Northern Territory Environment Protection Authority

ASSESSMENT REPORT 76

MT TODD GOLD PROJECT

VISTA GOLD AUSTRALIA PTY LTD

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Abbreviations and Glossary

AAPA	Aboriginal Areas Protection Authority
ABA	Acid Base Accounting
AHD	Australian Height Datum
ALRA	*Aboriginal Land Rights Act*
AMD	Acid and Metalliferous Drainage
ANC	Acid neutralising capacity
ANZECC	Australian and New Zealand Environment Conservation Council
APP	Acid producing potential
ARI	Annual recurrence (or 'return') interval
CIL	Carbon in leach
CIP	Carbon in pulp
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DFS	Definitive feasibility study
DLPE	Department of Lands, Planning and the Environment (NT)
DLRM	Department of Land Resource Management (NT)
DME	Department of Mines and Energy (NT)
DoE	Department of the Environment (Cmth)
Draft EIS	Draft Environmental Impact Statement
EA Act	*Northern Territory Environmental Assessment Act*
EAAP	Northern Territory Environmental Assessment Administrative Procedures
ECNT	Environment Centre Northern Territory
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
FIFO	Fly in/fly out
FSANZ	Food Standards Australia New Zealand
GCL	Geo-synthetic Clay Liner
GHG	Greenhouse Gas

H	Horizontal
HDPE	High density polyethylene
HLP	Heap leach pad
HPGR	High pressure grinding rollers
IPCC	Intergovernmental Panel on Climate Change
LGO	Low grade ore
LLDPE	Linear low density polyethylene
LPM	Low permeability material
MNES	Matters of National Environmental Significance
NAF	Non-acid forming
NAG	Net acid generation
NAPP	Net acid producing potential
NLC	Northern Land Council
NT	Northern Territory of Australia
NT EPA	Northern Territory Environment Protection Authority
NTG	Northern Territory Government
PAF	Potentially acid forming
PAG	Potentially acid generating (interchangeable with PAF)
PFS	Pre-feasibility study
PGM	Plant growth medium
RP	Retention pond
RWD	Raw water dam
SEWPaC	Australian Department of Sustainability, Environment, Water, Population and Communities
SOCS	Site of Conservation Significance
TSF	Tailings storage facility
V	Vertical
WAD	Weak acid dissociable (in relation to cyanide)
WDL	Waste Discharge Licence
WQO	Water Quality Objective
WRD	Waste rock dump
WTP	Water treatment plant

the Minister	Northern Territory Minister for Lands Planning and the Environment
the Project	Mt Todd Gold Project
the/this Report	This Assessment Report 76, for the Mt Todd Gold Project
the Responsible Minister	Minister for Mines and Energy
The Supplement	The Supplement to the draft EIS

Units and Symbols

%	percent
>/<	greater than/less than
ha	hectare
km	kilometre
km^2	square kilometre
L/s	litres per second
m	metre
mm	millimetre
m^3	cubic metres
m^3/s	cubic metres per second
t	tonne
tpd	tonnes per day
ML	mega litre (million litres)
Mm^3	million cubic metres
MW	mega watts (million watts)
Mtpa	million tonnes per year
Mt	million tonnes
ktpd	kilotonnes per day
ppm	parts per million
mm/y	millimetres per year
m/s	metres per second

°C	degrees centigrade (celcius)
oz	ounce
m^3/h	cubic metres per hour
kph	kilometre per hour
PM_{10}	particulate matter that is 10 micrometres or less in diameter.

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 Mt Todd Gold Project (the Project), proposed by Vista Gold Australia Pty Ltd (the Proponent).

The Project was assessed under an accredited assessment process by the NT Government on behalf of the Australian Government to satisfy requirements of both the NT *Environmental Assessment Act* (EA Act) and the Australian *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

This Assessment Report forms the basis of advice to the NT Minister for Lands, Planning and the Environment and the Australian Government Minister for the Environment on the environmental issues associated with the Project. The NT Minister is required to make comment and/or recommendations with regard to the proposal to the Minister for Mines and Energy (the responsible Minister). Recommendations are made to address relevant construction activities, ongoing operation and closure of the Project.

Major Issues

The key risks associated with the Project are:

- Acid and Metalliferous Drainage (AMD) seepage and runoff from the waste rock dump, ore stockpiles and tailings storage facilities potentially contaminating surface and ground waters during mine operations and continuing long after the mine has ceased operation;
- Potential contamination of surface water from AMD causing adverse impacts on downstream water quality and ecology of the aquatic environment, and downstream users;
- Potential contamination of groundwater from AMD causing groundwater quality impacts outside of the mineral lease or release of contaminated groundwater expressing to surface water;
- The challenges of managing and treating large volumes of acidic and metal laden water currently existing on the site during construction to ensure AMD is adequately contained when mining commences;
- The proposed design of the waste rock dump (WRD) leading to risks of AMD seepage and runoff, erosion and failure both during construction and into the long term requiring active management post-closure;
- Potential impacts on the largest known population of the endangered Gouldian finch from clearing of foraging and breeding habitat, dust generated by mine activities during the breeding season, and cumulative impacts in the Yinberrie Hills;
- Challenges of successful mine closure and rehabilitation or management if the mine is forced into early care and maintenance; and
- The potential for failure of AMD containment and treatment strategies post-closure such that parts of the Daly River catchment downstream from the mine are significantly impacted.

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. A number of unresolved issues require substantial effort by the Proponent to address through the Proponent's Mining Management Plan (MMP) under the *Mining Management Act*, through waste discharge licensing under the *Water Act* and, where changes to the design as a result of the EIA process are necessary, notification of such alterations to the NT EPA for consideration under clause 14A of the Environmental Assessment Administrative Procedures.

The NT EPA considers that there remain substantial unresolved risks to key receptors from the Project. It is possible that these risks may be managed in a manner that avoids unacceptable environmental impacts provided that the commitments, safeguards and recommendations detailed in the EIS and this Report, are implemented.

In particular, there remain significant challenges with respect to the stabilisation and closure of structural components, and treatment of AMD on the Project site. Whether the mine continues to the end of its scheduled life or is forced into early care and maintenance or closure, the uncertainties associated with the WRD design, TSF covers and the post-closure water treatment into the long term must be reduced to provide comfort that these aspects can be designed and constructed, and can function to be ecologically sustainable into the long term. Careful planning and leading practice design should be incorporated during the definitive feasibility phase of the Project. If it is found during the production phase that the final design or treatment options selected are unlikely to be successful in the long term, it may be very difficult to reconfigure these components retrospectively given the limitations of the site.

Accordingly, the NT EPA has provided recommendations that it considers will improve the long-term outcomes of these aspects of the Project, including the requirement for alternative WRD design consideration, refinement of modelling to assess cover systems and continued research, development and trials of passive water treatment systems during production with active treatment ceasing only when passive systems are demonstrably successful.

The uncertainties associated with the Gouldian finch population in the Yinberrie Hills are substantial and the development of an effective reactive monitoring and management program to effectively protect 98% of the core breeding habitat from dust levels exceeding 50µg/m^3 will be necessary. It is essential that such a program is accompanied by measures to offset cumulative impacts on finches to ensure the mine can co-exist with a healthy finch population.

The MMP for the Project will be subject to review to the satisfaction of the DME. It is recommended that management plans be developed in consultation with key stakeholders, including the Jawoyn Association. 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.

Information gaps remaining from the EIA process require the Proponent, government and the regional community to rely on intensive, post-assessment data collection, analyses and monitoring to determine the significance of, and appropriate responses to, potential impacts. These requirements are largely captured in the commitments made by the Proponent and recommendations in this Report. Where data indicates that alterations are required to aspects of the Project and the alterations change the environmental significance of the Project, the Proponent will need to notify the NT EPA. The ongoing consideration of design, 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 and for key risks, substantially less.

