

**ASSESSMENT REPORT 74**

**TWIN BONANZA GOLD MINE  
ABM RESOURCES NL**

MAY 2014

<b>Abbreviations and Glossary .....</b>	<b>1</b>
Units and Symbols.....	1
<b>Executive summary .....</b>	<b>2</b>
List of Recommendations .....	3
<b>1 Introduction.....</b>	<b>6</b>
1.1 Environmental impact assessment process.....	6
1.2 Regulatory framework .....	7
1.3 Environmental impact assessment history.....	7
1.4 Ecologically Sustainable Development .....	8
<b>2 The Project .....</b>	<b>9</b>
2.1 The Proponent .....	10
2.2 Project Location .....	10
2.3 Schedule .....	11
2.4 Workforce and construction camps .....	13
2.5 Construction .....	13
<b>3 Environmental Impact Assessment.....</b>	<b>13</b>
3.1 Introduction .....	13
3.2 Summary of environmental issues.....	14
3.3 Ecology and biodiversity .....	16
3.4 Water and Water Management .....	18
3.5 Historic and Indigenous cultural heritage.....	20
3.6 Decommissioning .....	21
3.7 Social and Economic considerations .....	24
3.8 Environmental Management.....	24
3.9 Environmental Management Plan.....	27
<b>4 Matters of National Environmental Significance .....</b>	<b>28</b>
<b>5 Conclusions .....</b>	<b>37</b>
<b>6 References .....</b>	<b>38</b>
<b>Appendix A Approved Conservation Advice for the crest-tailed mulgara (<i>Dasycercus cristicauda</i>).....</b>	<b>42</b>

## Abbreviations and Glossary

Draft EIS	Draft Environmental Impact Statement
CLC	Central Land Council
Cwlth	Commonwealth
EA Act	<i>Environmental Assessment Act</i>
EAAP	Environmental Assessment Administrative Procedures
EIS	Environmental Impact Statement
EL	Exploration Lease
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
ESD	Ecologically Sustainable Development
FIFO	Fly in – Fly out
MLA	Mining Lease Area
MMP	Mining Management Plan
NOI	Notice of Intent
NT EPA	Northern Territory Environment Protection Authority
The Australian Government Minister	The Australian Government Minister responsible for the <i>Environment Protection and Biodiversity Conservation Act 1999</i>
The Minister	Northern Territory Minister for Lands, Planning and the Environment
The Project	The Twin Bonanza Gold Mine
The Proponent	ABM Resources NL
Responsible Minister	Northern Territory Minister for Mines and Energy
The Supplement	The Supplement to the draft EIS

## Units and Symbols

%	percent
ha	hectare
km	kilometre
km <sup>2</sup>	square kilometre
L	Litre
m	metre
mm	millimetre
t	tonne

## Executive summary

Environmental impact assessment (EIA) is the process of defining those elements of the environment that may be affected by a development proposal and analysing the risks associated with the identified potential impacts. This Assessment Report (the Report) assesses the environmental impact of the Twin Bonanza Gold Mine (the Project), proposed by ABM Resources NL (the Proponent).

The Twin Bonanza Gold Mine Project intends to mine gold from a series of open pits in the Tanami Region of the Northern Territory. The Project will be undertaken as a staged approach and is estimated to have a short term extraction rate of between 200 000 and 300 000t of ore per annum. The expected open pit life is estimated to be 3-4 years with further operations dependent on the results of exploration.

The Northern Territory Environment Protection Authority (NT EPA) has produced this Report as advice to the Minister for Lands, Planning and the Environment (the Minister) on the EIA of the Project. The Minister is required to give a copy of this Report to the Minister for Mines and Energy (the responsible Minister), together with any written comments made by the Minister in relation to this Report. The responsible Minister, taking into consideration this Report, will then decide whether or not to issue an approval under the *Mining Management Act* for the Project and if so, the conditions that may be applied.

Analysis by NT Government of the Notice of Intent for the Project identified a number of environmental risks. On the basis of these, it was determined that an EIS was required for the Project. Key risks that contributed to the decision were:

- The risks to items and places that have indigenous and non-indigenous cultural or archaeological significance;
- the clearing and loss of potential habitat and individuals of a number of conservation significant species;
- risks to flora, fauna and vegetation communities during operation;
- potential impacts to groundwater resources;
- the risks associated with land degradation, the management and disposal of wastewater and other contaminants; and
- potential social and economic risks.

Information requirements based upon identified risks were described in the final EIS Guidelines for the Project and the Proponent submitted the draft EIS to address these requirements. The Proponent broadly categorised the respondent's issues and concerns into the following topics for discussion in the Supplement to the draft EIS.

The NT EPA considers that the environmental issues associated with the Project have been adequately identified. Appropriate environmental management of some of these issues has been resolved through the EIA process, while the remainder would be addressed through monitoring and management actions detailed in issue-based management plans under provisions of the *Mining Management Act*.

The NT EPA considers that the Project can be managed in a manner that avoids unacceptable environmental impacts provided that the commitments, safeguards and recommendations detailed in the EIS, this Report and in the final management plans approved by the Department of Mines and Energy, are implemented and subject to regular reporting and compliance auditing.

The final EMP for the Project will be subject to review to the satisfaction of the relevant Northern Territory agencies prior to its incorporation into the Mining Management Plan. It is recommended that management plans also be developed in consultation with key stakeholders, including the CLC and Traditional Owners (where relevant). The management plans will be working documents for the life of the Project and will require periodic review in the light of operational experience and changed circumstances.

Future requirements to verify modelling and predictions are largely captured in the commitments made by the Proponent and recommendations in this Report. The ongoing risk analysis, environmental monitoring and management required from the Proponent must demonstrate that environmental impacts from the Project are no greater than those predicted in this assessment.

## **List of Recommendations**

### **Recommendation 1**

**The Proponent shall ensure that the Project is implemented in accordance with the environmental commitments and safeguards:**

- a) Identified in the Twin Bonanza 1 Gold Mine Environmental Impact Statement (draft Environmental Impact Statement and Supplement to the draft Environmental Impact Statement); and**
- b) Recommended in this Assessment Report.**

**The Northern Territory Environment Protection Authority considers that all safeguards and mitigation measures outlined in the Environmental Impact Statement are commitments made by the Proponent.**

### **Recommendation 2**

**The Proponent shall advise the Northern Territory Environment Protection Authority and the responsible Minister of any changes to the proposed action, in accordance with clause 14A of the Environmental Assessment Administrative Procedures including (but not limited to) any proposal to undertake mining activities below the water table or any change in the characterisation of waste rock that causes greater risks.**

### **Recommendation 3**

**The Weed Management Plan is to be prepared in consultation with the Department of Lands Resource Management and incorporated into the MMP for approval by the Department of Mines and Energy. The final Weed Management Plan should specify the equipment and vehicle wash-down locations and a rationale for their selection. The final Weed Management Plan is to be implemented prior to the commencement of mining activities within the Mining Lease Area.**

### **Recommendation 4**

**In addition to the Water Management Plan, the Proponent should prepare a Site Water Account and Management Plan for inclusion in the Mining Management Plan. The Site Water Account and Management Plan will include:**

- A table detailing the water usage for each stage of the development;**

- the location of new and existing monitoring bores that have been used to assess water quality and extraction across the operation;
- baseline water information that is acceptable for use in ongoing groundwater monitoring; and
- details of the aquifer properties and groundwater resources.

The Site Water Account and Management Plan should be consistent with the Water Management Plan.

#### **Recommendation 5**

A Road Transport and Traffic Management Plan, which provides appropriate mitigation in response to traffic risks, must be prepared to the satisfaction of the Department of Mines and Energy and submitted as part of the Mining Management Plan.

The Road Transport and Traffic Management Plan is to be implemented for all stages of the Project and reviewed on an annual basis, taking into account concerns or complaints raised during the annual review of the Plan.

#### **Recommendation 6**

The Proponent taking the proposed action is wholly responsible for implementation of all conditions of approval and mitigation measures contained in the Environmental Management Plan and must ensure all staff and contractors comply with all requirements of conditions of approval and mitigation measures contained in the Environmental Management Plan.

The Environment Management Plan, and sub-plans, should form part of the Mining Management Plan. In preparing each plan, the Proponent will include any additional measures for environmental protection and monitoring contained in this Assessment Report.

#### **Recommendation 7**

Within three years of commencing the Project, the proponent must commission and pay the full cost of an independent environmental audit of the project. The audit should:

- Be conducted by a suitably qualified, experienced and independent team of experts;
- Assess the environmental performance of the project and review whether the Proponent has complied with all recommendations, conditions and commitments;
- Review the adequacy of the plans and procedures and recommend appropriate measures or actions to improve the environmental performance of the action, including any plans or procedures.

The results of the audit should be submitted to the Department of Mines and Energy and the Northern Territory Environment Protection Authority. The results of the audit must be made available on the Proponent's website.

#### **Recommendation 8**

**The Biodiversity Management Plan should include a mechanism to record road strikes affecting the greater bilby. The log should be reported annually to the Department of Mines and Energy, and made available to other relevant agencies upon request.**

**Recommendation 9**

**Should the Australian Government decide that offsets are required to compensate for the residual significant impacts to matters of national environmental significance, the Proponent shall submit a revised offset plan for consideration and approval. The revised offset plan should clearly define the mitigation, management and compensatory measures that will be implemented on site. Any offset measures should be consistent with Australian Government's Offset Policy and calculator.**

# 1 Introduction

ABM Resources NL (the Proponent) intends to develop the Twin Bonanza 1 Gold Mine and associated processing facilities (the Project) in the Tanami Region of the Northern Territory. The Project is located within Mining Lease Area (MLA) 29822 which is located approximately 527km west of Tennant Creek, and 14km east of the Northern Territory and Western Australia border. The mine will require the excavation of a series of open pits with the aim of extracting gold. The Proponent has stated in its Notice of Intent (NOI) that the action involves the construction and operation of the following components:

- A series of open pits (including cutbacks) down to a maximum depth of ~100m using drill, blast, load and haul techniques;
- installation of associated water storage and tails dams;
- the installation and operation of gravity processing equipment for refining ore;
- installation of ancillary infrastructure, including: generators/power plants, staff accommodation, workshop and office areas;
- reverse osmosis plant for producing potable water;
- upgrading and lengthening of the existing Bonanza airstrip; and
- upgrade of existing, and construction of new, access roads around the proposed mine site.

The Proponent predicts that the Project will have an initial open pit mine life of 3-4 years. This estimate is based on a short term extraction rate of between 200 000 and 300 000t per annum. Should any additional resources be identified, the proponent notes that the life of the open pit mine may extend beyond 3-4 years. Additional mining activities, including underground mining will require further investigation and for this reason ABM has not included this within the scope of the action.

The total mine footprint is 26 ha, and the proposed disturbance area is 257.4 ha (proposed disturbance area includes cleared areas, and all areas directly adjacent to activities that may be impacted by noise, dust, and general traffic). See Figure 2 for proposed mine layout.

The purpose of this Assessment Report (this Report) is to identify and evaluate the Project's risks to the environment and to recommend whether the risks are acceptable. This report will identify the potentially significant risks of an environmental impact occurring as a result of the Project components and activities, and evaluating the Proponent's corresponding safeguards or prevention measures to remove or mitigate the risks. The contents of this Report form the basis of advice to the Minister for Lands, Planning and the Environment (the Minister) on the environmental impact assessment (EIA) of the Project and the acceptability of any residual risks to the environment.

## 1.1 Environmental impact assessment process

The EIA process should:

- Identify potential impacts on the environment (where environment is defined broadly according to the *Environmental Assessment Act* (EA Act)); and
- evaluate the risks of those impacts occurring.

Through the assessment of the environmental risks of the Project, the Proponent must demonstrate:

- that these risks can be satisfactorily managed within acceptable levels, e.g. impacts would not result in long-term or irreversible environmental detriment; and



- the effectiveness/feasibility of management measures in a precautionary/risk management framework.

That the assessment gives weighted consideration to:

- values and risks;
- estimation of the likelihood of success of preventative and remedial measures; and
- the validity and comprehensiveness of programs established to provide ongoing measures of the environmental effects of the Project.

The assessment of environmental risk can be more reliably evaluated when there is a substantial baseline of relevant information. Where this information is limited or not available, risk assessment is inevitably constrained and far less precise. In the absence of sufficient baseline information it is appropriate to use the precautionary principle to evaluate possible impacts. If potential impacts are understood with a reasonable level of certainty, monitoring programs can be better informed to detect impacts, and management measures can be more effectively targeted to address those impacts.

This Report evaluates the adequacy of commitments and environmental safeguards proposed by the Proponent to avoid or mitigate the risks of potential impacts identified in the EIA process. The safeguards may be implemented at various levels in the planning framework of a project and include (among other approaches):

- Design and layout of the mine components including construction camps, access roads and other infrastructure, associated with the Project;
- Management of construction activities; and
- Management of processes used in, and during operation of the mine (e.g. inputs and outputs).

## 1.2 Regulatory framework

Environmental assessment was undertaken in accordance with the requirements of the EA Act. The proposal was determined to be a controlled action under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) as it was determined to have significant impacts on listed threatened species and communities and listed migratory species which are matters of national environmental significance (MNES). The Project has been assessed by the Northern Territory Environment Protection Authority (NT EPA) on behalf of the Australian Government.

The NT EPA has produced this Report as advice to the Minister on the EIA of the Project. The Minister is required to give a copy of this Report to the Minister for Mines and Energy (the responsible Minister), together with any written comments made by the Minister in relation to this Report. The responsible Minister, taking into consideration this Report, will then make a decision as to whether or not an approval should be granted under the *Mining Management Act* and if so, whether any conditions should be applied.

The Australian Government Minister responsible for the EPBC Act (the Australian Government Minister) will need to consider the Project for an approval decision under the EPBC Act. This Report will inform the consideration. The approvals and regulatory requirements for the Project are set out in Chapter 2 of the draft EIS.

## 1.3 Environmental impact assessment history

On 11 January 2013, the Northern Territory Environment Protection Agency received the Notice of Intent (NOI) for the Twin Bonanza 1 Gold Mine Project for consideration under

the EA Act. The NOI was referred to the NT EPA by the Department of Mines and Energy (DME) due to the potential impacts to listed threatened species. On 15 May 2013, the NT EPA Board decided that the Project required assessment under the EA Act at the level of Environmental Impact Statement (EIS).

On 13 March 2013, ABM Resources referred the Project to the then Australian Government Department of Sustainability, Environment, Water, Population and Communities (SEWPaC). The action was determined to be a controlled action on 23 April 2013 and therefore required assessment and approval under the EPBC Act. The Project was considered likely to have significant impacts on listed threatened species and communities (sections 18 & 18A) which is a matter protected under Part 3 of the EPBC Act.

On 16 May 2013, a delegate for the Australian Government Minister agreed to accredit the assessment process under the EA Act for the purposes of assessing the Project.

Draft guidelines covering matters to be addressed in the EIS were subject to a public review period for 14 days between 29 June 2013 and 12 July 2013. On 31 July 2013, a delegate for the NT EPA directed the Proponent to prepare the EIS addressing the matters set out in the final guidelines (NT EPA, 2013b).

