the perimeter of the bunded fire pit for at least 6m to prevent unintentional fire spread.

16.2.3.5 Fire fighting equipment

Fire extinguishers

Portable fire extinguishers are located in easily identifiable locations throughout the buildings. Their locations and suitability for use on various types of fires (e.g. electrical, flammable liquids, ordinary combustibles) will be instructed through the site induction. The operating instructions and designated use criteria are displayed on each extinguisher in word and pictogram format.

Mobile water tanks

Mobile water tanks that will be routinely used for dust suppression will be available to distribute water in the event of an uncontrollable or large fire. These should only be used by suitably trained staff.

16.2.3.6 Vehicle inspections

All vehicles on site and arriving on site will be checked daily as part of the daily vehicle prestart check to ensure that they are fitted with appropriate safety and fire control equipment that includes a fire extinguisher and two-way radio. In addition, engine bays and exhaust systems will be checked for vegetation to prevent ignition of vegetation by hot engines.

16.3 Noise and vibration

The presence of operational noise and vibration has the ability to both disturb and produce health issues in local communities (Department of Resources Energy and Tourism 2009). It is acknowledged that the proposed mining operation will introduce a level of noise and vibration that does not currently exist at the site. As the Twin Bonanza Project is located 120 km from the nearest permanent settlement of Balgo, the management of noise and vibration around the site is focused on the impact to ABM staff and contractors. Additional receptors in the area can include local populations of native fauna, including bilbies and mulgaras. For the purposes of noise management, fauna are considered as receptors. To manage site noise and vibration, a Noise Management Plan (NMP) that outlines clear objectives and management/mitigation strategies has been produced. All staff and contractors are required to adhere to the plan at all times for the management of noise and vibration at the Twin Bonanza Project (Appendix Y: Noise Management Plan). The purpose of the NMP is to provide an effective management system to identify and control potential noise impacts.

Potential noise sources above existing environmental noise include:

- noise produced by mobile equipment during operations
- noise produced by fixed plant including crushers, ball mill and other process plant equipment
- power generator noise
- open pit blasting noise and vibration
- the landing and take-off of aircraft from the airstrip.

Potential impacts from noise emissions and vibrations associated with the project are expected to be minimal. The remote location of the project, and the absence of nearby residential facilities, will limit any adverse impacts.

16.3.1 Consultation

During operations, ABM, if required, will consult with employees, contractors, and regulatory authorities (assessed on a case by case basis), when a decision is to be made that may affect noise management at the Twin Bonanza mine site and accommodation facilities. Examples of situations requiring consultation include, but are not limited to:

- changes to work environments, work methods, work systems, or equipment which may significantly alter noise impacts (e.g. blasting times will be set by operative requirements)

- periods of blasting.

Consultation will involve but not be limited to:

- undertaking, or reviewing, risk assessments and implementing controls
- a Job Safety Analysis (JSA) is undertaken for a new task
- investigating incidents and complaints.

16.3.2 Risk assessment

While noise from mining operations will be present in this sparsely populated and remote region, noise emissions will be inaudible at the nearest residential area of Balgo and Coyote mine site located 120km and 45km respectively from the project. As the most sensitive receptors on site will be the workforce and native fauna, rather than undertake noise modelling, surveys will be completed as the site is developed.

During project implementation, a noise risk assessment considering the sources and levels of noise will be conducted. This risk assessment will identify the risks associated with the different aspects of the mine with regards to noise impacting on the workforce and native fauna. As no prescriptive guide is given under the Waste Management and Pollution Control Act, the acoustic quality objectives from the Queensland Environmental Protection (Noise) Policy 2008 will be adopted for the purposes of the risk assessment. This policy seeks to protect the biodiversity of ecosystems and human health and wellbeing. Where a risk exists to personnel and fauna, a hierarchy for noise control will be adopted that will attempt to avoid, minimise or manage noise.