List of Recommendations

Recommendation 1

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

- **Identified in the Mt Todd Gold Project Environmental Impact Statement (draft EIS and Supplement);**
- **Identified in further information provided by the Proponent on the NT EPA's direction; and**
- **Recommended in this Assessment Report.**

All safeguards and mitigation measures outlined in the Environmental Impact Statement are considered commitments by the Proponent.

Recommendation 2

The Proponent shall advise the NT EPA and the responsible Minister of any changes to the proposed action, in accordance with clause 14A of the Environmental Assessment Administrative Procedures.

Recommendation 3

The Proponent must undertake a rigorous evaluation of alternative WRD cover designs prior to authorisation of the Project. Modelling work underpinning the design of covers, and subsequent monitored trial covers, must demonstrate that the covers can meet the required cover objectives within the context of the wet-dry cycling environment of the Top End and other biophysical factors that have the potential to affect cover integrity in the long term.

The modelling must be subject to rigorous peer review by an independent party with practical experience with the issues that affect the real world performance of the modelled cover system/s.

Recommendation 4

In designing and constructing waste rock facilities for the Project, the following principles must be adhered to:

- **Lining of the surface drainage channels that are to be covered by the WRD with NAF waste rock to ensure that any clean natural flow-through does not come into contact with PAF or uncertain waste rock;**
- **No PAF or uncertain waste rock to be placed beneath operational or final WRD slopes;**
- **NAF waste rock or soil is required over the relatively flat top and any benches of the WRD to form a low net percolation cover, which should preferably be based on the store and release principle to avoid shedding excessive rainfall runoff over the side slopes.**

For the high PAF waste rock proportion expected at Mt Todd this will necessitate a relatively low level WRD covering a large area, rather than the high pyramid shape proposed.

Recommendation 5

The Proponent must undertake modelling of the proposed store and release cover system for the TSFs using dynamic climate data to assess the long-term integrity of the design under conditions of extended, high rainfall periods. Monitored trial covers should subsequently be constructed to demonstrate that the cover designs achieve acceptably low net percolation.

Recommendation 6

The Proponent must become a signatory to the International Cyanide Management Code.

The water quality monitoring program must include monitoring of cyanide in tailings supernatant and include the parameters of WAD, free and total cyanide. The standard, safe no-discharge level of 50mg/L WAD cyanide is to be set as the threshold to trigger corrective action.

Recommendation 7

The Proponent must undertake revised water balance modelling prior to authorisation of the Project using the most up-to-date data and assumptions based on regulatory requirements. The water balance modelling is to be peer reviewed by an appropriately qualified independent expert and the review provided to the regulator.

Revised modelling outputs will be used to inform the water management and treatment options for the site, including the water treatment plant capacity.

Recommendation 8

The 95% species protection level, determined in accordance with ANZECC 2000, is to apply to the immediate receiving waters for mine site discharge at, or prior to, the commencement of mining. This level must not be exceeded as a result of licensed discharges from the mine site.

Recommendation 9

An appropriately qualified, independent party is to review the macroinvertebrate monitoring plan to determine its adequacy in detecting impacts and determining the cause of any impacts to inform implementation of an appropriate monitoring program prior to commencement of construction.

Recommendation 10

A survey of potential Gouldian finch nesting sites to be cleared and within a reasonable adjacent area must be conducted in the 2015 breeding season as agreed with and to the satisfaction of the NT EPA prior to commencement of Project works to ascertain the potential direct impacts of clearing.

Recommendation 11

In the absence of an appropriate threshold for the Gouldian finch with respect to safe levels of ground level PM_{10} dust, the upper safe limit for human health of 50µg/m³ is to be applied to the Yinberrie Hills SOCS core breeding habitat in the first instance as a trigger for mitigative action.

Recommendation 12

The Proponent must conduct laboratory studies to develop a more appropriate threshold limit for inspirable dust impacts on representative finch species and evaluate the feasibility and value of a sentinel bird program that is responsive to mine-related impacts.

Results from the sentinel bird program evaluation must be provided to the DME and the NT EPA prior to the commencement of construction and serious consideration given to implementing the program subject to the results.

Recommendation 13

A baseline (pre-mining) and ongoing (during construction and mining) Gouldian finch population monitoring program must be established and implemented prior to the construction phase of the Project. The program must:

- **Allow for a substantial baseline survey effort to be undertaken;**

- **Have sufficient rigour to detect short-term changes in the Gouldian finch breeding population;**
- **Distinguish between natural variation in the population and mine-related impacts;**
- **Establish appropriate trigger levels and management responses to enable reactive and effective impact minimisation.**

The program design must be peer reviewed by an appropriately qualified, independent person, to the satisfaction of DME and the NT EPA prior to survey commencement. The baseline survey report is to be provided to the DME and the NT EPA prior to authorisation of the Project.

Recommendation 14

In recognition of the difficulty in establishing a reactive monitoring program that can establish causal effects of dust on Gouldian finches, the Proponent shall ensure that dust levels within the Gouldian finch nesting aggregation area or 'core breeding habitat' are maintained below the threshold stated in Recommendation 11 unless a more appropriate threshold is determined in accordance with Recommendation 12.

A baseline (pre-mining) and ongoing (during construction and mining) program to monitor the extent of dust deposition over Gouldian finch habitat must be established and implemented to the satisfaction of the NT EPA and the DME prior to the construction phase of the Project. The program must:

- **Be capable of detecting Project-related ground level PM10 dust (above baseline);**
- **Be capable of monitoring the range and extent of Project-related dust;**
- **Ensure that 98% of Gouldian finch core breeding habitat remains below the default Project-related PM10 dust level; and**
- **Include annual reporting of monitoring results and allow for program review.**

A baseline monitoring report is to be provided to the DME and the NT EPA prior to authorisation of the Project.

Recommendation 15

Any authorisation of further mining or related activities associated with the Mt Todd mineral leases should not be considered until the NT EPA has been notified and consideration has been given to the activities under clause 14A of the Environmental Assessment Administrative Procedures in accordance with Recommendation 2 of this Report.

Recommendation 16

Prior to commencement of activities likely to disturb potential Northern quoll habitat, the Proponent is to conduct pre-clearance procedures to salvage any individual quolls that may be affected and relocate to a pre-arranged recovery area.

Recommendation 17

Prior to commencement of activities that would directly disturb suitable habitat for the Crested shrike-tit, surveys should be conducted and the area avoided if active nesting is found, until such time as the nest is abandoned or any young fledge.

Recommendation 18

Prior to commencement of vegetation clearing activities, surveys should be conducted by trained experts in the accurate identification of microbats to identify and relocate any Bare-rumped sheathtail bats in the area to be cleared.

Recommendation 19

Appropriate offsets for potentially significant impacts to the Gouldian finch population of the Yinberrie Hills must be implemented by the Proponent in accordance with the Australian Government's *EPBC Act Environmental Offsets Policy, October 2012.*

Recommendation 20

The Proponent is to undertake regular monitoring of the mineral leases for exotic fauna species and implement control measures should the densities become a risk to biodiversity.

Recommendation 21

The Proponent must factor into the design of its above-ground waste structures an appropriate design lifetime to the satisfaction of the DME to ensure that structures will be sustainable into the long term, taking into account the uncertainties of climate variability.

Recommendation 22

The Proponent must consider in detail the costs and the benefits of backfilling the pit with PAF waste rock and/or tailings and an appropriate cover at mine closure in accordance with leading practice mine closure principles. The benefit/cost analysis should include partial backfilling scenarios through disposal of the more reactive material as well as the full backfilling option. Details should be provided to the DME.

Recommendation 23

Consideration must be given in the conceptual closure plan to methods for improving the water quality of the pit lake after closure if backfilling cannot be achieved.

Recommendation 24

The Proponent must undertake further analyses and trials of options for passive water treatment during mining to ensure that such treatment options can meet the 95% species protection level for the receiving environment into the long term without periodic assistance.

Recommendation 25

Active water treatment is to continue at the mine site until such time as it can be demonstrated that successful treatment of all site AMD using passive treatment options is occurring in accordance with Recommendation 24.