The draft EIS for the Project underwent an eight week public exhibition period commencing on 14 December 2013 and finishing on 7 February 2014. Ten submissions were received by the NT EPA on the draft EIS. Of those submissions received, seven were from Government agencies and three from non-Government organisations. All submissions were forwarded individually to the Proponent. The Proponent prepared a Supplement as required under the EA Act to address the issues raised by the respondents. A list of submissions on the draft EIS, including the Proponent's responses, are included at Appendix A of the Supplement.

The NT EPA received and circulated the Supplement to Government advisory bodies and suitably qualified individuals and organisations for comment. This Report is based on a review of the draft EIS, the Supplement and comments from the Proponent, non-Government respondents and Government advisory bodies on the draft EIS. The NT EPA has prepared this Assessment Report and provided it to the Minister for Lands, Planning and the Environment and the Federal Minister for the Environment.

The EIA chronology, draft EIS and supplement can be viewed on the Twin Bonanza Gold Mine project page of the NT EPA website at:

<http://www.ntepa.nt.gov.au/environmental-assessments/assessment/register/twin-bonanza-gold-mine>

## 1.4 Ecologically Sustainable Development

The Australian Government affirmed its commitment to sustainable development at the United Nations conferences on environment and development, notably via the Rio Declaration and Agenda 21 in 1992 and the Johannesburg Declaration at the United Nations 2002 World Summit. Australia reaffirmed its commitment at the Summit to promote the integration of the three components of sustainable development – economic development, social development and environmental protection – as interdependent and mutually reinforcing pillars.

Australia developed the National Strategy for Ecologically Sustainable Development (ESD) identifying five national principles. The Strategy identified ways to apply the principles to a range of industry sectors and issues such as climate change, biodiversity conservation, urban development, employment, economic activity, and economic diversity and resilience.

In December 1992 the NT Government endorsed the National Strategy and agreed, along with all other States and Territories, to the Intergovernmental Agreement on the Environment.

The Strategy defines ESD as:

*‘Using, conserving and enhancing the communities’ resources so that ecological processes, on which life depends, are maintained and the total quality of life now and in the future can be increased.*

*ESD is development that aims to meet the needs of Australians today, while conserving our ecosystems for the benefit of future generations.’*

**Table 1. The principles of Ecologically Sustainable Development**

<b>ESD Principle</b>	<b>Definition</b>
Integration principle	Consideration needs to be given to the long and short-term economic impacts as well as other environmental, social and equitable impacts.
Precautionary principle	Where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.
Inter- and intra-generational equity	The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of present and future generations.
Conservation of biological diversity and ecological integrity	The conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making
Improved valuation, pricing and incentive mechanisms	Should be promoted to ensure that the costs of environmental externalities are internalised and that the polluter bears the costs associated with environmental pollution.

To achieve the objectives of ESD, the Project needs to continually be informed and guided by the ESD principles. Accordingly, the assessment of this proposal, its potential impacts (positive and negative) and the management measures used to enhance positive and reduce negative impacts was undertaken in the context of ESD principles.

Subsequent decision-making processes by approval bodies must be guided by ESD principles and the continued project design and development, as well as the development and implementation of management and monitoring programs by the Proponent, should all aim to meet the objective of ESD.

## 2 The Project

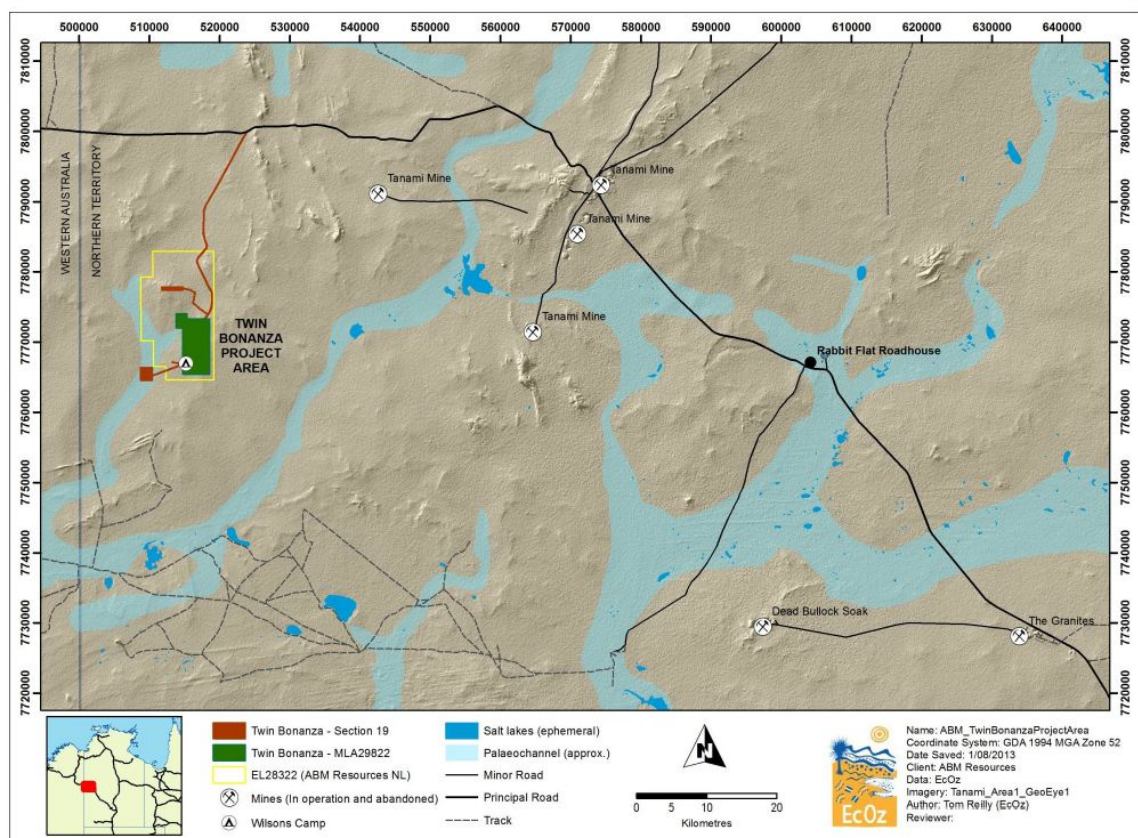
ABM Resources has provided a detailed description of the Twin Bonanza Project in Chapter 2 of the draft EIS. Since publishing the draft EIS, ABM Resources has reconfigured and added some infrastructure to the Project. Amendments were also made to the some environmental management measures. These amendments have been outlined in Chapter 3 of the Supplement.

## 2.1 The Proponent

The Twin Bonanza 1 Gold Mine has been proposed by ABM Resources NL (ACN / ABM: 58 009 127 020). ABM Resources is a Western Australian based exploration company which operates wholly within the Northern Territory. The draft EIS notes that ABM is an exploration company developing several gold discoveries in the Central Desert region of the Northern Territory with Twin Bonanza 1 being its first mine. The company is listed on the Australian Securities Exchange under code ABU. ABM Resources currently holds exploration licences and application portfolios covering more than 33 000km<sup>2</sup>. ABM has stated in the draft EIS that it has a total resource estimation base of 3.5Moz across multiple projects in the highly prospective Central Desert.

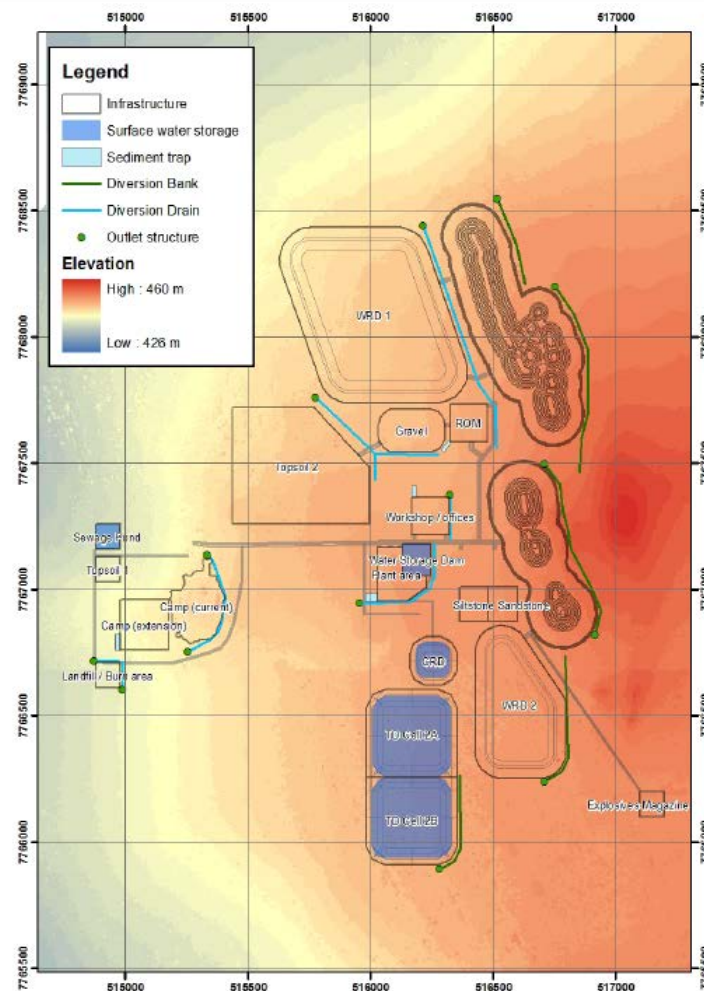
## 2.2 Project Location

The Mining Lease Area 29822 (MLA) is located within exploration lease EL 28322, which is approximately 15km east of the Northern Territory-Western Australia border. The closest major settlement is Tennant Creek, 527km to the east. Alice Springs is 617km to the south east and Darwin 874km to the north (see Figure 1). The project area falls within the Mt Frederick No 2 Aboriginal Land Trust. All of EL 28322 falls under Aboriginal land and is held as inalienable freehold title under the *Aboriginal Land Rights Act 1976* (Cwlth).



**Figure 1. Twin Bonanza Project Area (includes MLA29822 and Section 19) (source: EcOz 2013)**





**Figure 2. Revised layout of the proposed Twin Bonanza Gold Mine (source: Supplement to the draft EIS).**

## 2.3 Schedule

The Proponent predicts that the project will have an initial open pit mine life of 3-4 years. The Proponent has based this estimate on a short term extraction rate of between 200 000 and 300 000t of ore per annum. Should any additional resources be identified, the life of the open pit mine may extend well beyond 3-4 years.

The Proponent is proposing to undertake excavations in a series of stages with the first stages commencing at the shallowest depths of the ore-body. Initially stage one (under exploration licence / mining management plan) will involve the following activities:

- Operation of a pilot processing facility running at 150t per day on a split shift basis;
- Processing of ore from the top 5m of selected areas of the deposit;
- Extraction of water from existing bores;
- Establishment of a small scale portable mining camp;
- Stockpiling of waste rock adjacent to the excavation area; and
- Storage of tailings in a lined tailings dam.

The Proponent notes that once authorisation to mine has been received stage two of the action will commence. Initial earthworks and development will commence within 1 month with mining and processing occurring within 2 months. Stage three will include a deepening of the open cut pits to continue high grade quartz vein mining at depth. Stage three is likely to include an expansion of stage one / two plant to allow for processing 24 000t per annum.

**Table 2 Project stages for the Twin Bonanza Project (source Chapter 3 of the draft EIS).**

Component	Stage one (underway 2013)	Stage two (modelled and will be updated following stage one)	Stage three (will be updated during stage one)
Resource	10 000 tonnes @ 10g/t gold	276 000 tonnes @ 12.3g/t	1Mt @ 10g/t
Mining rate	60 to 200 tonnes per day depending on shifts and maintenance.	120 000 to 150 000tpa	240 000 to 300 000 tpa
Mine life	3 to 5 months	2 years	4 years
Mining method	Open pit mining using rock-breaker.	Open pit mine using conventional drilling, blasting, loading and haulage methods.	Open pit mining expansion using conventional drilling, blasting, loading and haulage methods.
Tailings	Tailings discharged to below natural surface tailings dam	New tailings dam construction – old tailings dam converted to a water storage dam	Tailings dam designs 2A and 2B, and concentrated residual dam (within EIS) represents staged designs for the management of tailings until the end of stage three
Pit dimensions	Multiple small test pits up to 200m long 5 to 20m wide.	Separate pits for Old Pirate and Golden Hind. Maximum size 800m x 200m	Pit design in this EIS represents the early part of stage three. Pits cover an area of 22.5 hectares
Waste rock	Stored on surface next to the excavation areas.	Stored on surface in waste rock dump	Two waste dumps as contained in this EIS with a nominal height of 20 metres and covering a total area of 60.5 hectares. Potential to expand in the future.
Processing	Small scale gravity gold plant.	Small scale gravity gold plant with potential intensive cyanide leach if required.	Expanded scale gravity gold plant with possible intensive cyanide leach if required.
Power	Diesel generators with 1 to 2MW	Diesel generators 1 to 2MW	Diesel generators 2 to 3MW
Product	3 000 ounces of gold	109 000 ounces of gold	340 000 ounces of gold
Transport	Air freight for gold product	Air freight for gold product	Air freight for gold product
Water management	2 bores	2 bores +	2 bores +
Workforce	Approximately 30	Approximately 68	Approximately 68

The Proponent has taken a risk managed approach to production and expects to ramp up extraction in the short term to a rate of between 200 000t per annum and 300 000t per annum. The 2012 scoping study envisages that mining operations to a maximum depth of ~100m below surface with a strip ratio of 13:1 (waste:ore). A revised scoping study is intended to be completed in early 2013 and will be based on updated resource models and open pit designs prior to the commencement of mining. The revised scoping study will incorporate information obtained from trial mining and processing.

Depending on ongoing exploration and mining results, the existing open pit mining may be further expanded or underground mining undertaken, in conjunction with or at the conclusion of open pit mining.

## **2.4 Workforce and construction camps**

As mining and processing operations change, the Proponent has noted that staff numbers will fluctuate. If and when the scale of operations are expanded, or if additional requirements become evident with planned operations, such as an increased strip ratio for open pit mining, the Proponent will seek additional staff on site. The staff roster will revolve around a 3 shift work force, with each shift working 2 weeks on and 1 week off. Staff will be Fly-in Fly-out (FIFO) and will be housed in on-site accommodation while on-site. A breakdown of the estimated work-force for the Project has been outlined on Table 13-5 of the draft EIS.

Staff will travel to the site via Perth or Broome before boarding a private charter flight to the Twin Bonanza Airstrip. On occasions staff may be required to drive from Alice Springs which will require the use of the Tanami Road.

## **2.5 Construction**

Mining operations are proposed to be undertaken using conventional open pit mining methods (drill, blast, load and haul), but with a particular focus on maximising the recovered grade from the deposit. The Proponent has outlined more detailed construction and mining operations in Chapter 3 of the draft EIS.