16.3.3 Risk management – operational control

ABM environmental manager, with a suitably qualified person, will complete a noise risk assessment. This risk assessment will result in the establishment and implementation of both the management and operational controls to mitigate the effect of noise and vibration at the mine site, and the accommodation area.

Certain mine activities will have operational controls to adhere to, regardless of the outcome of the noise risk assessment. These include:

1. construction phase
2. general operations
3. shot firing / blasting

16.3.3.1 Construction phase

Construction noise emitted from the project is assessed with consideration to the NT EPA Noise guidelines for development sites in the Northern Territory (NT EPA 2013). The NT EPA recommends standard hours for construction activity between 7 am to 7pm Monday to Saturday and on Sundays 9am to 6pm. Given the location of the mine site and the large distance between sources and residential receptors, extended working hours are not expected to present a noise issue; and construction generally will be completed at the mine site between the hours of 6.30am and 6.30pm, 7 days a week.

The NT EPA provides a noise limit for construction noise levels, at residential receptors / residential area using standard hours for construction. NT EPA set the construction noise limit at background noise + 5dB(A). These noise limits are calculated based on the adopted rating background level (RBL) at nearby residential locations. As the mine accommodation will be located 1 km from construction activities that will occur from 6.30am to 6:30pm noise will not exceed the construction noise limit.

During construction when employees and contractors are involved in tasks that exceed occupational health and safety limits for noise (above LAeq,8h of 85 dB(A)) they will be required to wear hearing protection that meets Australia Safety Standard in accordance with AS/NZS 1269.3 Occupational noise management – hearing protector program.

16.3.3.2 General operations

ABM staff and contractors will ensure equipment is maintained to reduce noise emissions which would impact on workers and fauna. Where required, suitable hearing protection equipment will be provided and is to be worn by all personnel while in hearing protection areas. Appropriate signage under the Australian Standards will designate hearing protection areas. Workers, visitors and sensitive fauna are the primary receptors given that there are no residential areas or communities in the area.

All equipment (both fixed and mobile) will comply with AS/NZS 1269.3:2005 - Occupational noise management, in regard to design and operating noise levels. It is the duty of the supplier to ensure equipment is compliant with safe levels of noise and vibration, and the supplier must provide documented proof of compliance, such as test results. Employees will be trained in the appropriate use and application of machinery to minimise noise emissions as far as practicable. ABM's Health and Safety staff and section managers (i.e. processing, environmental) will be responsible for compliance with the AS/NZS 1269.3 Occupational noise management – hearing protector program guidelines.

ABM will establish a maximum practicable distance between accommodation units and power generators. Physical bunds will be placed around mining and camp infrastructure including power generators (e.g. gensets) that will generate significant noise disturbance

during operation, with the aim to reduce excessive noise disturbance to receptors. Where practicable ABM will also position infrastructure including waste dumps to form noise barriers around stationary plant and locate administration buildings away from noise sources.

A complaints register will be maintained for the site. All legitimate noise and vibration complaints will be investigated and appropriate actions taken.

16.3.3.3 Shot firing and blasting

Noise and vibration from shot firing will be present during operations. All shots will be planned and designed to achieve the required outcomes with minimal impacts on workforce, community and fauna.

The Australian and New Zealand Environment and Conservation Council (ANZECC) Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration (ANZECC 1990) provides guidance when dealing with potential blasting noise and vibration. This guidance applies to sites close to residential areas; therefore ABM will monitor and listen to any complaints made regarding blasting noise.

Recommended ANZECC blasting limits for air blast overpressure and noise are 115 dB(lin) peak, however the level of 115dB may be exceeded on up to 5% of the total number of blasts over a period of 12 months, but never over 120dB(lin) peak. Ground vibration limits are set at 5mm/s peak particle velocity, although the level of 5mm/s may be exceeded on up to 5% of the total number of blasts over a period of 12 months, but never over 10mm/s. Blasting safety and responsibility for the noise and vibration effects from the blasting will be the qualified blasting personnel. ABM will monitor and comply as practicable.