Recommendation 26

As part of the Project aquatic monitoring program, the Proponent must contribute to periodic tissue sampling of fish and other species from the Edith and Daly Rivers to monitor edible species and inform human health risk assessments.

Recommendation 27

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

Recommendation 28

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

- **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 are to be submitted to the DME and the NT EPA. The results of the audit must be made available on the Proponent's website.

Introduction

1.1 Environmental impact assessment process

Environmental impact assessment (EIA) 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 environmental detriment; and
- the effectiveness/feasibility of management measures in a precautionary/risk management framework.

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.

This assessment considers that risks can be more reliably evaluated where 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, and in keeping with the object of the *Northern Territory Environment Protection Authority Act* (NT EPA Act) to promote ecologically sustainable development, the NT EPA adopts the guiding principle that 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. 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 components, such as tailings facilities, waste rock dump, process plant and other infrastructure, associated with the Project;
- Management and treatment of water currently existing on site and when mining commences;
- Management of construction activities; and
- Management of processes used in operation of the mine (e.g. inputs and outputs).

Commitments made by the Proponent are included in Chapter 23 of the draft Environmental Impact Statement (draft EIS). Additional safeguards are recommended in this Report, where appropriate.

1.2 Regulatory framework

Environmental assessment was undertaken in accordance with the requirements of the EA Act. The proposal was declared a controlled action under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) as it was considered likely to have significant impacts on Matters of National Environmental Significance (MNES). The Northern Territory Environment Protection Authority (NT EPA) assessed the Project under the accredited assessment process between the NT and Australian Governments.

The 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 make a determination as to whether or not the Project should be authorised under the *Mining Management Act* and if so, the conditions that may be applied.

The Australian Government Minister responsible for the EPBC Act (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 4 of the draft EIS.

1.3 Environmental impact assessment history

On 11 April 2011, the former Department of Natural Resources, Environment, The Arts and Sport (NRETAS) (the Department then responsible for administering the EA Act) received the Notice of Intent for the Project for consideration under the EA Act. On 8 August 2011, the then Minister for Natural Resources, Environment and Heritage decided that the Project required assessment under the EA Act at the level of an Environmental Impact Statement (EIS).

The Project was referred to the then Australian Government Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) and on 30 June 2011 was determined to be a controlled action under the EPBC Act. The Project was considered likely to have significant impacts on the following MNES that are protected under Part 3 of the EPBC Act:

- Listed threatened species (sections 18 & 18A); and
- Listed migratory species (sections 20 & 20A);

On 11 April 2013, a delegate for the Australian Government Minister determined that the Project would be assessed under the accredited assessment process between the NT and Australian Governments. Prior to this, the assessment had been conducted under the bilateral agreement until its expiry in 2013.

Draft guidelines covering matters to be addressed in the EIS were subject to a public review period between 27 August and 9 September 2011. On 26 September 2011, the Minister for Natural Resources, Environment and Heritage directed the Proponent to prepare the EIS addressing the matters set out in the final guidelines.

On 4 June 2013, the Proponent submitted a variation under clause 14A of the Environmental Assessment Administrative Procedures. The NT EPA decided that the alterations were significant but could be assessed through the existing EIA process.

The draft EIS for the Project underwent a six week public exhibition period commencing on 28 June 2013. Nine submissions on the draft EIS were received from government agencies, and four from non-government respondents. All submissions were forwarded individually to the Proponent. The Proponent prepared the Supplement to the draft EIS (Supplement) as required under the EA Act to address the issues raised by the respondents. The raw submissions on the draft EIS were not included in the Supplement.

On 4 November 2013, the NT EPA received the Supplement and circulated it to government advisory bodies for comment and non-government respondents for information. On 22 November 2013, the NT EPA directed the Proponent to provide further information. The Proponent provided a draft of the further information for an adequacy review in January 2014 and the NT EPA provided additional directions for information following its review. The Proponent provided the final draft of the further information on 20 May 2014.

Throughout the process, the NT EPA consulted with and invited comment from the Australian Government on MNES.

This Report is based on a review of the draft EIS and the Supplement (collectively referred to as the EIS), comments from non-government organisations and government advisory bodies on the EIS and further information provided by the Proponent as directed by the NT EPA. The NT EPA prepared this Report and provided it to the Minister, the Proponent and the Australian Government Minister.

The EIA chronology and EIS documentation can be viewed on the Mt Todd project page of the NT EPA website at:

http://www.ntepa.nt.gov.au/environmental-assessments/assessment/register/mount_todd_gold

1.4 Ecologically sustainable development

The Australian Government affirmed its commitment to sustainable development at 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 four national principles (Table 1). 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

ESD Principle	Definition
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 would need to be continually informed and guided by the ESD principles.

The relevant objectives of the NT EPA as stated in the NT EPA Act are as follows:

(a) To promote ecologically sustainable development;

(b) To protect the environment, having regard to the need to enable ecologically sustainable development;

In addition, the NT EPA is required to integrate both long-term and short-term economic, environmental and social equity considerations in its decision making.

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 approving bodies must be guided by ESD principles. Should the Project's viability be demonstrated, continued project design and development, as well as the development and implementation of management and monitoring programs by the Proponent, must all aim to meet the objective of ESD.

2 The Project

A detailed description of the Project is presented in Chapter 2 of the draft EIS. The following section provides an overview of the Project, and its components, that comprise the proposed action.

Mt Todd Gold Mine is a brownfield site previously mined for gold, with a total mining lease area of 5365 hectares (ha). Remnant mine infrastructure includes the (currently flooded) Batman Pit, a heap leach pad, a 16 million tonne (Mt) waste rock dump, a tailings dam, low grade ore stockpiles, a raw water dam (RWD) and the remains of processing facilities. Vista Gold Australia Pty Ltd (the Proponent) is proposing to re-open the mine. Mining and associated operations would occur primarily on Mineral Leases MLN 1070, MLN 1071 and MLN 1127.