Final open pit designs will incorporate information obtained from trial mining and processing. The areas identified for this project's mining and processing are significantly larger than those incorporated in the 2012 scoping study. Subsequent open pit designs are expected to incorporate the 690m of strike at Old Pirate, 110m of mineralised strike at Golden Hind, as well as other mineralised areas. Open pit mining will require the clearing of top soil and establishment of safety and abandonment bunding. Roads, pads and waste dumps will be constructed.

# **3 Environmental Impact Assessment**

## **3.1 Introduction**

The purpose of this Report is to evaluate the Project and to determine whether it can proceed with acceptable environmental impacts. This is achieved by identifying the potentially significant risk of an environmental impact occurring as a result of the Project components and activities, and evaluating the Proponent's corresponding safeguards or prevention measures to remove or mitigate the risks. Where the proposed safeguards are considered insufficient, or where a safeguard is deemed particularly important, recommendations are made to add to or emphasise commitments made by the Proponent.

The environmental acceptability of the Project is based on analysis of the following from the EIS:

- Adequacy of information outlining the proposed action (particularly which components or activities are likely to impact the environment);
- Adequacy of information on the existing environment (particularly environmental sensitivities);
- Adequacy of information on the range and extent of potential impacts and the risks of those impacts occurring within the Project context; and
- Adequacy of the proposed safeguards to avoid or mitigate potential impacts.

In this Report, the recommendations (in **bold**) are preceded by text that identifies concerns, suggestions and undertakings associated with the Project. For this reason, the recommendations should not be considered in isolation.

Minor and insubstantial changes are expected in the design and specifications of the Project following the conclusion of the EIA process. It will be necessary for approval mechanisms to accommodate subsequent changes to the environmental safeguards described in the EIS and recommendations in this Report. If the Proponent can demonstrate that changes are unlikely to significantly increase the risks of an impact on the environment, an adequate level of environmental protection may still be achieved by modifying the conditions attached to relevant statutory approvals governing the Project. Otherwise, further environmental assessment may be required.

Therefore, subject to decisions that permit the Project to proceed, the overarching recommendations of this Report are:

#### **Recommendation 1**

**The Proponent shall ensure that the Project is implemented in accordance with the environmental commitments and safeguards:**

- c) **Identified in the Twin Bonanza 1 Gold Mine Environmental Impact Statement (draft Environmental Impact Statement and Supplement to the draft Environmental Impact Statement); and**
- d) **Recommended in this Assessment Report.**

**The Northern Territory Environment Protection Authority considers that all safeguards and mitigation measures outlined in the Environmental Impact Statement are commitments made by the Proponent.**

#### **Recommendation 2**

**The Proponent shall advise the Northern Territory Environment Protection Authority and the responsible Minister of any changes to the proposed action, in accordance with clause 14A of the Environmental Assessment Administrative Procedures including (but not limited to) any proposal to undertake mining activities below the water table or any change in the characterisation of waste rock that causes greater risks.**

### **3.2 Summary of environmental issues**

Analysis by the NT Government of the NOI for the Project identified a number of environmental risks. On the basis of these, it was determined that an EIS was required for the Project. Key risks that contributed to the decision included:

- the potential for the action to impact sites with Indigenous and non-indigenous cultural or archaeological significance;



- the clearing and loss of potential habitat and individuals of a number of species listed as threatened under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the *Territory Parks and Wildlife Conservation Act* (TPWC Act);
- an increased risk of environmental damage or degradation to the site. In the absence of suitable mitigation or management measures, ongoing degradation could result in significant impacts to the environment, in particular flora and fauna and remnant vegetation;
- potential ongoing impacts to groundwater resources through the establishment and abstraction of water from at least two bores and a borefield;
- uncertainty around the scope of the Project in relation to the scale, size and complexity of all components;
- the potential for ongoing land degradation and impacts associated with the management and disposal of wastewater and other contaminants; and
- based on the information provided and in the absence of further assessment or analysis, the introduction and operation of a new development with associated infrastructure is likely to significantly alter the current social and economic aspects of the region.

Information requirements based upon identified risks were described in the EIS Guidelines for the Project (NT EPA, 2013a) and the Proponent submitted the draft EIS to address these requirements. The Proponent broadly categorised the respondent's issues and concerns into the following topics for discussion in the Supplement:

- Further clarification of project description;
- Management of weeds and feral animals; and
- Impacts on the greater bilby; mulgara and the great desert skink.

A number of issues and concerns identified through the EIA process were addressed by the Proponent to the satisfaction of respondents and advisory bodies and are not discussed further. The remainder of Section 3 of this Assessment Report discusses the important issues and concerns, based on potentially significant risk, raised throughout the EIA process and the Proponent's commitments to address and manage these issues and concerns. Recommendations to complement or strengthen environmental management strategies and safeguards are provided.

The Project has been declared a controlled action under the EPBC Act. The controlling provisions are listed threatened species and communities (sections 18 and 18A).

A search on the Australian Government's Environmental Reporting Tool identified the potential presence of 20 listed threatened species and 18 migratory species listed under the EPBC Act. The NT EPA requested that the EIS quantify the Project's impacts to these species, discuss how the impacts would be mitigated and outline whether the impacts (following mitigation) would be acceptable. Vegetation assessment was to be undertaken within a suitable buffer distance along the length of the project area, at an intensity appropriate to identify significant or sensitive vegetation types. Where identified, the extent of significant or sensitive vegetation types was mapped at an appropriate scale. The intent of the queries was to confirm that the survey timing corresponds with the optimum time to survey for EPBC Act listed species.

Of primary concern were the potential impacts of the Project on the greater bilby, mulgara and the great desert skink.

### 3.3 Ecology and biodiversity

#### 3.3.1 Flora

Flora surveys identified a total of 102 species (EcOz, 2013). The surveys did not identify any threatened or near threatened species. A single data deficient species (*Trachymene villosa*) and three not evaluated species were located during the survey (*Clerodendrum floribundum*, *Ehretia saligna* and *Evolvulus alsinoides*). Infestations of the weed buffel grass (*Cenchrus ciliaris*) were identified at the Tanami Road junction, Wilson's Camp and Wilson's Bore. The potential impacts of this weed on species of conservation significance has been discussed further at section 4 of this Assessment Report.

Vegetation surveys led EcOz (2013) to conclude that there are five main vegetation types occurring within the survey area. These are:

- Vegetation type 1: Low *Eucalyptus brevifolia* isolated trees ± mid high *Acacia lysiphloia* or low *A. hilliiana* isolated shrubs over *Triodia basedowii* open hummock grassland;
- vegetation type 2: *Triodia basedowii* and *T. intermedia* mid open hummock grassland with *Acacia minutifolia* and *A. adoxa* var. *adoxo* low open shrubland.;
- vegetation type 3: Open *Triodia* spp. hummock grassland ± low *Eucalyptus brevifolia* or *Hakea lorea* isolated trees with tall ± *Grevillea wickhamii* or *Acacia* spp. open shrubland;
- vegetation type 4: Low *Corymbia opaca* or *Eucalyptus victrix* ± *Eucalyptus brevifolia* open woodland with tall *Acacia sericophylla* open shrubland over *Triodia pungens* open hummock grassland; and
- vegetation type 5: *Acacia aneura* woodland over mixed tussock grass.

There were no vegetation types that were identified on site that are listed as threatened ecological communities under the *Territory Parks and Wildlife Conservation Act* or the EPBC Act.

#### 3.3.2 Fauna

Separate Dry (EcOz, 2013) and Wet season (GHD, 2012) fauna surveys have been undertaken on the Twin Bonanza Site. The surveys identified and recorded 73 terrestrial vertebrate species (42 birds, 16 reptiles and 15 mammals). Two species listed as threatened were recorded on the site (greater bilby - *Macrotis lagotis*) and (brush-tailed mulgara - *Dasycercus blythi*) were recorded on site.

#### 3.3.3 Weeds

The spread of weeds through construction and mining operations has been identified as a potential environmental risk by the NT EPA (NT EPA, 2013b). Potential vectors for the introduction and spread of weeds onto and through the site are most likely to result during the movement of traffic as well as new infrastructure. The establishment and spread of weeds on site is generally related to environmental disturbances caused by the construction related activities but can also be related to the movement of vehicles, machinery or personnel. Surveys on the site were undertaken by EcOz (EcOz, 2013) and GHD (GHD, 2012) and identified the presence of buffel grass (*Cenchrus ciliaris*) on site.

At least three weed infestations have been located within the Project area occurring at Wilson's Camp, Wilson's Bore and the junction of Tanami Road/Wilson's Camp access track. The Proponent has identified in its draft EIS that it intends to commence control and monitoring activities for buffel grass at the infested locations as soon as possible.

### 3.3.4 Submissions

Submissions from Government and non-government agencies did not raise any issues or concerns about impacts to general flora, fauna. One submitter recommended that the Proponent implement the findings of Appendix D of the Supplement to address concerns about the potential risks to groundwater dependent ecosystems from water extraction.

### 3.3.5 Potential Risks

The NT EPA initially identified the following potential risks to biodiversity as a result of the proposal:

- Degrade the environment through the introduction of weeds and pest fauna species within and adjacent to the Project area; and
- risk local biodiversity through the clearing of vegetation, edge effects, introduction of pest animals, weeds and fragmentation of habitat.

### 3.3.6 Assessment of risks to flora

The NT EPA's environmental objectives for this environmental risk are to maintain the conservation status, diversity, geographic distribution and productivity of flora and fauna at the species and ecosystem levels through the avoidance or management of adverse impacts.

The NT EPA acknowledges that vegetation from the site will be progressively removed during construction of mining infrastructure and during mining activities. The impacts have been examined and the NT EPA considers that the clearing of 257.4 ha of vegetation which is locally or regionally common is unlikely to have a significant residual impact on the environment in the Tanami Region. The NT EPA considers that the mitigation measures identified in Chapter 6 of the draft EIS will suitably reduce the impact on native vegetation to an acceptable level.

ABM Resources notes in its draft EIS that all land clearing activities for the Project will be undertaken in compliance with the Land Clearing Procedure (Appendix D) and a Ground Disturbance Management Plan. The NT EPA notes that the Land Clearing Procedure has been prepared by ABM Resources to be consistent with the Northern Territory Land Clearing Guidelines (NRETAS, 2010). To reduce the potential risks of soils to wind and water erosion, ABM Resources is only proposing to clear vegetation when it is required. To prevent any unanticipated clearing, ABM Resources will demarcate areas with cones or pegs.

A vegetation condition program will be implemented over the life of the project to monitor the health of the vegetation on site, this includes groundwater dependent vegetation. The methodology to be used is still yet to be finalised but will be based on the techniques used by the regional biodiversity monitoring program. The NT EPA notes that the mitigation and management measures outlined in the Biodiversity Management Plan will be sufficient to mitigate and avoid potential impacts on adjacent areas of vegetation that have not been identified for clearing. The NT EPA acknowledges that there may be risks to groundwater dependent vegetation from water extraction activities. To ensure these risks are addressed, the NT EPA expects the Proponent to implement the recommendations in Appendix D of the Supplement (see Hanrahan and Low, 2014).

### 3.3.7 Assessment of risks to fauna

The Biodiversity Management Plan outlines a number of mitigation measures to reduce the potential impact of clearing activities on threatened fauna but does not specifically state any salvage or mitigation measures for unlisted fauna. The NT EPA notes that the proposal to initiate controlled burns to allow for pre-clearance surveys for the mulgara and bilby is likely to disperse other fauna that are living in native vegetation and therefore would reduce the impact on general biodiversity.

### 3.3.8 Assessment of risks from weeds

The NT EPA notes that with construction and mining related activities increasing on the site the potential for weed spread and establishment will increase. To mitigate and manage the risks associated with the introduction and spread of weeds, the NT EPA recommends that the Proponent develop and implement best practice weed hygiene protocols as part of a Weed Management Plan. The Weed Management Plan should be implemented for all construction, mining and rehabilitation related activities. While the management measures outlined in the Weed Management Plan will be sufficient to avoid introducing or spreading weeds within the Project area, the NT EPA stresses the importance of ongoing management actions, including follow up monitoring for quantifying the spread of existing incursions as well as identifying new weeds on site. Further discussion of the potential risks to species of conservation significance has been provided at section 4.1.2.4 of this Report.

### Recommendation 3

**The Weed Management Plan is to be prepared in consultation with the Department of Lands Resource Management and incorporated into the MMP for approval by the Department of Mines and Energy. The final Weed Management Plan should specify the equipment and vehicle wash-down locations and a rationale for their selection. The final Weed Management Plan is to be implemented prior to the commencement of mining activities within the Mining Lease Area.**

## 3.4 Water and Water Management

### 3.4.1 Description

The Twin Bonanza Project is located within the Tanami region which is semi-arid and characterised by hot, wet summers and mild relatively dry winters. The average annual rainfall for the region ranges from 400-500mm with approximately 85% falling between November and April (BoM, 2013). Rainfall on the site, while infrequent is characterised by intense events that are capable of delivering 50mm in 24hrs on average at least once per year. The average pan evaporation for the region is approximately 3000mm/yr (BoM, 2013) which far exceeds the rainfall average. The site of the Twin Bonanza Project is located high in the landscape and does not intersect surface water features. The site does not have any permanent water features with the dominant surface water flow process being sheet flow following large rainfall events.

Information provided in the draft EIS suggests that the site contains two types of aquifers (hardrock and unconsolidated sedimentary aquifer). Groundwater recharge on the site is understood to generally occur only after significant rainfall events with 4.5mm/year or 1% of the annual average rainfall considered a reasonable estimate of recharge to palaeochannels (unconsolidated sedimentary aquifers) by Earth Systems (2013). The draft EIS did not provide any estimates of groundwater recharge to the bedrock (hardrock) aquifer. The Proponent has indicated that it will target the palaeochannel aquifers to identify potential sources of water for the Project. The Supplement identified a number of target areas from palaeochannels for further hydrogeological investigations.

Currently, the trial operations on the Project Site are using water that has been extracted from Wilson's Bore and Corsair Bore at a combined rate of approximately 2L/s. The draft EIS has identified that a third bore (Timmy's Bore), may be required for operational purposes. The third bore is located approximately 5km west of the main project area within the Nora palaeochannel. The draft EIS has identified a potential corridor for the pipeline to the bore. While Timmy's bore has collapsed, the draft EIS notes that the historical depth to water was less than six metres below ground level. The three existing groundwater extraction bores occur within or adjacent to the MLA. The locations of the bores are outlined on Figure 1 at Appendix E of the Supplement.

The NT EPA notes that there are currently no dedicated monitoring bores located within the Project Area and limited information is available from the existing bores in and around the site. To monitor groundwater quality and extraction, ABM is proposing to establish a monitoring bore network, comprising the existing and 17 new bores (within the bedrock and palaeochannel aquifers), across the site. Monitoring activities will include the testing of established and re-established bores in the region (Corsair, Wilson's and Timmy's) as well as the collection of baseline water data for the purpose of monitoring activities. The findings of the baseline and ongoing monitoring should be incorporated into the site water account and management plan.