The mine manager or delegate will be responsible for notifying all staff and visitors of the blast schedule and will schedule such blasts to coincide close to the change in shifts, approximately 6 pm, (night / day shift) to prevent disturbance to night shift workers sleep patterns. This is in line with ABM's fatigue management policies.

Shots will not be fired in the middle of the day when bilby and mulgara are at their least active (asleep, unless in the event of re-blasting / clearing of existing holes), scheduling of blasts will align with the change of shift which will be close to the evening or dawn, (6pm), when both nocturnal and diurnal fauna will be active and less disrupted. The aim is to prevent disturbance to activities and habitats of nocturnal and diurnal animals alike, particularly bilbies and mulgaras which are present locally.

16.3.4 Risk management – biodiversity and native fauna

There are no government policies or widely accepted guidelines with regard to noise criteria for fauna; however the effect of noise on wildlife can be similar to the effects observed in humans. Noise can adversely affect wildlife by interfering with communication or breeding activities, causing stress or avoidance reactions and (in the extreme) result in temporary or permanent hearing damage.

Experiments with noise impulses throughout the night-time sleep period of animals resulted in poorer daytime task performance and learning ability of those animals (Fletcher and Busnel 1978). The animal's initial reaction to a new noise source is fright and avoidance but if other sensory systems are not stimulated (for instance optical or smell), the animal learns quite quickly to ignore the noise source, particularly when it exists in the presence of humans. These findings are supported by local observations of bilby activity at the Coyote Gold Mine (pers. comm. Jeremy Shepherdson 2013, Principal of Ecotec Proprietary Limited) and Dr Richard Southgate's findings that: "Bilbies can tolerate disturbance. For example, Bilby activity occurred along part of the easement for the Ghan Railway line north of Tennant Creek during the construction phase and they have continued to occur near the railway line." (Southgate, 2012). Bearing this in mind, blasting and shot firing has the potential to cause the most noise and vibration disturbance to local fauna, and as such blast timing is to coincide with animal activity (both nocturnal and diurnal) with the aim to reduce the impact. Additionally, where practicable, noise sources are to be established at the greatest distance from potential bilby and mulgara habitat; with the aim to reduce excessive noise disturbance.

16.3.5 Monitoring

Noise at Twin Bonanza mine site and accommodation facilities will be monitored in the following ways.

Monitoring will incorporate:

- Regular reviews of the number, frequency and type of noise and vibration complaints. Data will be examined for potential trends that may be developing and, if required, mitigation measures will be implemented.
- A complaint form and a register of all complaints will be available.
- Regular inspections of the workplace and discussions with the workforce, via toolbox and safety meetings to identify any noise hazards that require action or control measures.
- Monitoring the maintenance of mobile and fixed plants to ensure noise emissions are maintained at an acceptable level.
- Monitoring the implemented control measures to ensure they are controlling noise

hazards.

Specifically, monitoring and maintenance of onsite machinery will focus on checking for changes in noise levels – badly worn bearings and gears, poor lubrication, blunt blades, loose parts, unbalanced rotating parts and steam or air leaks all create noise that can be reduced with good maintenance; including controls such as vibration mountings, impact absorbers, gaskets, seals, silencers, barriers and other equipment. Regular inspection and maintenance will be conducted in accordance with the Code of Practice- NT Worksafe – Managing and preventing hearing loss at work.

To monitor the social impacts of the operations a record of both internal and external complaints will be entered in a register with an annual review of the complaints. This will assist in determining the environmental aspects of the complaint and requirement for additional controls or management strategies to limit the noise impacts.