2.1 The Proponent

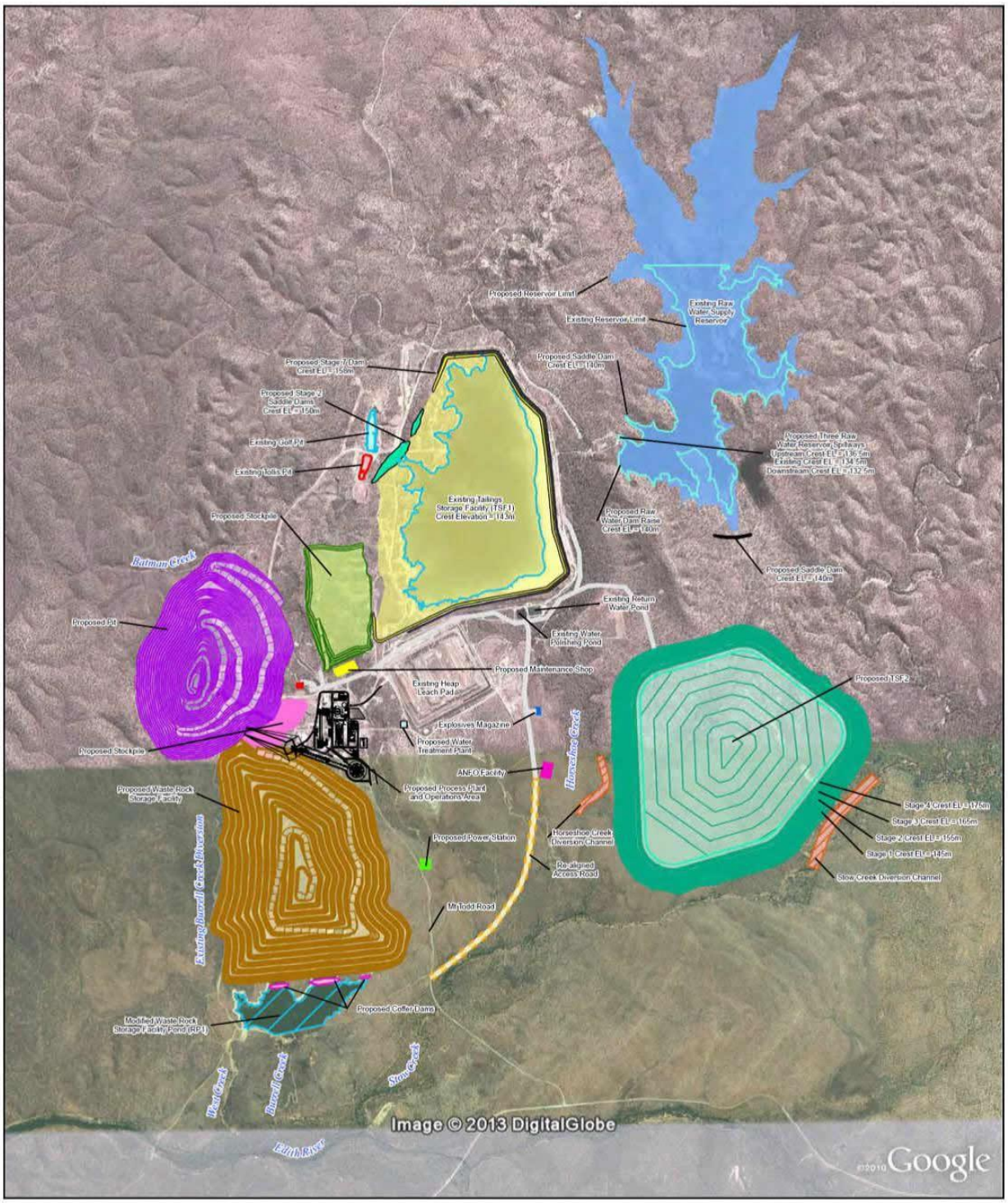
The Proponent of the Project is Vista Gold Australia Pty Ltd, which is a wholly owned subsidiary of Vista Gold Corporation. Vista Gold Corporation is an international gold mining company with interests in the United States, Mexico and Indonesia, in addition to Australia.

2.2 Project location

The Mt Todd Gold Mine site is located approximately 55 kilometres northwest of Katherine and 250km south of Darwin in the Northern Territory.

Figure 1. Existing infrastructure on the Mt Todd mine site (Source: Mt Todd Gold Project draft EIS)

Figure 2: Proposed infrastructure for the Mt Todd Gold Project (Source: Mt Todd Gold Project draft EIS)



2.3 Mine site components

2.3.1 Existing facilities

Existing facilities that will be used by the Project are the:

- Waste rock dump, retention pond (RP1) and pumping system;
- Tailings storage facility (TSF1) and associated decant and polishing ponds;
- Retention Pond 5 (RP5);
- Low grade ore (LGO) stockpile, associated retention pond (RP2) and pumping system;
- Scats stockpile;
- RWD;
- Gas pipeline;
- Groundwater production and monitoring bores;
- Power transmission lines from the main electricity grid;
- Sealed road to site and mine roads and other ancillary facilities (e.g. pipelines); and
- Fuel facility.

The existing mine site is shown in Figure 1.

2.3.2 Proposed facilities/activities

Mining is proposed to involve the following:

- Expansion (from the current footprint of 40ha to 137ha) and deepening (from the current depth of 114m to 588m) of Batman Pit by conventional truck and shovel methods;
- Expansion (from the current footprint of 70ha to 217ha), raising (from the current height of 24m to 350m), and encapsulation of the existing 16Mt waste rock dump (WRD), to provide capacity for a combined total of up to 510Mt of waste rock;
- An ore processing plant capable of processing approximately 50 000 tonnes per day (tpd) of ore, requiring 36 000 cubic metres per day (m^3/day) or 36 million litres (ML) of water (sourced from the tailings storage facility (TSF) reclaim, the 8.4 million cubic metres (Mm^3) capacity RWD, and a water treatment plant (WTP));
- Raising the existing TSF1 from its current height of 16m to 34m to ultimately cover an area of 239ha;
- Constructing a new TSF2 over four stages to a height of up to 60m and an area of 301ha, including the diversion of Horseshoe and Stow Creeks adjacent to TSF2 to provide flood protection;
- Reprocessing or rehabilitation of the existing 39ha by 20m to 25m-high heap leach pad (HLP), with side slopes as steep as 58 degrees (1H:1.6V), and deep erosion gullies and rills;

- Processing and/or reclamation of the existing LGO stockpiles;
- Establishment of clay borrow area(s) (as yet unproven);
- Establishment of an anaerobic treatment wetland covering an area of approximately 10ha;
- Raising of the existing RWD by approximately 2m;
- Construction of a camp for 70 workers, and a single person accommodation facility for 100 workers and new houses for 120 workers in Katherine; and
- Construction over an anticipated two years of new facilities including an ore processing plant, a 41m^3/day potable water treatment plant (WTP), a 76 million watt (MW) gas-fired power station (including the rerouting of the existing gas pipeline), new fuel infrastructure, explosives and dangerous goods storage, and administration and plant site buildings.

The footprint of the proposed infrastructure is indicated in Table 2.

It is proposed to process approximately 17.8 million tonnes per annum (Mtpa) of ore by the carbon in leach (CIL) process, and the tailings are proposed to be detoxified and stored in an impoundment from which process water will be recycled to the process plant. Gold dore (unrefined gold bars) will be transported, presumably by truck to the Port of Darwin, for onward secure shipment to a refinery.

Table 2. Comparison of infrastructure (current, original proposal and final Project case)

Facility / Infrastructure	Existing Footprint	NoI (30ktpd case) Proposed Footprint	EIS (50ktpd case) Proposed Footprint
Batman Pit	Depth – 114m Area – 40ha	Depth – 471m Area – 100ha	Depth – 588m Area – 137ha
WRD	Area – 70ha Height – 24m	Area – 200ha Height – 140 – 170m	Area – 217ha Height – 350m
TSF1	Area – 170ha Height – 16m	Area – 170ha Height – 34m	Area – 170ha Height – 34m
Process Plant and Operations Area	Area – 15ha	Area – 15ha	Area – 15ha
Heap Leach Pad (HLP)	Area – 40ha	Area – 40ha	Area – 40ha
LGO1	Area – 10ha	Area – 10ha	Area – 10ha
LGO2	N/A	Area – 30ha	Area – 30ha
WTP	Process Plant and Operations Pad	Decommissioned during the construction period and replaced by a new WTP	Decommissioned during the construction period and replaced by a new 500m^3/hr WTP
RWD	Volume – 4,287,313m^3	Volume – 4 287 313m^3	Volume – 8 400 000m^3
Limestone Kiln	N/A	0.6ha	N/A
Equalisation Pond	N/A	Area – 1.7ha	Area – 1.7ha
Sludge Disposal Cell	N/A	Area – 2ha	Area – 2ha
TSF2	N/A	Area – 420ha	Area – 420ha

		Height – 80m	Height – 60m
Clay Borrow Area	N/A	Area – 12ha	Area – 12ha
Construction Camp	N/A	N/A	Area – 2.5ha
Anaerobic Treatment Wetlands	N/A	Area – 10ha	Area – 10ha

Mining

Mine operations will be 24-hour, split across two shifts (6am – 6pm and 6pm – 6am). Drilling and blasting, to loosen rock ahead of mining, will be undertaken to produce rock sizes that conform to processing requirements. Blasted ore will be loaded into haul trucks for transportation either directly to the primary crusher, ROM pad or LGO stockpile.

Based on a review of geological data and current bench slopes, a detailed pit design involving mining in four separate phases, or cut backs, was included in the EIS and is outlined below:

- Phase 1 pit design during pre-production would start from the current pit pushback limit on the eastern side of the pit and mine it to -188m Australian Height Datum (AHD);
- Phase 2 would mine around the phase 1 pit to a depth of -246m AHD, with the exception of a short common wall on the west side of the pit;
- Phase 3 would expand the pit to the south and west, to a depth of -336m AHD; and
- Phase 4 would establish the ultimate pit, expanding the previous phases to the north and west to a pit depth of -396m AHD (588m below the pit crest).