### 3.4.2 Submissions

Key concerns raised in the public submissions were:

- Location of the camp sewerage leach pond and landfill relative to the boundary of MLA 29822;
- Water management and hydrogeological conditions on site to address the risk of extracting groundwater beyond sustainable yields;

### 3.4.3 Assessment

The NT EPA's environmental objectives for this risk is to ensure that surface water and groundwater resources and quality are protected both now and in the future, such that ecological health and land uses, and the health, welfare and amenity of people are maintained.

The NT EPA initially identified the following potential risks associated with the proposal on the water resources in the region:

- Surface water quality may be impacted by spills to surface water and runoff containing hazardous substances or elevated sediment concentrations; and
- Contamination of groundwater could occur through the incorrect storage and handling of contaminants, chemicals and toxicants.

The draft EIS notes that main water requirements for the Project are for ore processing, dust suppression, laundering, camp and the operation of a wash-down bay. The Proponent has identified that stage one and stage two water requirements for the Project will be in the order of 4.1L/s. Water requirements will be in the order of 11.1L/s for stage three including loss to tails, loss at the processing plant, camp use and mining. The draft EIS and Supplement identified some gaps with respect to available water resources and the potential yield of bores on-site. To inform the water balance and ensure sufficient quantities of water are available for the Project, the Proponent has commissioned a number of studies with the aim of addressing the information gaps. The NT EPA notes that the gaps in information are unlikely to present a risk to the environment (but are likely to) affect the operational capacity of the mine.

The NT EPA acknowledges that dewatering is unlikely to be required in the pits as the ground water outside the palaeochannels is typically greater than 100m below ground level. ABM Resources has acknowledged that future mining activities may require mining below the water table and that groundwater may be produced as a by-product. The potential risks associated with mining are likely to require that the Proponent submit an application under the EA Act. Consistent with recommendations 1 and 2 of this Assessment Report, the NT EPA considers that any mining activities below the water table would be considered to be outside the scope of this assessment and would require a separate NOI to be submitted for consideration under the EA Act. Further to this, the NT EPA notes that the Proponent is not proposing to take, or use surface water for the operation of the mine. If any future use of surface water is proposed, the Proponent will need to consult with relevant stakeholders and seek the appropriate approvals.



### 3.4.4 Summary

The NT EPA considers the key environmental factor of maintaining surface quality and quantity have been adequately addressed. While further information is required regarding the potential yields from groundwater aquifers, the impacts of additional extraction are not considered likely to impact the environment in the Tanami Region. To ensure that the operational risks from water availability are suitably addressed, the NT EPA recommends that the Proponent include the results of the further water sustainability studies in the revised Water Management Plan.

### Recommendation 4

**In addition to the Water Management Plan, the Proponent should prepare a Site Water Account and Management Plan for inclusion in the Mining Management Plan. The Site Water Account and Management Plan will include:**

- **A table detailing the water usage for each stage of the development;**
- **the location of new and existing monitoring bores that have been used to assess water quality and extraction across the operation;**
- **baseline water information that is acceptable for use in ongoing groundwater monitoring; and**
- **details of the aquifer properties and groundwater resources.**

**The Site Water Account and Management Plan should be consistent with the Water Management Plan.**

## 3.5 Historic and Indigenous cultural heritage

### 3.5.1 Description

The heritage surveys included in the draft EIS and summarised in Chapter 13 note that the first recorded non-Aboriginal visitors to the region were between 1898 and 1900 when the Davidson expedition visited Central Australia. The route took the expedition approximately 16km northwest of the current airstrip and 35km south-southwest of Old Pirate. There have been no recorded non-Aboriginal visits to the Old Pirate project area until 1990 when North Flinders Mines first identified the site. The results of the heritage study concluded that there were no sites identified that have non-Aboriginal cultural significance.

The results of cultural heritage surveys identified six archaeological sites or individual objects on the site. The survey identified two spatially discrete / low density stone artefact scatters with small ephemeral clay-pans and three isolated artefacts. The survey also identified a single site that had an extensive but low density stone artefact scatter. The stone material used for tool production appears to be predominantly chert and silcrete which were most likely to have been sourced from quarries outside of the study area. The results of the archaeological sites within the Twin Bonanza study area were concluded by ABM Resources to be of low significance, however the scientific significance is noted. The level of significance was based on the fact that the sites and area were not identified as being culturally significant during anthropological investigations and the artefacts located suggest that there is a likelihood that a larger quarry and occupation site occurs outside of the Project site.

### 3.5.2 Submissions

Key concerns raised in the public submissions were:

- Potential impacts to the cultural landscape associated with the height of the waste rock dumps; and
- Clarification about the person that conducted the heritage surveys on site;

### 3.5.3 Assessment

The NT EPA's environmental objectives for this risk are to identify, understand and mitigate the potential impacts of the project on items or places which have historic and/or cultural heritage values and are protected under the *Heritage Act* and/or *Aboriginal Sacred Sites Act*.

The Proponent has developed a Cultural Heritage Risk Management Plan which outlines a number of strategies for managing the known and any potential heritage sites. The Plan appears to adequately address the mitigative requirements that will be implemented to lessen the risk to heritage sites. The Plan also includes a cultural heritage monitoring program which appears to adequately address the issues. The NT EPA considers that the potential impacts on cultural or heritage sites with respect to the *Heritage Act* and the *Aboriginal Sacred Sites Act* have been appropriately addressed through the EIA process.

### 3.5.4 Summary

As noted previously, the surveys that were commissioned by the Proponent identified six sites that have cultural heritage significance. These sites will be managed under a Cultural Heritage Risk Management Plan which includes prescriptive measures for ensuring that mining activities avoid impacting any of the sites.

The Proponent sought advice from the Aboriginal Areas Protection Authority with respect to sacred sites listed under the *Aboriginal Sacred Sites Act*. The results of the search identified one site within the MLA near the northeast boundary (see Appendix W of the draft EIS). ABM Resources has not stated whether it intends on applying for a certificate under the *Aboriginal Sacred Sites Act*.

NT EPA has considered the information provided by the Proponent and is satisfied that the implementation of an appropriate Cultural Heritage Risk Management Plan will ensure that the risks to cultural heritage items will be minimal.

## 3.6 Decommissioning

### 3.6.1 Description

The Proponent has provided a Conceptual Mine Closure Plan in the draft EIS. The Conceptual Mine Closure Plan outlines the schedule to decommission and rehabilitate the mine site. The plan also outlines the proposed monitoring and compliance auditing activities on site with respect to the completion criteria identified in the Plan. As part of the Conceptual Mine Closure Plan, the Proponent is proposing to annually review the cost of rehabilitation and closure in order to ensure that sufficient financial resources will be available. The Proponent proposes the following closure, decommissioning and rehabilitation measures at the site.

### 3.6.2 Mining and Accommodation Infrastructure

During decommissioning of the staff accommodation, the Proponent will remove all infrastructure above ground and will cut deeper services 0.5m below the surface prior to backfilling. The decommissioning plans state that all ponds, landfills and below ground septic systems will be decommissioned and backfilled. The Proponent has stated that the workshop, hydrocarbon storage areas and any unused chemicals will be removed from the site. Surveys will be undertaken to determine any areas that may be contaminated through operational activities or spills. If contaminated sites are found on

site, a plan will be implemented to isolate the material and either treat it onsite or dispose of it consistent with legislative requirements. The Proponent is proposing to consult with Traditional Owners with respect to closing the site and rehabilitating the tracks and roads on site. If roads or tracks are to be left in-situ, the Proponent will leave the roads be left in a condition where the width is reduced. All other roads/tracks will be rehabilitated using windrows to establish natural drainage patterns and water infiltration.

### 3.6.3 Tailings and Water Storage Dam

The mining pits are predicted to cover a total area of 22.6 ha and will be left when the mine closes. When the mine is closed the Proponent has stated that it will construct an abandonment bund around the perimeter of the pit to prevent access after closure. The backfilling of the pits will only be considered by the Proponent if it does not affect the viability of the operation, result in an increased safety risk or potentially sterilise a future resource. If the pits are backfilled, the infill will be contoured to blend in with the surroundings.

Currently the proposed water storage dam is being used as a tailings storage facility during trial mining and prior to full operation. To ensure the tailings are stored correctly the facility is lined with a 2mm plastic HDPE liner. Following closure and decommissioning, the Proponent has stated that it intends to leave the plastic liner in situ to contain any tails within the storage facility. Future rehabilitation of the facility will involve the removal of pipework as well as follow up monitoring to determine whether any of the tailings are resulting in contamination of the area. The Proponent notes that if contamination is detected it will be capped with a low permeability clay cap or compacted mine waste. The dam will be filled above ground level with the remaining facility to become a 1.3m high elevated pad above the previous dam. After capping the facility, the Proponent has stated that topsoil will be replaced to facilitate rehabilitation.

Any tailings produced during operate of the mine will be stored in the tailings storage facility on site. The tailings storage facility will be constructed with a low permeability layer to reduce seepage and contamination. The Proponent has stated that the residual cyanide produced from operations will be separated and stored in a lined evaporative dam. Standard tailings that have no cyanide will be stored in the tailing storage facility that has a standard lining. The Proponent has stated that it will construct the tailings dam with a cap of 1.6m of siltstone, sandstone and pisolite/gravel. The waste rock dumps will be designed and constructed to prevent erosion of the structures. Each facility will be designed and constructed to withstand a 1:1000yr peak flow event at the closure of the mine.

### 3.6.4 Rehabilitation

The total area to be cleared over the life of the Project has been estimated by the Proponent to be 255.8 ha. The Proponent has stated in its Conceptual Mine Closure Plan that it is proposing to initially clear the site progressively to avoid the effects of soil degradation and erosion. Following clearing, the Proponent will retain the topsoil (100mm of material) and ensure that it is kept in a manner that reduces the handling and storage time in order to minimise topsoil loss and deterioration during storage. Areas that are contoured back to original ground level will be covered by 100mm of topsoil. If areas are to be rehabilitated, they will be done so with locally collected vegetative material and achieved using indigenous staff. Any areas that have been rehabilitated will have appropriate signage installed and all access restricted to prevent any chance of further disturbance.

### 3.6.5 Care and Maintenance

The Proponent has prepared a Conceptual Care and Maintenance Plan (Appendix P of the draft EIS) that outlines the potential risk to the environment that may result if operations are suspended. The Conceptual Care and Maintenance Plan steps out the mitigation and management measures that will be implemented to address any



environmental risks that may result from mining operations or the equipment on site. In addition, the Conceptual Care and Maintenance Plan identifies the environmental aspects, statutory obligations and commitments that will be implemented by the Proponent. The Proponent has stated that it intends on periodically reviewing the Conceptual Care and Maintenance Plan. The review will ensure that the plan remains relevant and effective throughout the operation of the mine.

### 3.6.6 Closure

The project would be decommissioned in accordance with the legislations and guidelines at the end of the project life and in consultation with relevant stakeholders (CLC, Traditional Owners) and regulatory authorities. The Proponent has stated in its draft EIS that a final decommissioning plan and rehabilitation program would be developed and implemented to ensure that areas disturbed are suitably rehabilitated.

### 3.6.7 Submissions

Key concerns raised in the public submissions were:

- Seeking clarification of the final landforms; and
- Recommending that infrastructure areas be stabilised using revegetation, mulching or other appropriate means.

### 3.6.8 Assessment

The NT EPA's environmental objectives for this risk are to demonstrate that:

- a) rehabilitation achieves a stable and functioning landform which is consistent with the surrounding landscape and other environmental values; and
- b) prevention and mitigation of risks associated with closure and rehabilitation of the underground mine and the potential impact on the closure of the existing operation is adequately addressed.

The EPA notes that unplanned mine closure or long-term periods of care and maintenance may also result in open pit voids that could periodically contain water. The EPA is concerned that these pits are likely to attract native and introduced fauna thus changing fauna habits and populations and consequently impacting the ecology. If the Proponent intends to leave pits open, it is recommended that the final Closure Plan justify the reasons. The justification should include a discussion of the economic, social, safety and environmental risks associated with leaving the mining voids open. The justification should identify the long-term potential risks associated with open voids and potentially increased water availability in the landscape (if relevant). The EPA recommends that all closure and rehabilitation measures including the re-creation of landform and re-establishment of surface water flows be undertaken in a sequential and progressive manner.

### 3.6.9 Summary

The NT EPA considers that the measures outlined in the Conceptual Mine Closure Plan provide a thorough framework for progressive rehabilitation, closure and decommissioning of the site. To ensure that the site does not create ongoing environmental impacts or hazards, the NT EPA recommends that the progressive rehabilitation component of the Plan be implemented throughout all stages of the Project. The NT EPA considers that the Conceptual Closure Plan provides a thorough approach for the progressive and eventual decommissioning and closure of the Twin Bonanza Mine. The NT EPA agrees with the approach to continually review and revise the plan over the life of the mine and in response to the financial situation of the Project.

### 3.7 Social and Economic considerations

Chapter 13 of the draft EIS provides a summary of the social, economic risks associated with the Project. The Proponent has developed and included a Social Impact Management Plan (SIMP) that sets out the risks and management measures for ensuring that the Twin Bonanza Project does not result in significant residual impacts to local communities and businesses. The SIMP sets out the financial and in-kind commitments that the Proponent has entered into with local communities, the CLC and Traditional Owners. In addition, the SIMP sets out the monitoring and reporting requirements for the Project as well as the clear performance indicators for the Project. The potential risks associated with any interactions between freight/transport vehicles and other road users have been summarised in Chapter 12 of the draft EIS and will be managed under the Road Transport and Traffic Management Plan. The NT EPA has considered the management plans provided in the draft EIS and considers that the potential social risks from the action have been adequately addressed.

### 3.8 Environmental Management

#### 3.8.1 Bushfires

The Proponent should be aware of sections of the *Bushfires Act* and Regulations that apply to the Project and address risk and management of bushfires. The ongoing development of the Fire Management Plan should be in consultation with traditional owners, pastoralists and their representative organisations, including the Central Land Council which has specialist knowledge in fire management.

The Proponent has prepared and included a Fire Management Plan in the draft EIS which sets out the policies and procedures for fire management on the Project Mine site. The proponent has stated in the Fire Management Plan that the objective of the document is to ensure that fire control practices are implemented to minimise the risk of fire from site operations and bushfires. The outline of the Plan is designed to describe how the risk of fire will be managed on-site including the details of fire safety measures for all staff. The Proponent states that the site will operated under the general principal of fire avoidance and if required, fire control measures. The Fire Management Plan also specifies that no employee, or contractor, is permitted to light fires. Back burning will only be permitted in the case of a direct emergency, where evacuation and/or infrastructure are compromised and no other form of fire protection is available, or for reducing fuel loads in consultation with traditional owners.