16.4 Biting Insect Management

The vectors of disease that are of relevance to Australia are mosquitoes, flies, ticks and mites. Of these, mosquitoes are considered to be the most important (Whelan et al. 2003). To manage the potential for insect borne diseases, a Biting Insect Management Plan (BIMP) has been developed with reference to the Guidelines for Preventing Mosquito Breeding Sites Associated with Mining Sites 2005 by the Northern Territory Government - Department of Health and Families.

The purpose of the BIMP (Appendix AA) is to ensure that biting insect control practices are implemented on site to minimise the risk of creating biting insect breeding sites, namely mosquitos, associated with mining activities. The objectives of the plan are to:

1. prevent the occurrence of potential mosquito breeding sites and the presence of adult mosquitos
2. minimise mosquito breeding sites created by construction activities.

The BIMP applies existing industry management practices and policies in regard to biting insect management and expands to include all biting insect management during construction, operation and closure of the proposed mine at Twin Bonanza. The BIMP will be subject to ongoing review and change to ensure that it remains relevant and effective throughout the life of the operation.

16.4.1 Environment and species

The Tanami area is likely to harbour a number of mosquito species. Some of the species are potential disease vectors of arbovirus, while others are responsible for nuisance biting (Table 16-1). Transmitted arboviruses include Ross River Virus (RRV), the most frequently transmitted mosquito borne disease in the Northern Territory, and Murray Valley Encephalitis (MVE), a potentially lethal disease.

Mosquitoes breed in standing water. There is no permanent standing water in the project area. The area's summer rainfall pattern potentially provides breeding habitat during the summer months. For example mosquito numbers increase during the summer months in Alice Springs and in Tennant Creek to the north. Summers with high levels of rainfall experience higher numbers of mosquitoes than occur in lower rainfall years (Whelan et al., 2003). Alice Springs and Tennant Creek experience high levels of RRV and MVE during summers with a December to February rainfall in excess of 100mm (Whelan et al., 2003). Numbers of adult biting mosquitoes can be expected to reach peaks within three weeks of heavy rainfall (Whelan and Van Den Hurk, 2003). It is anticipated that, during the operation, standing water will be present in the water storage and tailings dam during the majority of the year which can result in additional breeding habitat and prolonged breeding periods.

Other possible sources of breeding sites for biting insects may include:

Camp

- potable water storage tanks
- septic systems
- storm water containment bunds
- stormwater drains and sediment traps
- cleared areas
- borrow pits for roads/building pad construction
- airstrip
- any additional potential water pooling receptacles associated with this area

Mine site

- storm water drains, storm water collection ponds, sediment traps, discharge sites
- excavation Pits
- water dams and water tanks
- tailings Dam

- waste rock dump
- processing plant
- process water/wash down water
- borrow pits for roads/building pad construction
- dust suppression water tanks
- truck wash down bay
- septic systems
- any additional potential water pooling receptacles associated with this area

Mine closure and rehabilitation

Progressive rehabilitation will minimise the potential mosquito breeding sites remaining after the cessation of mining operations. All disturbed areas will be rehabilitated to be free draining where practicable.

Table 16-1 Species of mosquito likely to be encountered in the Tanami (from Anon. 2010 cited in ABM Resources Report, 2013).

Common name	Scientific name	Possible abundance	Breeding places	Disease potential
Brown house mosquito	Culex quinquesfasciatus	Domestic situations	Septic tanks, polluted pools, stormwater drains, sumps, gully traps, tins, drums tanks and discarded receptacles	Low, a biting pest
Common banded mosquito	Culex annulirostris	Most common biting mosquito in the NT	Freshwater swamps, vegetated streams, storm water drains, grassy edges of sewage ponds, inundated low lying grassy areas	Murray Valley encephalitis, Ross River virus*, Barmah Forest virus,
Receptacle mosquito	Aedes notoscriptus	Where there are breeding sites	Tree holes, rock pools, fallen palm fronds, rain filled receptacles e.g. tins, drums, tyres, tanks, gutters etc.	Probable Ross River virus
Pale larvae mosquito	Aedes tremulus	Regular presence	Tree holes and stumps, discarded receptacles	A biting pest
Northern salt marsh mosquito	Aedes vigilax	Uncommon to rare, carried south on north-westerly wind from monsoons/ cyclones	Brackish to salt water swamps and temporary pools	Ross River virus, Barmah Forest virus, potential for Murray Valley encephalitis
Salt water anopheles mosquito	Anopheles hilli	Very rare	Brackish coastal swamps margins and flood plains	Suspected malaria (no current malaria in the NT)
Common Australian anopheline	Anopheles annulipes	Rarely a pest	Temporary and permanent fresh water pools with grassy edges, discarded receptacles	Suspected malaria