Ore processing

The proposal would involve construction of a new ore processing plant on the previous process plant site. The process plant would treat free milling ore using conventional technology to recover cyanide leachable gold using a CIL process.

The ore processing plant would undertake comminution (crushing and grinding of ore); adsorption and detoxification; and gold extraction. The simplified process is illustrated in Figure 2-9 of the draft EIS.

Ore would be fed into a primary gyratory crusher, either directly by haul truck from the pit or by front-end loader from the ROM pad and LGO stockpile. The Proponent proposed to reprocess ore contained within the existing LGO stockpile and scats from the scats stockpile if economical to do so. Primary crushed ore would then be fed into secondary crushers, then into the high-pressure grinding rollers, slurried and fed into the hydrocyclones, and then finally into the ball mills. Oversized materials would be separated through screening at various stages and returned through comminution. The final undersized product would be thickened and pumped to the CIL process circuit.

The CIL circuit consists of a pre-leach thickening stage followed by conventional leaching and adsorption. Pre-aeration reduces cyanide consumption during CIL leaching. Cyanide is added to the slurry to dissolve the gold after which carbon is added to adsorb the dissolved gold. Reactivated carbon, supplemented with fresh carbon as necessary, would be added to the final tank in the circuit.

CIL plant tailing would be directed to a cyanide detoxification circuit in which the cyanide is reduced through the air/sulfur dioxide process. The residual weak acid dissociable (WAD) cyanide target for discharge from this circuit is <10 parts per million (ppm). The

slurry exiting the detoxification tanks would gravitate into a tailings pump hopper and then be pumped to tailings storage.

Lead nitrate is proposed to be used to separate gold from a secondary copper mineral, chalcocite, which may be present in some of the ore. Ore containing chalcocite would be processed separately with lead nitrate to reduce cyanide consumption. The Proponent indicated that lead from this process would report to the tailings as insoluble compounds due to anions contained in the slurry.

Gold is recovered from the loaded carbon into solution and then electro won from the pregnant (gold rich) solution onto stainless steel wool. The resultant barren solution (once gold grades are below economic levels) would be returned to the CIL circuit. The stainless steel cathodes are washed under high pressure to obtain the solids, which are dried, then fluxed and smelted in a furnace, and poured into dore bars.

Waste rock dump

Waste rock from the Batman Pit would be hauled to the proposed WRD, which would subsume the current WRD and extend to an area of 217ha with a final height of 350m above ground level. The ultimate design would incorporate an angle of repose slope of 1 vertical (V) to 1.8 horizontal (H) (29 degree slope overall) with 8m-wide benches at 30m vertical intervals (with 34 degree interbench slope) on its face. These benches would function as stormwater drainages and as access for closure cover installation, reclamation activities and maintenance.

The intent is to dump potentially acid-forming (PAF) and uncertain waste materials in the interior of each lift during the construction of the WRD, with non-acid-forming (NAF) material dumped to the outer edge of each lift. The draft EIS stated that at least a 10m rind of NAF material would encapsulate the PAF material.

At the completion of each 30m lift, a geosynthetic clay liner (GCL) with a total width of 52m is proposed to be laid on top of each bench to provide full overlap from bench to bench. Benches would be slightly sloping (figures in the EIS and pre-feasibility study (PFS) vary between 2 degrees and 5 degrees, and 1.5% and 5% slope) to promote drainage to the outer portions of the dump. However, during construction and following closure, stormwater (predicted to be 21% of annual precipitation uncovered and 7% with the cover) would be expected to infiltrate through the structure to the underlying PAF rock.

Stormwater runoff would be conveyed to the toe of the WRD. A surface water collection ditch would be constructed along the down-gradient toe of the WRD. Clean surface runoff from the reclaimed WRD is proposed to be routed around RP1 and into West Creek to separate it from any acid and metalliferous drainage (AMD) from the WRD to RP1. This would require appropriately identified benign waste rock that is not likely to produce metalliferous leachate or runoff.

The information provided in the EIS regarding closure of the WRD indicated that a 0.3m layer of fine material would be placed over the GCL and then covered with a 1m layer of NAF material to prevent erosion. The EIS was contradictory as to whether the final cover of the WRD would be vegetated or not. Regardless, it is expected that weathering of the cover and natural recruitment of vegetation over time would eventually lead to vegetative growth on the WRD.

Tailings facilities

Processing of the ore is expected to produce approximately 223Mt of additional thickened tailings, of which 62Mt is proposed to be stored in TSF1 and 161Mt in TSF2.

It is proposed to raise the existing TSF1 embankment from the current height of 16m to 34m requiring 4Mt of NAF borrow material.

It is proposed to raise the main TSF1 embankment by the centreline method, discharging thickened tailings by spigots from the embankment crest, composed of either fill or waste rock and raised vertically. There would also be two saddle dams constructed on the west side of TSF1.

Following the TSF1 raise, a new 60m high TSF2 will be constructed in four stages, requiring 45Mt of NAF borrow material.

It is proposed to construct TSF2 by the upstream method on top of beached tailings. The entire facility is proposed to be underlain by a system of under-drains, a geomembrane liner, toe drains and over-drains. The under-drainage network would consist of primary and secondary drains installed along natural surface drainage paths throughout the footprint. The primary drains are proposed to be constructed from 250mm diameter, doublewalled, perforated and corrugated high density polyethylene (HDPE) pipe. The under-drainage network would be extended at each additional construction stage.

The thickened tailings would be discharged sub-aerially from spigots along the TSF2 embankment crest, forming a decant pond towards the centre of the facility where a floating barge with pumps and pipes would convey the reclaimed water back to the process plant. TSF2 is designed to act as a zero-discharge facility. As the TSF footprint covers and obstructs parts of Horseshoe and Stow Creeks, the obstructed sections would be diverted around the toes of TSF2.

Upon closure, the Proponent proposes a store and release cover overlain with plant growth medium for the TSFs.

2.3.3 Water treatment plant and retention ponds

The mine has nine facilities that store water as their primary or secondary function, and a pumping and pipeline network that aims to eliminate discharges from ponds during all but extreme rainfall events. Drains intercept and divert clean water, such as in the upper reaches of Horseshoe and Burrell Creeks. Drains also divert runoff from disturbed areas such as LGO stockpiles and direct it to ponds. There are also existing and proposed creek diversions.

The objective for the proposed site is to transfer excess contaminated water to the proposed 60 000m^3 equalisation pond for treatment through a 12 000m^3/day WTP, without overflows[1]. The equalisation pond would be lined with linear low density polyethylene (LLDPE) or equivalent. The pond cells would likely include a spillway or decant system and containment structures to address overflows. In the event of a system failure or shutdown for maintenance of the proposed WTP, the equalisation pond would provide approximately five days of AMD storage.

Treated water in excess of that required for future processing and dust suppression is proposed to be discharged to the Edith River via Batman Creek.

During operations, the TSFs are predicted to be the main sources of seepage. However, the Proponent has not yet conducted modelling to determine TSF seepage volumes and has therefore estimated seepage to be approximately 10% of reclaim from the TSFs. Seepage/decant volumes are estimated to range from 9600 to 10 200m^3/day during the Dry season, and 19 200m^3/day during the Wet season. Operational seepage would be held in the various ponds and the equalisation pond, and treated in the WTP.

[1] The draft EIS is conflicting and inconsistent in terms of the size of the equalisation pond and WTP. Pps. 10-17 and 10-20 state that a 300m^3/hr WTP will be used for 3 years and then 500m^3/hr in years 4-12. The NT EPA has chosen to adopt the figures quoted.