To reduce the potential risk of fire on site, the Proponent intends to undertake reduced-fuel burning along fire breaks to create a reduced fuel buffer of 50m around the facilities and as a standard feature of fire prevention. The overall intent of the firebreak is to control fires that may be approaching the mine site. Other operational areas, such as the accommodation and essential infrastructure will be situated in cleared areas and surrounded by a 6m fire break where all vegetation and debris have been removed. The Proponent states that any hazardous materials that may present a fire risk will be housed in an area compliant with AS 1940-2004 - *The storage and handling of flammable and combustible liquids; appropriate hazard separation*. Any welding, cutting and grinding activities on site will require that the Proponent obtain a hot work permit under the *Workplace Health and Safety Act* and will be conducted in accordance with Safe Work Australia's Welding Processes Code of Practice.

Provided the Fire Management Plan is maintained, regularly reviewed and implemented, the NT EPA believes that the environmental risks associated with fires at the Twin Bonanza Mine will be appropriately managed.

### 3.8.2 Noise and Vibration

To mitigate the potential impacts of noise and vibration on sensitive receptors, the Proponent has prepared a Noise Management Plan for the Project and MLA 29822. The intent of the management plan is to ensure that there is an effective management system to identify and control potential noise impacts from construction and operation. The Noise Management Plan outlines measures to ensure compliance with legislation and regulatory requirements applicable to mining activities.

The Proponent has outlined the distance between the mining operations at the Project Bonanza from communities and existing towns and communities. While the Proponent does not expect noise or vibrations to impact on communities or towns it has stated that it will monitor the noise and vibration levels on site and maintain a complaints register during construction and operations. Any complaints received will be reviewed on an annual basis with further action taken (where necessary).

The NT EPA considers that the Noise Management Plan that was provided by the Proponent in the draft EIS (Appendix Y) adequately addresses the risks associated with noise and vibration on sensitive receivers. The NT EPA agrees with the conclusion that there is limited potential for impact to sensitive receptors in the region other than employees. The establishment of a complaints register will ensure that any noise/vibration impacts resulting from operations are able to be raised and addressed (if required).

### 3.8.3 Air Quality

The draft EIS has identified that the construction and operation of the Project will result in the release of dust, emissions and odours to the surrounding environment. In particular, mining operations associated with transport of material and blasting will disturb sediment and dust on-site. The operation of vehicles, the processing plant and power stations will release emissions to the environment. The operation of sewage treatment facilities and landfills may produce odours.

As noted in the draft EIS, the Twin Bonanza Project site is located away from communities and towns and as such mining operations are unlikely to negatively affect air quality for people living in the region. The Proponent has concluded in the draft EIS that the influence of mine operations on air quality will be negligible. To mitigate and avoid potential impacts of declining air quality on site, the Proponent has outlined a number of mitigation measures in its Environmental Management Plan (Chapter 14 of the draft EIS). In particular, the Proponent will maintain equipment so as to maximise efficiency and prevent incomplete combustion of hydrocarbons. Machinery that has a high fuel efficiency and combustion will be purchased as well as fuel that has a low sulphur content.

The NT EPA has reviewed the risks, strategies and avoidance measures proposed by the Proponent for maintaining the air quality on the site. Provided the Proponent implements the strategies, mitigation and management measures outlined in its Environmental Management Plan, the NT EPA considers that air quality will be maintained on site. The NT EPA supports the Proponent using the NSW standards for dust deposition (DEC 2005) to monitor dust levels on site.

### 3.8.4 Road Transport

The Project site is located approximately 625 km north-west of Alice Springs and 267 km south-east of Halls Creek. The site is accessed via the Tanami Road from Alice Springs or Halls Creek. The Tanami Road is currently subject to use for mining haulage, supplying consumables and materials to existing operations at the Granites, Tanami Central and Tanami Coyote mine sites. The current maximum speed limit along the Tanami Road is 110 kph.

The Proponent has acknowledged in its draft EIS that during the operation of the mine, most of the road traffic to the site will comprise freight related transport. Estimated movements of light and heavy vehicles along the Tanami Road are predicted to result in an average increase of 3.1 (1.9%) light vehicles and 1.7 (5.1%) heavy vehicles per week using the road (see Table 12-2 of the draft EIS). Table 12-1 of the draft EIS provides a summary of the quantity and types of freight, personnel being transported along public roads.

The NT EPA notes that the increased traffic (particularly heavy vehicles) will result in increased wear on the Tanami and other regional roads. The NT EPA acknowledges that the condition of regional roads like the Tanami are likely to be a result of cumulative traffic flows (transport, mining and domestic travel). The NT EPA supports the approach by the Proponent to actively engage local councils and relevant authorities to address these cumulative impacts. The NT EPA has reviewed the Road Transport and Traffic Management Plan and considers that provided it is implemented effectively, the potential risks associated with increased traffic will be suitably managed.

## **Recommendation 5**

**A Road Transport and Traffic Management Plan, which provides appropriate mitigation in response to traffic risks, must be prepared to the satisfaction of the Department of Mines and Energy and submitted as part of the Mining Management Plan.**

**The Road Transport and Traffic Management Plan is to be implemented for all stages of the Project and reviewed on an annual basis, taking into account concerns or complaints raised during the annual review of the Plan.**

### **3.8.5 Waste**

Chapter 9 of the draft EIS describes the proposed management of wastes. For the purposes of assessing the potential risks, this report has differentiated the waste types into contaminated waste, sewage, waste water and putrescible and solid waste.

#### **Contaminated waste**

Contaminated wastes that are produced on site will be placed in designated disposal bins and transported off site for disposal at a licenced facility in the Northern Territory or Western Australia. The Proponent will store hydrocarbons and other chemicals in areas that are consistent with AS1940 which will include bunded areas that are located away from the accommodation site and any drainage lines. Spill containment material and cleanup kits will be used to control any spills and assist in clean-ups. Used containment material will be placed into disposal bins and disposed of offsite. Should any contaminated areas be identified, the Proponent is proposing to remediate these sites in accordance with the Western Australian Guideline for Bioremediation of hydrocarbon-contaminated soils in Western Australia. To manage the movement of sediment at the airstrip, the Proponent has committed to implementing its Erosion and Sediment Control Plan (Appendix E of the draft EIS) to manage the discharge of sediment and run-off from the airstrip. The NT EPA notes that the measures implemented at the airstrip to manage run-off should also focus on managing the spread of hydrocarbon contaminated fluids to the surrounding environment.

The Proponent has stated that all ore units are unlikely or have a low potential to be acid forming. Investigations into the characterisation of the tailings (Appendix L of the draft EIS), found that material associated with pyrite and arsenopyrite could generate small volumes of acid. To minimise oxidation and interaction with water, it is the preference of the NT EPA that any material capable of producing acidic or neutral mine drainage be placed centrally within the Waste Rock Dump. The NT EPA considers that the mitigation measures and commitments will ensure that the risks from acid forming material have

been addressed. If future waste rock characterisation identify greater risks than those assessed in this Report the Proponent should notify the NT EPA under clause 14A of the EAAP.

### **Sewage treatment and waste water**

The Proponent states in its draft EIS that septic tanks and leach and evaporation systems will be installed to manage waste water in accordance with the public health regulations (General Sanitation, Mosquito Prevention, Rat Exclusion and Prevention). While not confirmed in the draft EIS, the Proponent has identified that in the future it may upgrade or expand the existing septic system on site for the Project. Should this occur, the Proponent has stated that it will engage with the Department of Health to address the operational requirements. Appropriate fencing and signage will be placed around wastewater treatment facilities consistent with the requirements of the Department of Health.

The Proponent has stated that it will recycle any saline water produced during operation of the Reverse Osmosis plant by diluting it and feeding it back into the ore processing plant. If the reject water from the Reverse Osmosis plant is unsuitable for use in the processing plant the Proponent has stated that it may be directed into the sewage waste water dam.

### **Putrescible and solid waste**

The draft EIS notes that items such as paper, cardboard or similar wastes cannot be recycled they will be incinerated onsite using a turbo-burner. The Proponent has stated in the draft EIS that the objective of incinerator will be to reduce the volume of material and prolong the life of the landfill site. Putrescible waste will be managed so as to prevent endemic and feral fauna utilising the site as a potential food source. The Proponent has committed to fencing the landfill site to prevent entry by fauna.

## **3.9 Environmental Management Plan**

### **3.9.1 Environmental Management Plans proposed by ABM Resources**

A draft Environmental Management Plan (EMP) has been prepared by the Proponent and is at Chapter 14 of the draft EIS. The draft EMP sets out the project commitments to avoid or minimise potential environmental impacts as identified in the EIS and Supplement during construction and operational phases of the project.

The draft EMPs are divided into sub-plans corresponding to different chapters of the EIS (where applicable). Each sub-plan contains the following information:

- Environmental management objectives, actions and performance criteria to be implemented to mitigate impacts;
- Monitoring, reporting and auditing requirements; and
- Corrective actions if monitoring indicates that performance requirements have not been met.

Provided the Proponent implements the management plans included in the draft EIS, the NT EPA considers that the potential risks to the environment will be adequately avoided, mitigated or managed. To ensure that the EMP continues to be effective, the NT EPA recommends that the Proponent undertakes an annual audit and review of the EMP.

### **3.9.2 Proponent's commitments**

Appendix AC of the draft EIS outlines the initial commitments provided by the Proponent. A revised summary of the commitments was provided in the Supplement. The

commitments are derived from the mitigation measures referred to in the draft EIS and the Environmental Management Plan.

The NT EPA considers that the EMP will provide the mechanism to adequately avoid, mitigate and manage the potential environmental risks of the project. The NT EPA has recommended conditions to ensure that the Proponent implements the EMP over the life of the project. In addition to implementing the EMP, the Proponent should establish a monitoring, auditing and reporting regime to ensure that the measures outlined in the EMP are implemented and reviewed regularly.

#### **Recommendation 6**

**The Proponent taking the proposed action is wholly responsible for implementation of all conditions of approval and mitigation measures contained in the Environmental Management Plan and must ensure all staff and contractors comply with all requirements of conditions of approval and mitigation measures contained in the Environmental Management Plan.**

**The Environment Management Plan, and sub-plans, should form part of the Mining Management Plan. In preparing each plan, the Proponent will include any additional measures for environmental protection and monitoring contained in this Assessment Report.**

#### **Recommendation 7**

**Within three years of commencing the Project, the proponent must commission and pay the full cost of an independent environmental audit of the project. The audit should:**

- **Be conducted by a suitably qualified, experienced and independent team of experts;**
- **Assess the environmental performance of the project and review whether the Proponent has complied with all recommendations, conditions and commitments;**
- **Review the adequacy of the plans and procedures and recommend appropriate measures or actions to improve the environmental performance of the action, including any plans or procedures.**

**The results of the audit should be submitted to the Department of Mines and Energy and the Northern Territory Environment Protection Authority. The results of the audit must be made available on the Proponent's website.**

## **4 Matters of National Environmental Significance**

### **4.1.1 Listed Threatened Species and Communities (sections 18 & 18A)**

On 23 April 2013, the Australian Government decided that the Project was a controlled action under the EPBC Act due to likely significant impacts to listed threatened species and communities (sections 18 & 18A).

A search on the Australian Government's Environmental Reporting Tool (with a 20km buffer) identified the potential presence of the following four threatened species listed under the EPBC Act:



- (a) Australian Painted Snipe (*Rostratula australis*) – Vulnerable
- (b) Mulgara (*Dasyercus cristicauda*) – Vulnerable
- (c) Greater Bilby (*Macrotis lagotis*) – Vulnerable
- (d) Central Rock-rat (*Zyzomys pedunculatus*) – Endangered
- (e) Great Desert Skink (*Liopholis kintorei*) - Vulnerable

Surveys undertaken for the Project identified the greater bilby, mulgara and great desert skink in the project area based on previous records, the presence of suitable habitat in the vicinity of the project.

In 31 July 2013, the NT EPA issued final EIS Guidelines (NT EPA 2013) which set out the information requirements with respect to threatened species. The NT EPA requested that the draft EIS provide a detailed assessment as well as quantifying the Project's risks to the three species. In addition, the NT EPA required the draft EIS to outline suitable mitigation measures and discuss whether the residual impacts of the Project (following mitigation) would be acceptable. The following section includes a detailed discussion and assessment of the likely impacts of the Project on these species and the acceptability of the residual risks to each species.

The Australian painted snipe was discounted as occurring on-site due to an absence of suitable wetland areas that occurs largely in swamps and marshes with moderate cover (Simpson and Day, 2004). The central rock rat occurs in granitic boulder fields and quartzite scree slopes to eroded sandstone cliff lines and limestone hills (Nano, 2008). The habitat types within the MLA and adjacent areas do not meet the species habitat requirements.

#### 4.1.2 Greater Bilby (*Macrotis lagotis*)

The greater bilby (*Macrotis lagotis*) is a medium sized fossorial marsupial that occurs through arid areas of central Australia. The species is generally a solitary animal but can occur in estimated densities of between 12-16 individuals per km<sup>2</sup> in optimal habitat. Densities as low as 1-2 km<sup>2</sup> are typical in areas of sub-optimal suitable habitat (Southgate, 1987 in Pavey, 2006a).

The species was historically recorded from approximately 70% of continental Australia but has retracted to approximately 20% of its former range (Southgate, 1990 in Pavey, 2006a). The species now occurs across the following separate geographic areas:

1. The Pilbara, Central Australia and Kimberley regions; and
2. South-western Queensland.

In the Northern Territory, the greater bilby occurs in the central and western parts of the Tanami bioregion, the southern Sturt Plateau bioregion and the northern Great Sandy Desert bioregion (Pavey, 2006a). Surveys in the Tanami bioregion indicate that bilby sign is most likely to be found around the Granites-Rabbit Flat region and west of Tennant Creek. The National Recovery Plan for the bilby notes that it would be reasonable to consider the Tanami bioregion (west of the Stuart Highway) and the northern Great Sandy Desert bioregion as potential critical habitat of the species (Pavey, 2006a).

Extant population of the greater bilby occur within a variety of habitats, usually on landforms with level to low slope topography and light to medium soils. The species occupies three major vegetation types; open tussock grassland on uplands and hills, mulga woodland/shrubland growing on ridges and rises, and hummock grassland in plains and alluvial areas (Southgate, 1990b).

Broad-scale surveys across the Northern Territory indicate that laterite and drainage line land systems appear to be occupied by the greater bilby more frequently than sand plain and dune systems (Southgate et al., 2007; Pavey, 2006b). This landscape is characterised by sandy soils dominated by hummock (*Triodia* spp.) grasslands with an overstorey of low shrub cover dominated by acacia and melaleuca. These habitats support shrub species which have root-dwelling larvae that provide a constant food source for the bilby (Latz, 1995 in Southgate et al 2007). The habitat contains spinifex hummocks which provide for movement and foraging (Southgate et al., 2007). The greater bilby emerges from its burrow after twilight to forage. Southgate and Possingham (1995) found that males range more widely than females and regularly use different burrows during these foraging trips. Estimates for home range sizes in the Northern Territory were found to be between 1.1 km<sup>2</sup> to 3 km<sup>2</sup>.