* The common banded mosquito is the major vector for Ross River virus in the Northern Territory.

16.4.2 Management measures

16.4.2.1 Prevention

The most effective means to control biting insects, more specifically mosquitos, is to prevent their introduction to a site and prevent breeding habitats. To achieve this, the following practices are used:

- Ponds, dams, drains, sediment traps, bunded areas and onsite excavations will be periodically inspected for the presence of mosquito larvae at a frequency based on discussions with the NT Department of Health. Detected populations will be managed under recommendations from the Medical Entomology Branch NT.
- Any ponds and on-site excavations filled with water will be inspected for the presence of mosquito larvae during the wet season. If larvae are detected, the Medical Entomology Branch of NT Health will be contacted for assistance in choosing a suitable method of control.
- Where possible, any depressions created in the ground surface will be filled or drained to prevent the ponding of water and all drainage channels/spoon drains will be kept as shallow as possible to prevent ponding.
- Stockpiles will be placed in areas that do not impede drainage and will be shaped to prevent ponding.
- Sedimentation ponds will be emptied promptly after storm events to prevent long-term ponding.
- Ponds, dams and other water holding structures will be designed appropriately and maintained to minimise the potential for mosquito breeding.
- Care will be taken that ponding does not occur in rubbish storage areas.
- Erosion and washdown practices will be controlled to prevent sediment and debris forming standing water pools around the site.
- All accommodation facilities and offices will be screened and air conditioned to discourage mosquitos.
- All staff will be educated to be especially vigilant during the high mosquito borne disease risk periods (late dry season to post wet season) through the use of long sleeved shirts and trousers and the regular use of insect repellent. Insect repellent will be provided at work sites.
- Staff will be educated about the early symptoms associated with exposure to mosquito borne diseases and will be instructed on the need to report any symptoms to a medical officer.

16.4.3 Monitoring

ABM staff will periodically check mosquito activity within the accommodation and work areas, including the water storage dams, to identify the success of mitigation measures and to determine whether larval and adult eradication programs should be implemented.

Key performance indicators of the BIMP include:

- no increased larvae or adult mosquito activity present on site
- presence of PPE adequate to protect against bites
- minimal Impacts and bites from mosquitos reported to medical officer on site.

16.4.4 Control

If mosquitos and larvae are identified at an area as a result of ABM activities the following steps will be completed.

Define and map:

- Define the water bodies, extent of the occurrence and associated control program.
- Record the GPS locations (MGA 94) of the occurrences and the scale of infestation.
- Send data to environmental manager or delegate to record within the biting insect register.

Mosquito control:

Any significant mosquito activity will be reported to ABM's site manager and/or the Northern Territory Medical Entomology Branch.

ABM will seek advice from the Northern Territory Medical Entomology Branch before proceeding with chemical eradication of the mosquitos.

16.4.4.1 Habitat modification

The first step in Mosquito control will be habitat modification, specifically the modification of existing infrastructure and breeding receptacles to prevent mosquito breeding. The details of modification are similar to those outlined in section 16.4.2.1 – Prevention.

The aim of habitat modification is to reduce the surface water ponding onsite to discourage and reduce mosquito breeding.