Post-closure, seepage flows from the WRD, TSFs and HLP, and overflows from Batman Pit, should they occur, are proposed to initially be put through the WTP prior to release to the Edith River until volumes are reduced to be treatable through a passive water treatment system. The TSFs are estimated to generate combined seepage of 31.5 to 228.5m^3/day post-closure, while the WRD is estimated to generate no seepage in the Dry season and up to 2304m^3/day in the Wet season. These estimates depend very much on the success of the final engineered land forms and covers into the long-term. The Proponent expects the volumes of seepage water put through the WTP post-closure to decline from 380m^3/day initially to 39m^3/day eventually. Post-closure the pit is predicted to flood to an equilibrium level at approximately 15m AHD within a 500 year period, which is approximately 170m below the current pit crest.

2.3.4 Water supply and storage

The enlarged RWD would be the main source of water supply for the Project with a capacity of 8.4Mm^3. Processing 50 000tpd of ore will require up to 30 000m^3/day of water, and dust suppression is estimated to require 220 to 1153 m^3/day of water. This water demand would be met by the RWD, TSF reclaim water and the WTP.

2.4 Schedule

The production schedule of approximately 223Mt of processed ore will occur over a 13 year period.

The estimated 19-year mine life includes construction (2 years), operations (13 years), and closure and rehabilitation (4 years).

The Project proposed to commence during the first quarter of 2014; however, a slump in the gold price has led to uncertainty in the Project and the commencement date is now unknown. The Proponent in its 2013 Annual Report indicated that '*The current gold price does not justify the development of the project at this time, nor the completion of the feasibility study*'.

The Batman Pit contains a significant volume of water. It is currently unclear when this water would be pumped down to a sufficiently low level to allow commencement of mining were the mine to receive authorisation.

2.5 Workforce

The construction and operations workforces would be expected to peak at 450 and 350 personnel respectively (draft EIS).

The construction workforce would be housed in a purpose built camp. The location of this camp is still to be determined but it is likely to be located within 25km of the mine. An onsite accommodation camp is being considered.

The operations workforce of 350 would be expected to comprise 60 personnel drawn from the region with the remaining 290 personnel employed from elsewhere.

Accommodation options were proposed as follows:

- 70 workers at the construction camp, which would accommodate mainly fly-in, fly-out (FIFO) / drive-in, drive-out personnel;
- 120 workers (family households with or without children) in a mixture of:
    - new three and four bedroom houses located on existing vacant Katherine and regional land;

- existing (renovated if required) houses located in Katherine and regionally; and
- subject to real estate availability at the time of the arrangement, a small contained development on Katherine land.

- 100 workers located in a Katherine-based single person accommodation facility.

The EIS anticipated 40 workers would be required for decommissioning and closure and housed in FIFO facilities or the Katherine-based single person facility.

2.6 Closure and rehabilitation

The EIS documents proposed remediation and rehabilitation of a number of principal areas, described as follows:

- Heap leach pad and moat – leached ore would be removed and processed during years 12 and 13 of production. Contaminated material and the liner would then be removed and disposed of in TSF2 with the remaining material (approximately 156 000m^3) graded and capped with a 0.8m layer of low permeability material (LPM) and NAF rock, and a 0.2m layer of plant growth medium (PGM) for vegetation.
- TSFs – thixotropic tailings would be bridged with a 1m layer of NAF rock followed by a 0.8m layer of LPM and 0.2m layer of PGM for vegetation. TSF2 is proposed to be rehabilitated progressively.
- The process plant site would be decontaminated and demolished with salvageable equipment sold and other structures broken up and disposed of on site within areas to be reclaimed. The site would then be graded to drain towards Batman Creek and covered with a 0.8m layer of LPM and NAF rock, with a 0.2m layer of PGM applied for vegetation growth.
- Roads would be closed by grading, ripping, applying 0.2m of PGM and revegetating.
- Residual ore would be removed from LGO2. Remaining material would be rehabilitated as for other landforms described above.
- A safety bund of 5m-wide base and 2m height would be constructed around the Batman Pit with a 10m offset from the pit edge to impede human access.
- A 1m layer of NAF waste rock would be placed over the surface of the final WRD. A cover layer composed of 0.3m bedding layer of crushed rock, a GCL and a further 0.3m layer of finely crushed rock would then be applied.

3 Regional Setting

3.1 Physical

3.1.1 Landform, soils and geology

The Mt Todd deposit is located in the Early Proterozoic Pine Creek Geosyncline. The Batman Pit is located within the Burrell Creek Formation and the rock types comprise greywackes (locally metamorphosed to hornfels at depth and to the west of the pit), shales and felsic tuff. The Batman Deposit shares some characteristics with intrusion-related gold systems, especially the association of gold with bismuth and reduced ore mineralogies. This makes the deposit unique in the Pine Creek Geosyncline. Sulfide

minerals associated with the gold mineralisation are pyrite, pyrrhotite, and lesser amounts of chalcopyrite, bismuthinite, and arsenopyrite.

The main natural topographic feature of the mine site is Mt Todd with an elevation of 230m AHD. The two primary land systems in the Project area include the Baker system, which consists of hills and strike ridges on persistent Burrell Creek greywacke, sandstone and siltstone, and the Bend system, which consists of undulating hills on lower Proterozoic sediments in the Burrell Creek Formation.

Soils vary from sandy and loamy red and yellow earths to lateritic and yellow podzolic soils, often over compacted clay sub-soils. Hill soils are stony and skeletal. Soil pH levels range from 4 to 4.2 with generally low sodium and plant macronutrients.

3.1.2 Climate

Rainfall

The region experiences a tropical savannah climate with distinct Wet (October to March) and Dry (April to September) seasons. Katherine Aviation Museum rainfall records since 1943 indicate maximum and minimum annual rainfalls of 1773mm in 1998 and 678mm in 1970, with an average annual rainfall of 1189mm. Wet season relative humidity ranges from 80 to 100%, while Dry season relative humidity ranges from 50 to 70%.

The region is susceptible to extreme wind speeds of up to 270kph and flooding rains during tropical cyclones and storms.

Temperature

Maximum temperatures in the Dry season typically range from 24°C to 36°C, occasionally reaching 39°C, while minimum Dry season temperatures can fall to 7°C. Maximum temperatures in the Wet season typically range from 27°C to 42°C.

Potential evaporation

Annual potential evaporation for the region is 2400mm.

Climate change

Climate change projections for Australia are available in the CSIRO publication Climate Change in Australia (CSIRO 2007). The CSIRO Report provides climate projections for the Top End region of the Northern Territory and more specific projections for Darwin across a range of scenarios and timeframes.

The CSIRO projections are based on the simulation of future climate by 23 climate models under different greenhouse gas emission scenarios developed by the Intergovernmental Panel on Climate Change (IPCC). The median of the model results for each climate parameter is presented as the 'best estimate' while the 10th and 90th percentiles represent the uncertainty range.

The EIS relies on the projected climate changes for Darwin based on the assumption that Darwin's climate is sufficiently consistent with that of the Katherine region for a high level analysis. Two IPCC scenarios are referenced: the A1B scenario (medium emissions scenario) for 2030 and the A1F1 (high emissions) scenario for 2070 to accommodate an upper level of risk.

For consistency with the EIS the Darwin projections are discussed below.

Temperature

Average annual mean temperature in Darwin is projected to increase by 0.7°C to 1.4°C by 2030, with a best estimate increase of 1°C (A1B scenario). By 2070, the average

annual mean temperature in Darwin is projected to increase by 2.3°C to 4.4°C, with a best estimate of 3.2°C (A1F1 scenario).

Number of days over 35°C

The CSIRO Report projects an increase in the number of extremely hot days (days above 35°C) per year for Darwin. In 2030, 44 extremely hot days are projected (A1B scenario best estimate) and in 2070, 141 extremely hot days are projected (A1F1 scenario best estimate). This compares to a Darwin baseline of 11 extremely hot days per year. Katherine (and Mt Todd) currently experiences a much higher number of extremely hot days than Darwin (Katherine baseline is 151 days per year) and it is unclear whether Katherine will experience the same level of increase in extremely hot days as Darwin.