The current occurrence of the greater bilby is strongly associated with higher rainfall and temperatures, which promote areas of higher plant and food production. The greater bilby may also prefer these conditions as higher rainfall and temperatures are not well tolerated by foxes (Southgate et al., 2007). The presence of the greater bilby is strongly associated with substrate type, mean annual rainfall, and the presence of dingoes in the area (Southgate et al., 2007). In the Tanami Desert bioregion juvenile bilbies were restricted to a mid-latitude zone, indicating that the southern and northern zones could be a demographic sink where mortality appears to be greater than natality (Southgate et al., 2007).

The major threat to the greater bilby in the Northern Territory is predation by the red fox (*Vulpes vulpes*) (Pavey, 2006a). It was noted by Pavey (2006a) that predation by feral cats and dingoes as well as competition with rabbits does still present a threat to some populations. Grazing by cattle and fire regimes also threaten the species by restricting breeding, affecting dispersal and reducing food availability (Southgate and Carthew 2006).

The Proponent conducted surveys for the greater bilby during the Wet season in April 2012 (GHD 2012) and again in the early Dry season in May 2013 (EcOz, 2013). The surveys involved the use of baited Elliot traps, baited cage traps, pitfall and funnel traplines. GHD (2012) undertook active searching and nocturnal surveys for animals. Opportunistic observations including scat/hair/bone skin analysis and were also used. Targeted surveys for the greater bilby were undertaken by EcOz (2013). The survey methodology involved spotlighting for the species and walking survey transects to search for burrows, diggings, tracks and scats. Camera traps were mounted at active bilby burrows to quantify activity and transect surveys were driven at night. The NT EPA has reviewed the survey method and believes that it is consistent with the Australian Government and the Northern Territory survey guidelines for detecting the species.

Initial screening by the NT EPA as outlined in the Statement of Reasons (NT EPA, 2013b) identified the following concerns and environmental risks to the greater bilby:

- clearing of habitat;
- fire regimes;
- introduced species; and
- risk of mortality during construction and operation activities.

The following paragraph will include an assessment of the Project's risk and potential impact as well as reviewing the effectiveness of any mitigation, management and offsets (if proposed).



#### 4.1.2.1 Clearing of habitat

Mining activity and construction of linear infrastructure has been identified in the National Recovery Plan as having the potential to destroy or degrade greater bilby habitat especially where the development is located adjacent to a palaeochannel system (Paltridge and Southgate, 2001).

The fauna surveys included at Appendix A (EcOz, 2013) of the draft EIS identified 7 active burrows and observed two bilby within the MLA. Since undertaking the surveys, the Proponent has identified a total of 14 bilby burrows within the MLA.

The draft EIS has identified approximately 215 ha of vegetation will be cleared for the mining operations (Table 6-3) and includes the 12.5 ha of vegetation already cleared for the bulk sample. While fauna surveys (EcOz, 2013) confirm that bilbies prefer to burrow in vegetation type 2 (hummock grassland (*T. intermedia* & *T. basedowii*) with Acacia low shrubland). The NT EPA considers that all vegetation on site is suitable for foraging or dispersal for the bilby.

To avoid potential impacts to the bilby, the Proponent has rearranged some of the infrastructure on site so as to ensure that there will be no removal of active bilby burrows as a result of clearing/construction activities. While care has been taken to avoid significant impacts on the greater bilby, the NT EPA notes that construction of the Project may still result in impacts to habitat for the species. The Proponent has stated that it will implement the following mitigation measures to reduce potential impacts to the bilby:

- Infrastructure will be sited in areas that will least impact threatened species;
- Pre-clearance fauna surveys for all developments that require removal of previously undisturbed native vegetation;
- Adhering to agreed clearing boundaries as part of the EIS approvals;
- Manage clearing in accordance with the Biodiversity Management Plan; and
- Controlled burning of footprint areas prior to progressive clearing in association with traditional owners. The aim of controlled burning is to diminish the food sources and/or modify the habitat in the area resulting in marsupials moving to new areas prior to development.

The NT EPA considers that the above mitigation measures will be sufficient to avoid and mitigate the potential risks to the greater bilby from land clearing. The NT EPA considers that the implementation of the Biodiversity Management Plan will ensure that sufficient measures are implemented to protect the species during construction and operation of the mine.

#### 4.1.2.2 Fire regimes

Studies have found that the suitability of habitat at a site appears strongly influenced by the length of time since that area has been burnt (Southgate and Carthew, 2006; Parks and Wildlife Service of the Northern Territory [n.d]). It was proposed by Southgate et al (2007), that the process of fire in arid areas is one of the important factors influencing the distribution of the bilby.

The Proponent has prepared a Fire Management Plan (Appendix Z of the draft EIS) which outlines the mitigation and avoidance measures for reducing the risks associated with fire on site. The NT EPA has reviewed the proposed mitigation and avoidance measures outlined in the Biodiversity Management Plan (Appendix D of the draft EIS) and the Fire Management Plan and considers that they will be effective for reducing the risk of fire on the species. Provided these measures are implemented, the NT EPA

considers that the potential risks associated with fire on habitat for the greater bilby will be acceptable.

#### 4.1.2.3 Introduced fauna species

Historically, the Tanami Desert was dominated by medium sized (35-5500g) mammal fauna (Burbidge et al., 1988). In recent years, the diversity and abundance of medium-sized native mammals has been reduced severely due to a number of threatening processes, including predation by feral cats and European red fox, competition with rabbits and grazing pressure (Paltridge, 2002). Predation by feral cats and the red fox are listed as key threatening processes under the EPBC Act (DEWHA, 2008a and DEWHA, 2008b).

The Australian Government Environment Reporting Tool notes that the following introduced fauna species are likely to, or known to occur within the region:

- Dog (*Canis lupus*);
- feral cat (*Felis catus*);
- feral donkey (*Equus asinus*);
- feral horse (*Equus caballus*);
- house mouse (*Mus musculus*);
- European rabbit (*Oryctolagus cuniculus*);
- European red fox (*Vulpes vulpes*); and
- one-humped camel (*Camelus dromedarius*).

Surveys conducted by EcOz (EcOz, 2013) confirmed the presence of the feral cat and the one-humped camel occurring on site and within the greater MLA. Feral cats have played a significant role in the decline and could in some cases contributed to the extirpation of native fauna in the arid zone.

While not detected during surveys, the red fox has previously been recorded in regional locations to the south and north of the site (see Paltridge, 2002) and there is potential that the species may at time occur within the Twin Bonanza site depending on seasonal conditions. An increase of fox and feral cat numbers is expected to have significant impacts on threatened species, particularly the greater bilby (DEWHA, 2008a). The continued presence of a low density of dingoes on the site is of less concern as it is unlikely to threaten species like the bilby and may reduce the abundance of foxes and feral cats through mesopredator interactions.

The NT EPA notes that there is potential that the increased availability of water on site may provide favourable conditions for the red fox to become established on site (Brawata and Neeman, 2011). In comments provided to the Proponent on the draft EIS, the NT EPA recommended that the Biodiversity Management Plan include measures to monitor, and if detected, manage the red fox on-site. The Proponent has agreed to include the red fox in future management and control measures and will amend the Biodiversity Management Plan accordingly. The NT EPA notes that the monitoring measures proposed in the Biodiversity Management Plan will be adequate to detect any changes in the density or presence of predators on site

The One-humped camel is likely to cause localised impacts to vegetation and wetlands in areas where it occurs in high densities. The NT EPA notes that the environmental impacts of camels in arid Australia are not well understood. It can be assumed, however that the large size and preference for feeding on more than 80% of available plant species could result in changes to vegetation dynamics and density (Dorges and

Heucke, 1996). To ensure that camels do not increase in number around the Project site, the Proponent will install exclusion devices around water sources. The NT EPA considers that these measures will be adequate to ensure that camels do not become habituated to the site.

#### 4.1.2.4 Invasive weeds

In remote and intact areas, there is a high potential that new developments and activities can result in the introduction and / or spread of new or existing infestations of weed species. For species such as the bilby, the introduction or spread of weed species can alter the dynamics of an ecosystem and reduce the availability of food resources for the species (Pavey, 2006). Weeds can degrade habitat for the bilby by reducing the availability of particular food items and by causing congestion which reduces the ability for individuals to forage (Parks and Wildlife Service of the Northern Territory [n.d]). In particular, the invasive couch grass (*Cynodon dactylon*) and buffel grass (*Cenchrus ciliaris*) are two species identified as having the potential to degrade habitat for the greater bilby and mulgara especially along riparian areas (Parks and Wildlife Service of the Northern Territory [n.d]).

Vegetation surveys undertaken by EcOz on behalf of the Proponent, noted that the condition of the vegetation on the site comprises largely intact native vegetation, with only minor degradation from fire and weeds (EcOz, 2013). Within the MLA, surveys identified three weed infestations comprising relatively small incursions of buffel grass. The incursions were identified at Wilson's Camp, Wilson's Bore and the junction of Tanami Road/Wilson's Camp Access Track (GHD, 2012; EcOz, 2013).

Buffel grass is an introduced flora species but is not currently listed as a designated weed species under the *Weeds Management Act* or as a Weed of National Significance. While the species has been noted by graziers for its palatability and potential for controlling erosion it has been found to increase fuel loads resulting in higher burn severity (Miller et al., 2010). Buffel grass has the potential to invade areas and degrade suitable habitat for the greater bilby (Parks and Wildlife Service of the Northern Territory [n.d]; Smyth et al., 2009)

To mitigate the risks of this weed on site, the Proponent is proposing to undertake the following mitigation measures:

- minimising land clearing (thereby reducing soils that are susceptible for weed incursion);
- Progressive clearing of land, followed by progressive rehabilitation (thereby reducing soils that are susceptible for weed incursion); and
- Implementation of the Weed Management Plan.

The NT EPA has considered the proposed measures and strategies outlined in the Weed Management Plan (EcOz, 2013b) and considers that provided the Proponent implement the avoidance, mitigation and control measures outlined the potential risks of weeds on habitat for the greater bilby will be acceptable.

#### 4.1.2.5 Injury and mortality during construction phase

The NT EPA notes that there is potential that the initial clearing phase/construction activities have the potential to result in the injury or death of bilbies on site. The nocturnal activity patterns of the bilby mean that any construction activities that are occurring during daylight hours could crush active burrows resulting in injuries or mortalities to individuals. To reduce the risk of construction related mortality, the Proponent has avoided (where possible) the placement of any mining related infrastructure where burrows occur. The NT EPA notes that while there are still risks associated with the greater bilby during clearing and construction, the implementation of

a Biodiversity Management Plan that includes a Land Clearing Procedure, will mitigate/manage the impacts to the species. The Land Clearing Procedure has been prepared based on the existing Northern Territory Land Clearing Guidelines (NRETAS, 2010).

A submission received on the draft EIS requested information on the potential impacts of vibration on the burrows of the greater bilby. The Proponent responded to this comment in the Supplement noting that an example of bilbies being able to tolerate some level of disturbance as evidenced by the presence of the species along the Ghan Railway line north of Tennant Creek during and following the construction phase (Southgate, 2012). The NT EPA notes that while difficult, it would prefer that the Proponent takes the appropriate steps to ensure that noise sources are as far away as practicable from bilby burrows.

#### 4.1.2.6 Road related impacts

Haul roads constructed and operated during mining operations have been identified as a possible cause of bilby mortality at a local scale. This is due to the combination of haulage vehicles operating on roads at night and the location of mining operations which often occur adjacent to bilby habitat (Pavey, 2006). To mitigate potential impacts related to traffic and vehicle movements, the Proponent will implement a Road Transport and Traffic Management Plan (Appendix S of the draft EIS). The Road Transport and Traffic Management Plan specifies the following speed limits for all vehicles operating out of the Twin Bonanza Mine Site:

- Access roads: 60 kph;
- Mining Areas: 10 kph;
- Processing plant: 10 kph; and
- Camp: 10 kph.

The Road Transport and Traffic Management Plan also specifies that vehicles operating out of the Twin Bonanza Project should reduce limits where necessary in response to traffic conditions, weather conditions, road conditions and in response to the speed limit signs as posted.

The NT EPA notes that there are no studies that have investigated the rates of mortality for different speed limits. The NT EPA agrees with the Proponent's conclusion in its Supplement that the proposed speed limits are generally consistent with those either proposed in Traffic Management Plans or conditioned by environmental regulators. The NT EPA considers that reduced speed limits on site will decrease the risk of road related mortality to the greater bilby. Provided the Proponent implements and enforces the Road Transport and Traffic Management Plan in its current form, the NT EPA considers that the risks to listed threatened species have been suitably mitigated. To better inform future decisions relating to traffic management within bilby habitat, the NT EPA recommends that the Proponent keep a log of any road strikes and report these to the relevant agencies periodically.

#### Recommendation 8

**The Biodiversity Management Plan should include a mechanism to record road strikes affecting the greater bilby. The log should be reported annually to the Department of Mines and Energy, and made available to other relevant agencies upon request.**

#### 4.1.2.7 Potential impacts of fire on the greater bilby

The introduction of weed species to the site and spread of existing infestations have the potential to adversely impact threatened species populations that persist in the local area. Typically in the Tanami Desert, weed invasions that spread into undisturbed habitat are not common due to depleted soil nutrients, moisture and also competition with native spinifex grasses.

Unsuitable fire regimes can degrade habitat for the greater bilby which can potentially restrict breeding and impede dispersal and colonisation (Pavey, 2006). The association between the greater bilby with recently burnt habitat (< 1 year) was demonstrated in the Tanami Region by Southgate et al. (2007). Southgate and Carthew (2007) proposed that the relationship was influenced by the availability of *Yakirra* (*Panicum*) *australiense* which is an important component of the diet of the species in spinifex habitats.

The Fire Management Plan notes that the risk of fire is highest from August to November due to increased storm activity and lightning strikes in the region. To manage the risks, the Fire Management Plan includes existing management commitments with regards to fire management and safety during construction, operation and closure. The NT EPA notes that the measures outlined in the Fire Management Plan will be sufficient to reduce the risks of bushfires from operations at the Twin Bonanza Mine. The NT EPA recommends that the Fire Management Plan be implemented throughout all stages of the mine to reduce the risk of fire on habitat for the bilby.

#### 4.1.2.8 Offsets

While the Proponent has taken all possible steps to avoid impacts to active bilby burrows, the Twin Bonanza Project will directly disturb approximately 257.4ha of potential critical habitat for the species (see Chapter 15 of the draft EIS). The loss of this quantity of critical habitat for the species is likely to reduce the area of occupancy for the species and adversely affect habitat critical to the survival of the species. Therefore the NT EPA considers that it is appropriate that the Proponent offset the impacts to the species. The draft EIS acknowledges that there may be a significant residual impacts to the greater bilby and subsequently the Proponent has proposed to offset these impacts. The proposed offsets for the bilby largely will involve the funding of research from recognised researchers with the overall aim of publishing studies that will contribute to the conservation of the species. The research will be conducted by Desert Wildlife Services with the outcomes contributing to scientific datasets on the species, increasing knowledge of the species in the Tanami region and studying the effect of mining on bilbies.