16.4.4.2 Chemical controls

If necessary, areas that cannot be managed with other management controls will be treated as required with a control agent. The advantage of chemical control methods is that pesticides can be quickly applied with rapid results at relatively low cost. However, chemical usage will not be viewed as a long term control strategy as prolonged use can result in the development of resistance in mosquito populations and be detrimental to the ecosystem.

The effectiveness of the various 'acceptable' agents depends on appropriate formulations and local conditions and the target mosquito species of critical concern. Therefore ABM Resources will seek advice from the Northern Territory Medical Entomology Branch, before proceeding with chemical eradication of the mosquitos.

16.5 Vegetation clearing and ground disturbance

Poor vegetation clearing techniques and over clearing can cause habitat degradation. ABM have formulated a Ground Disturbance Management Plan (GDMP) for the purposes of managing land clearing and disturbance that will occur as part of mining and construction activities (Appendix X : Ground Disturbance Management Plan).

The objective of the GDMP is to ensure procedures and controls are in place to minimise the impact on vegetation during disturbance activities associated with the Twin Bonanza project.

To achieve the desired outcome of minimising impacts, the key principles in implementing the plan are:

- all ground disturbance activities are approved by relevant government agencies
- disturbance to native vegetation is minimised within approved areas, with vegetation retained where practicable
- areas are cleared progressively to minimise wind and water erosion on disturbed surfaces
- access is limited to undisturbed areas,
- clearing is avoided during periods of too wet or dry soil conditions
- rehabilitation/ stabilisation of infrastructure areas is undertaken progressively.

Aspects of erosion and sedimentation control which are related to clearing and ground disturbance are discussed in Chapter 7: Water management, with management strategies given in the Erosion and Sedimentation Management Plan - Appendix E.

All ground disturbances on site will not be commenced until the Land Clearing Procedure Checklist has been completed. A copy of the Land Clearing Procedure Checklist is contained

in Appendix X. Once the checklist is completed a copy will be stored in the records system. The person responsible for supervising the clearing will also be responsible for ensuring that:

- a minimum area is disturbed for establishment of the required infrastructure or landform
- all required approvals are in place and clearing complies with the approved areas
- the area to be disturbed is clearly marked in the field and machine operators are informed that only the demarcated area is cleared
- disturbance is progressive so that areas to be cleared for future use are left vegetated until such time as they are required.

16.5.1 Vegetation clearing

Before the removal of topsoil and subsoil by mechanised equipment vegetation will be pushed into windrows and located on the perimeter of the proposed footprint to avoid loss due to over-tipping with other excavated material. The stored vegetation is to be retained for fauna habitat and later rehabilitation.

16.5.2 Topsoil clearing

The topsoil will be salvaged prior to the construction of all mining landforms and infrastructure. Topsoil stripping will involve the top 10cm of material. The total area to be cleared over the life of the project is 215 hectares with an estimated topsoil volume of 172,144 m³. The location of the topsoil storage areas is presented in chapter 3 figure 3-2.

ABM is committed to retaining the topsoil as a viable resource to use for rehabilitation purposes at a later date. Within the footprint of the pit an additional 80cm of gravelly material below the topsoil will be recovered, this material will be stored to provide further growth medium for soil profile reconstruction over rehabilitated landforms. The topsoil will be stored in stockpiles less than 2m high proximal to the cleared areas for future use in rehabilitation and closure. Designated topsoil stockpiling areas will be located to minimise topsoil losses via wind and water erosion. Furthermore, topsoil stockpile areas will be signposted to prevent inadvertent use. Topsoil stockpiling heights and storage time will be minimised as deterioration of the chemical, physical and biological properties of soil can occur during storage.

Soil degradation and erosion will be minimised by conducting the clearing in dry conditions. Progressive rehabilitation will be undertaken during the life of the mine, to optimise topsoil properties. Stockpiles that are retained for longer periods of time will be encouraged to re-vegetate naturally.