Rainfall

No change in the annual mean rainfall for Darwin is projected for 2030 (A1B scenario best estimate), with an uncertainty range of -7.0% – 6.0% change. For 2070, annual mean rainfall for Darwin is projected to change by -1% (A1F1 scenario best estimate), with an uncertainty range of -21% - 20%. While little change in annual rainfall is projected, albeit with a large degree of uncertainty, best estimate projections show a decrease in Dry season rainfall.

Potential evaporation

Annual potential evaporation in Darwin is projected to increase by 3% in 2030 (A1B scenario best estimate) and 10% in 2070 (A1F1 scenario best estimate). Applying a 10% increase to Katherine results in an increase in potential evaporation from 2400mm/y (Katherine baseline) to 2640mm/y in 2070.

Current climate in the region is characterised by extremes in temperature and rainfall, particularly intensive short-term rainfall events. While there are substantial uncertainties about future climate given Australia's ongoing climate variability and the uncertainties of climate change, projections for the region suggest that these extremes may be exacerbated by climate change.

The design of infrastructure needs to consider projected climate and the risks posed from operational and post closure perspectives.

The 2030 projections are relevant to the life of the project, with the mine potentially in its operational phase in that year (depending on timing of project approval, construction and commencement of operations). The impact of projections on the site water balance and susceptibility of water storage infrastructure to extreme rainfall events warrant particular consideration.

The 2070 projections are relevant to the site following the completion of the project and the long term structures that would remain. The integrity of structures such as the waste rock dump and tailings storage facilities and effectiveness of their rehabilitation may be impacted by changes in future climate.

3.1.3 Surface water resources

The Mt Todd mine site is situated within the Daly River regional catchment. The Daly River catchment supports agriculture, mining and tourism, and is one of the NT's largest catchments with an area of 52 577km^2.

The Fergusson River (with a catchment of 1490km^2 and one of five main tributaries within the Daly River catchment, having a mean annual discharge of 23.49m^3/s), is located approximately 15km to the north-west of the mine. The perennial Edith River, the

largest tributary of the Fergusson River, is located immediately south of the mine, and several tributaries of the Edith River cross or are close to the Mineral Leases.

A gauging station on the Edith River downstream of the site captures a 671km^2 catchment. The maximum recorded river height at this station was 9.4m on 27 December 2011.

Under the *Water Act*, the declared beneficial use of the surface water from the Edith River and its tributaries is to sustain aquatic ecosystems. Agricultural land use (irrigation and stock watering) also occurs downstream of the site.

Tributaries of the Edith River traverse the mine site. Horseshoe Creek is an ephemeral watercourse fed by the RWD and a diversion drain north-west of RP7 (TSF1), and its catchment. It may also receive seepage from RP7. The riparian zone east of RP7 contains seasonal wetland species. Batman Creek is fed during the Wet season by its catchment upstream of the mine, and traverses the mine capturing discharges from RP5, RP2 and the HLP. Stow Creek is an ephemeral watercourse fed by Horseshoe and Batman Creeks. A large section of Burrell Creek is covered by the WRD, receiving water from the RP1 siphons during planned discharges, and it is a seasonal wetland. West Creek is ephemeral and located west of the WRD, being fed by the western diversion drain and RP1 spillway during periods of uncontrolled discharge.

3.1.4 Groundwater resources

The regional groundwater flow beneath the mine site is generally westwards, reflecting the surface water flow of the Edith River. Regional flow is likely to be interrupted by local groundwater highs and lows associated with groundwater sources and sinks created by the surface topography (Yinberrie Hills and Mt Todd, and springs at low points). Groundwater is discharged from direct rainfall infiltration, leakage from the perennial Edith River and ephemeral watercourses where river levels are above the surrounding groundwater level.

The Katherine region groundwater has declared beneficial use including raw water for drinking, agricultural and industrial purposes.

The bedrock Burrell Creek Formation is capable of providing maximum sustainable yields of 0.5 to 2L/s in zones of intense alteration, faulting or shearing. Groundwater flow is directed north to south towards discharges to the Edith River, and remains constant throughout the year. Groundwater levels and quality are extensively monitored via a series of existing boreholes. The background and locally mine-affected groundwater quality is not suitable as a reliable source of potable water without treatment.

The shallow alluvial deposits and highly weathered regolith have the highest estimated hydraulic conductivity of up to 5m/day (6 x 10^{-5}m/s). The lowest hydraulic conductivity is inferred for the bedrock, which forms an effective barrier to groundwater flow, at about 1 x 10^{-5}m/day (1 x 10^{-10}m/s).

The average estimated groundwater recharge to the Batman Pit is 13.75mm/y or 1% of rainfall. Batman Pit is poorly connected to groundwater, limiting groundwater inflows and the extent of drawdown during mining. Over the site as a whole, net recharge is small, with most rainfall running off to the nearest watercourse.

3.2 Biological

3.2.1 Vegetation

The mine site occurs in the Pine Creek Bioregion, just north-east of the Daly Basin Bioregion boundary. The Pine Creek Bioregion:

- Encompasses an area of 28 456km^2 comprising 2.12% of the total NT land area;

- Is characterised by foothill environments below and to the west of the western Arnhem Land sandstone massif;
- Supports the highly mineralised Pine Creek Geosyncline, comprising Archaean granite and gneiss overlain by Palaeoprotozoic sediments;
- Has the dominant vegetation types of tall open eucalypt forests, typically dominated by Darwin Woollybutt (*Eucalyptus miniata*) and Darwin Stringybark (*E. tetrodonta*), with smaller patches of monsoon rainforest, Melaleuca species woodlands, riparian vegetation and tussock grasslands; and
- Has a tropical monsoonal climate with 90% of the rainfall occurring between the months of November and April. The average rainfall varies from 1000mm inland to 1600mm in coastal areas.

The draft EIS identified eight local scale vegetation types on the mineral lease areas with five of those occurring in areas that are proposed to be disturbed by the Project. These vegetation types include:

Type 1 – Melaleuca forest, with bare areas;

Type 2 – *Eucalyptus bigalerita*, *E. spp*. open forest;

Type 4 – *Eucalyptus tintinnans*, *E. spp*., *Erythrophleum chlorostachys* woodland;

Type 6 – *Eucalyptus tintinnans*, *Corymbia dicromophloia* woodland;

Type 9 – *E. tectifica* woodland;

Type 10 – *E. tectifica*, *Corymbia confertiflora* woodland;

Type 11 – *Corymbia latifolia*, *E. bigalerita* open woodland with areas of grassland;

Type 16 – *E. tectifica* woodland / *E. tintinnans, E. spp*., *Erythrophleum chlorostachys* woodland

Vegetation types 2, 4, 6, 9 and 11 are expected to be disturbed by the Project.

Vegetation type 2 conforms with a sensitive or significant vegetation type identified in the NT Land Clearing guidelines. Type 2 occurs along Stow Creek, which is proposed to be diverted around TSF2.

The draft EIS noted an abundance of introduced flora around the previous mine facilities and infrastructure with weeds largely absent from the undeveloped areas of the mineral leases. The draft EIS stated that the definitive source of the introduced flora species is unknown but the weeds are likely to have become established with previous mining activities. Twelve weed species were observed in flora surveys for the Project.

Yinberrie Hills Site of Conservation Significance

The Yinberrie Hills area (in which the proposed development is located) is a significant site for the Gouldian finch, as acknowledged in the draft EIS. It is also recognised in the national recovery plan for the Gouldian finch (O'Malley 2006) and recognised in the draft EIS as a key site for, and containing the largest known breeding population of, this endangered species.

At national level, the importance of the Yinberrie Hills for Gouldian finches is the primary basis for the inclusion of the area on the Interim List for the Register of the National Estate and, at the Territory level, the recognition of the site as one of the Northern

Territory's Sites of Conservation Significance (Harrison *et al*. 2009; Ward and Harrison 2009: http://lrm.nt.gov.au/__data/assets/pdf_file/0015/13911/30_yinberrie.pdf).