Part of the offsets that have been proposed by the Proponent involve a predator and feral animal control program on-site. The NT EPA acknowledges that Proponents have used broad scale control programs to offset residual impacts previously (see EPBC 2010/5696, EPBC 2010/5706). These offsets required that the Proponent's fund large scale cat baiting programs that were in addition to the mitigation/management measures being implemented on the site of the mine.

The NT EPA notes that the draft EIS does not set out which component of the feral animal control program is an offset and which part is standard mitigation/management measure for addressing higher feral animals on site. In the absence of this information, the NT EPA is unable to consider whether the feral baiting offset would address the requirements of the Australian Government's Offsets Policy (DSEWPaC, 2012). The NT EPA recommends that the Proponent clearly identify which actions are mitigation and management measures and which are compensatory consistent with Chapter 4 of the Offsets Policy.

The Proponent has concluded that, in the absence of further assessment of distribution and potential impacts there is a real chance or possibility that the action will significantly



impact the great desert skink. The NT EPA disagrees with this statement due to the small footprint (bore infrastructure and pipelines) that are proposed to be located within suitable habitat for the species.

## Recommendation 9

**Should the Australian Government decide that offsets are required to compensate for the residual significant impacts to matters of national environmental significance, the Proponent shall submit a revised offset plan for consideration and approval. The revised offset plan should clearly define the mitigation, management and compensatory measures that will be implemented on site. Any offset measures should be consistent with Australian Government's Offset Policy and calculator.**

### 4.1.3 Mulgara (*Dasycercus cristicauda*)

The crest-tailed mulgara (*Dasycercus cristicauda*) is listed as a vulnerable species under the EPBC Act and occurs from the southern Simpson Desert through the Tirari and Strzelecki Desert in South Australia (Woolley et al., 2013). The likely habitat for the species has been describe as arid zones comprising sand dunes with sparse cover of vegetation, in particular sandhill canegrass (*Zygochloa paradoxa*). The species has also been recorded around salt lakes with nitre bush (*Nitraria billardieri*) (Masters, 2008).

Surveys were undertaken on site by GHD (2012) and EcOz (2013a) and were consistent with the methods specified by the Australian Government's Survey Guidelines for Threatened Mammals (DSEWPaC, 2011a). The results of the survey failed to detect any *D. cristicauda*. The survey did locate one female and multiple young brush-tailed mulgara (*D. blythi*). The surveys identified a number of mulgara burrows, however it was not possible to identify whether these were from *D. cristicauda* or *D. blythi*.

The absence of *D. cristicauda* from the site may be a result of the habitat on site. It was noted by Thompson and Thompson (2014) that while both *D. cristicauda* and *D. blythi* do occur in sympatry in some locations, the presence of one or both species is dependent on the arrangement of their preferred habitat. Pavey et al (2011) reported that *D. cristicauda* appears to be confined to crests and slopes of sand ridges, whereas *D. blythi* is mostly found on gibber and sand plains which generally lack spinifex cover. This is consistent with the findings of the fauna surveys conducted by GHD (2012) and EcOz (2013a) and suggests that *D. blythi* may be the only species of mulgara occupying the site. The identifications were confirmed by experienced zoologists and a vertebrate expert from the Museum and Art Gallery of the Northern Territory.

While not listed under Commonwealth legislation, the mitigation/avoidance measures proposed by the Proponent in its Biodiversity Management Plan will reduce the potential impacts to *D. blythi*. The NT EPA considers that the Project will not result in unacceptable impacts to *D. cristicauda*. As the species is unlikely to occur on site, the NT EPA believes that there is unlikely to be a significant residual impact and the Australian Government Offset Policy (DSEWPaC, 2012) will not apply.

The NT EPA notes that there is no current recovery plan for *D. cristicauda*. The Australian Government does have an approved conservation advice for *D. cristicauda*. The conservation advice has been attached to this Assessment Report at Appendix A.

### 4.1.4 Great Desert Skink (*Liopholis kintorei*)

The great desert skink (*Liopholis kintorei*) is a large burrowing lizard restricted to sandy and gravelly habitats in the western deserts region of Central Australia. Listed nationally as vulnerable, the great desert skink has a scattered distribution across its range, and is known to have disappeared from former habitats, particularly in the Gibson Desert, Great Victoria Desert and Great Sandy Desert regions.

There are six currently known populations of the species and all occur within Aboriginal land. Strongholds appear to be in the Tanami Desert in the Northern Territory, within Uluru-Kata Tjuta National Park, and on Ngaanyatjarra Lands in the vicinity of Patjarr (Karilywara) and Kiwirrkura Communities in Western Australia. A rough estimate puts the total population size of the species at less than 6 250 individuals. The main threats to the great desert skink appear to be inappropriate fire regimes and, to a lesser extent, feral predators (McAlpin, 2001).

It was proposed by Pearson et al (2001) that fire history may be a habitat factor that explains the scattered distribution of the species at different sites. Pearson et al (2001) observed that burrow complexes for the species occurred in small areas of hummock grassland that had escaped recent fires and were characterised by large hummocks and *Eremophila leucophylla* shrubs. These areas were suggested to provide the species with suitable substrate for digging as well as food and insulation from extreme weather. In addition, Pearson et al (2001) found that *Solanum centrale* was an important component of the diet of *L. kintorei* and is highly dependent on disturbance, particularly fire.

The habitat type for this species in the vicinity to the Project site is largely restricted to the palaeochannels to the west of the lease boundary. Areas of low open woodland and hummock vegetation occur to the west of the boundary within the palaeochannel. Two separate surveys were undertaken to locate the great desert skink within the area of palaeochannel adjacent to the MLA. The first survey was undertaken during the Wet season by GHD (GHD, 2012) and involved a targeted survey looking for individuals, latrine sites and burrows. The second survey was undertaken by EcOz (EcOz, 2013) during the Dry season and was undertaken by experienced observers during a random search in suitable habitat. Submissions raised concern about the survey effort and expertise of the observers. The Proponent responded to this comment detailing the survey effort and experience of the team. The NT EPA has reviewed the survey effort in line with the Guidelines for Australia's Threatened Reptiles (DSEWPaC, 2011) and believes that they were sufficient to detect the species if it was present on site.

The NT EPA considers that the Project will not result in unacceptable impacts to great desert skink. As the species has not been recorded on-site and the Project will directly impact a small area of unoccupied habitat, the NT EPA believes that the Project is unlikely to have a significant residual impact on the species and therefore, consistent with the Australian Government Offset Policy (DSEWPaC, 2012) offsets may not be applicable.

## 5 Conclusions

The NT EPA considers that the environmental issues associated with the Project have been adequately identified. Appropriate environmental management of some of these issues has been resolved through the EIA process, while the remainder would be addressed through monitoring and management actions detailed in issue-based management plans under provisions of the *Mining Management Act*. The NT EPA considers that the Project can be managed in a manner that avoids unacceptable environmental impacts provided that the commitments, safeguards and recommendations detailed in the draft EIS, this Report and in the final management plans approved by the Department of Mines and Energy, are implemented and subject to regular reporting and compliance auditing.

The final EMP for the Project will be subject to review to the satisfaction of the relevant Northern Territory agencies prior to its incorporation into the Mining Management Plan. It is recommended that management plans also be developed in consultation with key stakeholders, including the CLC and Traditional Owners (where relevant). The management plans will be working documents for the life of the Project and will require periodic review in the light of operational experience and changed circumstances.

Future requirements to verify modelling and predictions are largely captured in the commitments made by the Proponent and recommendations in this Report. The ongoing risk analysis, environmental monitoring and management required from the Proponent must demonstrate that environmental impacts from the Project are no greater than those predicted in this assessment.

## 6 References

Brawata, R.L., and Neeman, T. (2011) Is water the key? Dingo management, intraguild interactions and predator distribution around water points in arid Australia, *Wildlife Research*, **38**: 426-436

Burbidge, A.A., Johnson, K.A., Fuller, P.J., and Southgate, R.I., (1988) Aboriginal knowledge of the mammals of the Central Deserts of Australia, *Australian Wildlife Research* **15**:9-39.

Australian Bureau of Meteorology (BOM) 2013, retrieved from <http://www.bom.gov.au>.

Cogger, H.G. 2000. *Reptiles and Amphibians of Australia*, Reed New Holland, Sydney.

Department of Environment and Conservation 2005, *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales*. New South Wales Government. Available from: <http://www.environment.nsw.gov.au/resources/air/ammodelling05361.pdf>. [20 August 2013].

Department of Natural Resources, Environment, The Arts and Sport (NRETAS) (2010) *Land Clearing Guidelines*, Department of Natural Resources, Environment, The Arts and Sport, Darwin. Northern Territory.

Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) (2011a). *Survey guidelines for Australia's threatened mammals. EPBC Act survey guidelines 6.5*. [Online]. EPBC Act policy statement: Canberra, ACT: DSEWPAC. Available from: <http://www.environment.gov.au/epbc/publications/threatened-mammals.html>

Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) (2011b). *Survey guidelines for Australia's threatened mammals. EPBC Act survey guidelines 6.5*. [Online]. EPBC Act policy statement: Canberra, ACT: DSEWPAC. Available from: <http://www.environment.gov.au/epbc/publications/threatened-mammals.html>.

Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) (2012) *Environment Protection and Biodiversity Conservation Act Environmental Offsets Policy*, October 2012 [online]. Canberra ACT, Available from: <http://www.environment.gov.au/system/files/resources/12630bb4-2c10-4c8e-815f-2d7862bf87e7/files/offsets-policy.pdf>.

Department of the Environment, Water, Heritage and the Arts (DEWHA) (2008a). *Threat abatement plan for predation by the European red fox*, DEWHA, Canberra.

Department of the Environment, Water, Heritage and the Arts (DEWHA) (2008b). *Threat abatement plan for predation by feral cats*, DEWHA, Canberra.

Dorges, B. and Heucke, J., (1996) *Ecology, Social Organization and Behaviour of the feral Dromedary Camelus dromedarius in Central Australia* (L 1758), Internal Report, Northern Territory Department of Primary Industry and Fisheries.



- Earth Systems (2013) *Preliminary Groundwater Resource Assessment for the Old Pirate Gold Project, Tanami Desert, Northern Territory*, June 2013.
- EcOz (2013a) Flora and Fauna Report Dry Season, May 2013 Twin Bonanza Gold Project, Darwin, NT.
- EcOz (2013b), Twin Bonanza Gold Project, Biodiversity Management Plan-Appendix D of the draft EIS, Darwin.
- GHD (2012) Report for Old Pirate Vegetation, Flora and Fauna Survey, June 2012
- Gibson, D.F. (1986). A Biological Survey of the Tanami Desert in the Northern Territory. *Technical Report*. 30. Alice Springs, Northern Territory, Conservation Commission of the Northern Territory.
- Hanrahan, N., and Low, B., (2014) Desktop Assessment of the Potential Presence of Groundwater Dependent Ecosystems at the Twin Bonanza Project, Tanami Desert.
- Horner, P. 1992. Skinks of the Northern Territory. Northern Territory Museum of Arts and Sciences, Darwin.
- Masters, P. (2008). Crest-tailed Mulgara. In: Van Dyck, S. & R. Strahan, eds. *The Mammals of Australia*. Pages 49-50. 3rd edition. New Holland Publishers.
- McAlpin, S. 2001. A recovery plan for the Great Desert Skink (*Egernia kintorei*) 2001-2011. Arid Lands Environment Centre, Alice Springs.
- Miller, G., Friedel, M., Adam, P., Chewings, V. (2009, Ecological impacts of buffel grass (*Cenchrus ciliaris* L.) invasion in central Australia – does field evidence support a fire-invasion feedback?, *The Rangeland Journal*, **32**(4): 353-365.
- Nano, T, (2008) Central Rock-rat. In: Van Dyck, S. & R. Strahan, eds. *The Mammals of Australia*. Page(s) 659-660. 3<sup>rd</sup> edition. New Holland Publishers.
- Northern Territory Environment Protection Authority (NT EPA) (2012a) Final EIS Guidelines for the Preparation of an Environmental Impact Statement – Twin Bonanza Gold Mine Project. Online  
at: [http://www.ntepa.nt.gov.au/data/assets/pdf\\_file/0009/348156/final\\_eis\\_guidelines\\_twin\\_bonanza.pdf](http://www.ntepa.nt.gov.au/data/assets/pdf_file/0009/348156/final_eis_guidelines_twin_bonanza.pdf).
- Northern Territory Environment Protection Authority (NTEPA) (2012b) Statement of Reasons for the Twin Bonanza Gold Mine Project [online], available from: <http://www.ntepa.nt.gov.au/environmental-assessments/assessment/register/twin-bonanza-gold-mine>.
- Paltridge (2002) The diets of cats, foxes and dingoes in relation to prey availability in the Tanami Desert, Northern Territory, *Wildlife Research* **29**: 389-403.
- Pavey, C. (2006a). *Recovery Plan for the Greater Bilby, Macrotis lagotis, 2006- 2011*. (NT Department of Natural Resources, Environment and the Arts, Alice Springs).
- Pavey, C. (2006b). *Threatened Species of the Northern Territory, Greater Bilby Macrotis lagotis*. [Online]. Northern Territory Government, Department of Natural Resources, Environment, and the Arts. Available from: <http://lrm.nt.gov.au/plants-and-animals/threatened-species/specieslist>.
- Paltridge, R., (2002) The diets of cats, foxes and dingoes in relation to prey availability in the Tanami Desert, Northern Territory, *Wildlife Research* **29**(4) 389-403.

- Paltridge, R. & Southgate, R. (2001). The effect of habitat type and seasonal conditions on fauna in two areas of the Tanami desert. *Wildlife Research*. **28**:247-260.
- Pavey, C. (2006). *National Recovery Plan for the Greater Bilby* *Macrotis lagotis*. [Online]. Northern Territory Department of Natural Resources, Environment and the Arts. Available from: <http://www.environment.gov.au/biodiversity/threatened/publications/m-lagotis.html>.
- Pearson, D., Davies, P., Carnegie, N. & Ward, J. 2001. The Great Desert Skink (*Egernia kintorei*) in Western Australia: Distribution, reproduction and ethno-zoological observations. *Herpetofauna* **31**(1): 64-68.
- Parks and Wildlife Services of the Northern Territory, *Management Program for the Greater Bilby (Macrotis lagotis) in the Northern Territory of Australia*, online 2/4/14, available at: [http://www.lrm.nt.gov.au/\\_data/assets/pdf\\_file/0011/11171/bilby.pdf](http://www.lrm.nt.gov.au/_data/assets/pdf_file/0011/11171/bilby.pdf).
- Simpson, K; & Day, N. (2004). *Field Guide to the Birds of Australia*, 7<sup>th</sup> ed. Penguin Group, Australia p. 97.
- Smyth A., Friedel, M., O'Malley, C. (2009) The influence of buffel grass (*Cenchrus ciliaris*) on biodiversity in an arid Australian landscape, *The Rangeland Journal*, **31**:(3) 307-320.
- Southgate, R.I. (1987). *Conservation of the Bilby*. Report to World Wildlife Fund. (Conservation Commission of the Northern Territory, Alice Springs.)
- Southgate, R., 2012, *Peer review of the Browse Bilby Review, a report detailing the consolidated information relating to the occurrence of the Bilby Macrotis lagotis near the proposed Browse LNG Precinct (close to James Price Point) and more broadly on the Dampier Peninsula*. Available from: [http://www.epa.wa.gov.au/EIA/EPAReports/Documents/1444/Appendix\\_7/1444-BROWSE2.PDF](http://www.epa.wa.gov.au/EIA/EPAReports/Documents/1444/Appendix_7/1444-BROWSE2.PDF). [Accessed: 8 August 2013].
- Southgate, R. I. 1990a. Distribution and abundance of the greater bilby *Macrotis lagotis* Reid (Marsupialia: Peramelidae). In: J. H. Seeback, P. R. Brown, R. L. Wallis & C. M. Kemper (eds) *Bandicoots and Bilbies*, Surrey Beatty & Sons, Pages. 293-302.
- Southgate, R.I. (1990b). Habitats and diet of the greater bilby *Macrotis lagotis* Reid (Marsupialia: Peramelidae). In: Seebeck, J.H., P.R. Brown, R.L. Wallis & C.M. Kemper, eds. *Bandicoots and Bilbies*, Surrey Beatty & Sons: Chipping Norton, NSW, Pages 303-309..
- Southgate, R. & S. Carthew (2006). Diet of the bilby (*Macrotis lagotis*) in relation to substrate, fire and rainfall characteristics in the Tanami Desert. *Wildlife Research*. **33**:507-519.
- Southgate, R., R. Paltridge, P. Masters & T. Nano (2005). An evaluation of transect, plot and aerial survey techniques to monitor the spatial pattern and status of the bilby (*Macrotis lagotis*) in the Tanami Desert. *Wildlife Research*. **32**:43-52.
- Southgate, R., Paltridge, R., Masters, P., Carthew, S., (2007) Bilby distribution and fire: a test of alternative models of habitat suitability in the Tanami Desert, Australia, *Ecography*, **30**(6): 759-776.
- Southgate, R. and Possingham, H. (1995). Modelling the reintroduction of the greater bilby *Macrotis lagotis* using the metapopulation model analysis of the likelihood of extinction (ALEX), *Biological Conservation*. **73**: 151-160.

Thompson, G., and Thompson, S. A., (2014) Detecting burrows and trapping for mulgaras (*Dasyercus cristicauda* and *D. blythi*) can be difficult, *Australian Mammology*, **36**: 116-120.

Woolley, P. A., Haslem, A., and Westerman, M. (2013). Past and present distribution of *Dasyercus*: toward a better understanding of the identity of specimens in cave deposits and the conservation status of the currently recognised species *D. blythi* and *D. cristicauda* (Marsupialia: Dasyuridae). *Australian Journal of Zoology* **61**, 281–290

## **Appendix A – Approved Conservation Advice for the crest-tailed mulgara (*Dasycercus cristicauda*).**

**Approved Conservation Advice for  
*Dasycercus cristicauda* (crest-tailed mulgara)**

(s266B of the *Environment Protection and Biodiversity Conservation Act 1999*)

This Conservation Advice has been developed based on the best available information at the time this Conservation Advice was approved; this includes existing and draft plans, records or management prescriptions for this species.

## **Description**

*Dasycercus cristicauda* (crest-tailed mulgara), family Dasyuridae, is a carnivorous marsupial with a distinctive fin-like crest of black hairs on the tail. The coat is tan to ginger above and creamy white on the belly. Females have eight nipples in the pouch. The hind foot has long hair that folds over a third of the sole from lateral side. Males are up to 230 mm long with a 125 mm long tail and weigh up to 185 g. Females are up to 170 mm long with a 110 mm long tail and weigh up to 120 g (Masters, 2008).

## **Conservation Status**

The crest-tailed mulgara is listed as vulnerable under the name *Dasycercus cristicauda* Mulgara. This species is eligible for listing as vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999* (Cwlth) (EPBC Act) as, prior to the commencement of the EPBC Act, it was listed as endangered under Schedule 1 of the *Endangered Species Protection Act 1992* (Cwlth).

The species is also listed as extinct under the *Threatened Species Conservation Act 1995* (New South Wales), vulnerable under the *Territory Parks and Wildlife Conservation Act 2000* (Northern Territory), vulnerable under the *Nature Conservation Act 1992* (Queensland), endangered under the *National Parks and Wildlife Act 1972* (South Australia), vulnerable under the *Wildlife Conservation Act 1950* (Western Australia) and least concern under the IUCN Red List of Threatened Species Version 2013.1 (Woolley, 2008).

## **Cultural Significance**

The brush-tailed mulgara (*Dasycercus blythi*) and the crest-tailed mulgara are an Indigenous food resource (Woolley et al., 2013; Burbidge et al., 1988). There are more than 50 recorded Indigenous names for the crest-tailed mulgara, distributed across 15 Indigenous languages in the Northern Territory, Western Australia and South Australia (Burbidge et al., 1988). Indigenous people from these areas also acquired ecological knowledge of the species, such as preferred habitat, shelter and diet (Burbidge et al., 1988).

## **Distribution and Habitat**

The crest-tailed mulgara occurs in the southern Simpson Desert where the borders of the Northern Territory, Queensland and South Australia converge, and the Tirari and Strzelecki Deserts of South Australia (Masters, 2008; Woolley et al., 2013). There are no available quantitative data on the extent of occurrence, area of occupancy or abundance of the species. It occurs on sand dunes with a sparse cover of sandhill canegrass (*Zygochloa paradoxa*) or areas around salt lakes with nitre bush (*Nitraria billardieri*) (Masters, 2008).

Records since 1990 indicate that the crest-tailed mulgara has a more restricted contemporary range than previously known, although a lack of survey effort in suitable habitat may be a factor (Woolley et al., 2013). Historically, the species was known from the Canning Stock Route and near Rawlinna on the Nullarbor Plain in Western Australia, Ooldea on the eastern edge of the Nullarbor Plain and the Musgrave Ranges in South Australia, and

Sandringham Station in Queensland (Woolley et al., 2013). The brush-tailed mulgara (*D. blythi*) has been misidentified as the crest-tailed mulgara in the Little Sandy Desert (Start et al., 2013, cited in Woolley et al., 2013) and the Pilbara (Thompson & Thompson, 2008, cited in Woolley et al., 2013).

This species occurs within the Simpson Strzelecki Dunefields and Channel Country IBRA Bioregions and the South Australian Arid Lands, Desert Channels and Northern Territory Natural Resource Management Regions. The distribution of this species is not known to overlap with any EPBC Act-listed threatened ecological community.

The Department of the Environment has prepared survey guidelines for *Dasyercus cristicauda*. At the time of preparation of the guidelines, the species was known as *Dasyercus hillier* and relevant information for *D. cristicauda* is under that section of the guidelines. The survey guidelines are intended to provide guidance for stakeholders on the effort and methods considered appropriate when conducting a presence/absence survey for species listed as threatened under the EPBC Act.

<http://www.environment.gov.au/epbc/publications/threatened-mammals.html>

## Threats

The main identified threats to the crest-tailed mulgara are predation by cats (*Felis catus*) and European red foxes (*Vulpes vulpes*) (Masters, 2012); grazing and habitat degradation by livestock, rabbits (*Oryctolagus cuniculus*) and camels (*Camelus dromedarius*) (Masters, 2012); and inappropriate fire regimes (Woolley et al., 2013). Predation pressure is probably greatest a few years after heavy summer rainfall when predators have increased in numbers and rodent populations begin to crash (Masters, 2012). The species' strict annual breeding cycle and sedentary habit make it sensitive to the impacts of annual climate variance, fire and disturbance on habitat quality and food availability (Masters, 1998). A site's cumulative grazing history has been observed to alter flora composition within arid dune systems (Frank et al., 2013).

## Research Priorities

Research priorities that would inform future regional and local priority actions include:

- Design and implement a monitoring program for at least one representative population (Pavey et al., 2006) or support and enhance existing programs such as the one in south-west Queensland and adjacent parts of the Northern Territory (i.e. Dickman et al., 2001, 2011; Letnic et al., 2011; Pavey et al., 2011)
- More precisely assess population size, distribution, ecological requirements and the relative impacts of threatening processes (Pavey et al., 2006)
- Undertake survey work in suitable and potential habitat to locate any additional populations/occurrences/remnants
- Identify optimal fire regimes for maintenance of an appropriate vegetation structure, and identify responses to current prevailing fire regimes

## Regional Priority Actions

The following regional priority recovery and threat abatement actions can be done to support the recovery of crest-tailed mulgara:

### Habitat Loss, Disturbance and Modification

- Monitor known populations to identify and ameliorate key threats
- Monitor the progress of recovery, including the effectiveness of management actions and the need to adapt them if necessary
- Identify populations of high conservation priority



- Ensure there is no disturbance in areas where the crest-tailed mulgara occurs, excluding necessary actions to manage the conservation of the species

#### Trampling, Browsing or Grazing

- Develop and implement a management plan for the control and eradication of rabbits and camels in the region
- Implement appropriate livestock stocking rates that include lower cumulative grazing rates and destocking at the onset of drought

#### Animal Predation or Competition

- Develop and implement a management plan to control the adverse impacts of European red foxes and cats in the region

#### Fire

- Develop and implement a suitable fire management strategy for the habitat of crest-tailed mulgara

#### Conservation Information

- Raise awareness of crest-tailed mulgara within the local community
- Engage with private landholders and land managers responsible for the land on which populations occur and encourage these key stakeholders to contribute to the implementation of conservation management actions
- Enable recovery of additional sites and/or populations
- Investigate options for linking, enhancing or establishing additional populations

### **Local Priority Actions**

The following local priority recovery and threat abatement actions can be done to support the recovery of crest-tailed mulgara:

#### Habitat Loss, Disturbance and Modification

- Minimise adverse impacts from land use at known sites
- Protect populations of the listed species through the development of conservation agreements and/or covenants

#### Animal Predation or Competition

- Control introduced pests (European red foxes) and feral animals (cats) to manage threats at known sites, and continue baiting to control these species

#### Fire

- Implement an appropriate fire management regime for local populations

This list does not necessarily encompass all actions that may be of benefit to the crest-tailed mulgara, but highlights those that are considered to be of highest priority at the time of preparing the Approved Conservation Advice.

### **Existing Plans/Management Prescriptions that are Relevant to the Species**

- National feral camel action plan (NRMCC, 2010)
- Threat abatement plans for predation by European red foxes (DEWHA, 2008a) and feral cats (DEWHA, 2008b)
- Threat abatement plan for competition and land degradation by rabbits (DEWHA, 2008c)

These prescriptions were current at the time of publishing; please refer to the relevant agency's website for any updated versions.

## References

- Burbidge AA, Johnson KA, Fuller PJ and Southgate RI (1988). Aboriginal knowledge of the mammals of the central deserts of Australia. *Australian Wildlife Research* 15: 9-39.
- Department of the Environment, Water, Heritage and the Arts (DEWHA) (2008a). *Threat Abatement Plan for predation by the European red fox*.  
Viewed: 4 September 2013  
Available on the Internet at:  
<http://www.environment.gov.au/biodiversity/threatened/publications/tap/foxes08.html>
- Department of the Environment, Water, Heritage and the Arts (DEWHA) (2008b). *Threat Abatement Plan for predation by feral cats*.  
Viewed: 4 September 2013  
Available on the Internet at:  
<http://www.environment.gov.au/biodiversity/threatened/publications/tap/cats08.html>
- Department of the Environment, Water, Heritage and the Arts (DEWHA) (2008c). *Threat Abatement Plan for competition and land degradation by rabbits*.  
Viewed: 4 September 2013  
Available on the Internet at:  
<http://www.environment.gov.au/biodiversity/threatened/publications/tap/rabbits08.html>
- Dickman CR, Greenville AC, Tamayo B and Wardle GM (2011). Spatial dynamics of small mammals in central Australian desert habitats: the role of drought refugia. *Journal of Mammalogy* 92(6):1193–1209.
- Dickman CR, Haythornthwaite AS, McNaught GH, Mahon PS, Tamayo B and Letnic M (2001). Population dynamics of three species of dasyurid marsupials in arid central Australia: a 10-year study. *Wildlife Research* 28(5):493–506.
- Frank ASK, Dickman CR, Wardle GM and Greenville AC (2013). Interactions of Grazing History, Cattle Removal and Time since Rain Drive Divergent Short-Term Responses by Desert Biota. *PLoS One* 8(7):e68466.
- Letnic M, Story P, Story G, Field J, Brown O and Dickman CR (2011) Resource pulses, switching trophic control, and the dynamics of small mammal assemblages in arid Australia. *Journal of Mammalogy* 92(6):1210–1222.
- Masters P (1998). The mulgara *Dasycercus cristicauda* (Marsupialia: Dasyuridae) at Uluru National Park, Northern Territory. *Australian Mammalogy* 20:403–407.
- Masters P (2008). Crest-tailed Mulgara. In: Van Dyck S and Strahan R (eds). *The Mammals of Australia*. 3rd edition (pp. 49–50). New Holland Publishers.
- Masters P (2012). Crest-tailed Mulgara *Dasycercus cristicauda* (Krefft, 1867). In: Curtis LK, Dennis AJ, McDonald KR, Kyne PM and Debus SJS (eds). *Queensland's Threatened Animals*. CSIRO Publishing.
- Natural Resource Management Ministerial Council (NRMCC). *National Feral Camel Action Plan: A national strategy for the management of feral camels in Australia*. Prepared by the Vertebrate Pests Committee.  
Viewed: 4 September 2013  
Available on the Internet at:  
<http://www.environment.gov.au/biodiversity/invasive/ferals/camels/index.html>

- Pavey C, Cole J and Woinarski J (2006). *Threatened Species of the Northern Territory - Crest-tailed Mulgara (Ampurta) Dasycercus cristicauda*. Department of Natural Resources, Environment and the Arts, Northern Territory Government.  
Viewed: 3 September 2013  
Available on the Internet at:  
<http://www.lrm.nt.gov.au/plants-and-animals/home/specieslist>
- Pavey CR, Nano CEM, Cooper JB, Cole JR and McDonald PJ (2011). Habitat use, population dynamics and species identification of mulgara, *Dasycercus blythi* and *D. cristicauda*, in a zone of sympatry in central Australia. *Australian Journal of Zoology* 59:156–159.
- Woolley PA, Haslem A and Westerman M (2013). Past and present distribution of *Dasycercus*: towards a better understanding of the identity of specimens in cave deposits and the conservation status of the currently recognised species *D. blythi* and *D. cristicauda* (Marsupialia : Dasyuridae). *Australian Journal of Zoology* (online).  
Viewed: 3 September 2013  
Available on the Internet at:  
<http://dx.doi.org/10.1071/ZO13034>
- Woolley P (2008). *Dasycercus cristicauda*. In: IUCN (International Union for Conservation of Nature) (2013). *IUCN Red List of Threatened Species*. Version 2013.1.  
Viewed: 3 September 2013  
Available on the Internet at:  
[www.iucnredlist.org](http://www.iucnredlist.org)