The site is also recognised internationally as an Important Bird Area (through Birdlife International: see http://www.birdlife.org/datazone/sitefactsheet.php?id=24456), primarily because of its significance for the threatened Gouldian finch. These sites 'are amongst the Earth's most exceptional places for birds and are priority sites for bird conservation' (Dutson *et al*. 2009).

The Yinberrie Hills are characterised by rolling hills, rising from the extensive plains to the north, east and south and are distinct from the Arnhem Land escarpment to the east and north-east. The hills encompass an area of 1025km^2.

The hills are dominated by grassy open woodland, but provide habitat attributes that are scarce in the broader landscape including an understorey of perennial native grasses, retention of water in small rocky pools throughout the Dry season and smooth-barked eucalypts with hollows. The woodland includes a mixed overstorey of snappy or salmon gums (*Eucalyptus tintinnans*), *E. tectifica*, *Corymbia confertiflora* and an understorey dominated by tall annual spear-grasses.

The hills provide permanent water and foraging habitat for species including the Gouldian finch during the Dry season and hollow-bearing trees provide nesting habitat during the late Wet season and early Dry season. The lowlands adjacent to the hills support perennial grasses used by finches for feeding during the Wet season.

Other threatened species that inhabit the Hills include the Australian bustard, Crested shrike-tit (northern), Partridge pigeon, Northern quoll, Mertens' water monitor and Yellow-spotted monitor.

Around 8% of the Yinberrie Hills area is managed as a conservation reserve (Nitmiluk National Park). Significant tourism and mining occur and/or have occurred in the area.

The main management consideration in the Yinberrie Hills is a fire regime typified by large-scale, late Dry-season fires that encourage fire-tolerant plant species and reduce the availability of grass seed favoured by the Gouldian finch during the Wet season. Other management concerns include large numbers of feral pigs and cattle.

The Yinberrie Hills area is managed by Jawoyn Rangers and the Northern Territory Department of Land Resource Management (DLRM) for nature conservation and Aboriginal land uses.

3.2.2 Fauna

A total of 245 species were detected in the 2012 Dry and Wet season surveys, including 32 mammal, 145 bird, 48 reptile and 20 amphibian species.

Species were found during these studies that were not recorded previously. The Mineral Leases, including an adjacent 10km buffer zone, are now known to maintain, or to have maintained at some time, 346 species of terrestrial vertebrate: 50 mammal, 197 bird, 77 reptile and 22 amphibian species. Eight of these species are exotic in origin, one of which is the cane toad.

3.2.3 Matters of National Environmental Significance (MNES)

Ten species of national environmental significance protected under the EPBC Act were identified from desktop studies as potentially occurring within 10km of the Project area (Appendix N draft EIS). Of these, two were recorded on the site, the Gouldian finch (*Erythrura gouldiae*) and the Crested shrike-tit (Northern) (*Falcunculus frontatus whitei*), which was heard but not confirmed. The draft EIS indicated that the Partridge pigeon (*Geophaps smithii*) could be expected to occur on the site but was not recorded, whereas the remaining seven species were not considered likely to occur in the Project

area. These included the Northern quoll (*Dasyurus hallucatus*), Red goshawk (*Erythrotriorchis radiatus*), Bare-rumped sheathtail bat (*Saccolaimus saccolaimus nudicluniatus*), Masked owl (*Tyto novaehollandiae kimberli*), Northern brush-tailed phascogale (*Phascogale pirata*), Brush-tailed rabbit-rat (Conilurus penicillatus), and the Freshwater sawfish (*Pristis microdon*).

3.3 Aboriginal culture and heritage

The Project Area sits within a broader region that has been occupied by Indigenous people for at least 35 000 years. The region in which the Project is situated is sometimes described as a cultural landscape, with evidence of the past use and occupation by Jawoyn Aboriginal people, Chinese and early European miners, the Overland Telegraph Line (1872) and more modern mining ventures. The Mt Todd Project area also hosts a number of Aboriginal sacred sites including Mt Todd itself and the Yinberrie Hills, which are considered to be of the highest significance to the Jawoyn people and are protected under the NT *Aboriginal Sacred Sites Ac*t.

Heritage surveys have recorded large stone artefact quarries, Aboriginal camp sites and tool manufacturing areas across the Project Area. These include a number of early Chinese and European gold mine sites and the remains of the 1872 Overland Telegraph Line. It is highly likely that the Project area will contain additional as yet unrecorded sites. Discussions with traditional owner representatives indicate that all Aboriginal and some Chinese heritage sites still have cultural significance for contemporary Jawoyn people. Some of the historical sites are likely to also have significance to the broader community.

A description of the ethno-history of the Pine Creek/Katherine region can be found in Appendix Q of the draft EIS.

3.4 Socio/Economic

The Town of Katherine, located approximately 55km from the Project site, is likely to be the community where the majority of direct social impacts (positive and negative) would be experienced as a result of the Project. Katherine would be the main service centre for the supply of goods and services to the Project and a key location for housing of the operational workforce. Pine Creek to the north may also be impacted by the Project. The nearest community is at Werenbun, which is a Jawoyn community approximately 6.5km to the southeast of the site. It has eight houses, approximately 30 residents and an open air community school.

The Project site sits within Jawoyn Country, which is the traditional land of the Jawoyn people. The Jawoyn Association Aboriginal Corporation was established in 1985 as the representative body for the Jawoyn Aboriginal Traditional Owners. The Jawoyn Association work is dedicated towards relief of poverty, provision of general membership, welfare support benefits, and expansion of Indigenous employment, advancement of education, training and learning and the continuation and preservation of traditional Aboriginal culture. The Jawoyn Association is also a partner in the Mt Todd Project.

It is likely that there will be expectations amongst the Jawoyn people of benefits that may flow from the mine; however, anecdotally these expectations do not come at the expense of potential negative impacts to Jawoyn Country that could arise from the Project.

The region has hosted numerous mines and continues to host mining projects targeting various ore types, primarily gold. These mines have been seen to come and go over the years with changes in commodity prices and economic circumstances as discussed in Section 4 of this Report. Consequently, the Katherine community has developed a level

of resilience to the changes that frequently occur in the economic fortunes of the region associated with the mining industry.

Katherine itself is situated on the Katherine River and is a popular stop for many visitors and tourists to the Region. Its geographic location is a major influence on its economy and the town is a significant transport hub (linking Darwin, by road both south on the Stuart Highway, and to Western Australia via the Victoria Highway), tourist centre and service centre for a wide variety of regional industries including the mining and cattle industries, and defence. It is a key government administration centre providing health, education, housing and business development services to towns to the broader region, pastoral properties and outlying Aboriginal communities.

Nitmiluk (Katherine Gorge) National Park is located to the south east of the mineral leases. Leliyn (Edith Falls), on the western side of Nitmiluk National Park and upstream of the mine site on the Edith River, is a popular tourist attraction and an important sacred site of the Jawoyn people. Environmental values of Leliyn are water quality for swimming and ecosystem protection, and flora and fauna for bush walking. Nitmiluk is owned by the Jawoyn and managed jointly with the Parks and Wildlife Commission of the Northern Territory.

The Edith River flows eventually into the Daly River, which is described as a spectacular recreational fishing experience (Craig Ingram pers. comm.).

4 Historical background

4.1.1 Pine Creek Geosyncline

Gold mining in the Pine Creek Geosyncline has had two distinct phases, the first was the late 19th century gold rush, and the second phase commenced in the late 1970s. The 19th century mining was generally restricted to mining to the base of oxidation as below this the gold was generally associated with sulfides and refractory. This meant that it was generally uneconomic to mine and process this material. Another factor restricting development was the level of the water table, which meant that mining below the water table required substantial pumping equipment and rendered them uneconomic. By the early 1900s most mines in the region had closed with only small-scale mining and prospecting continuing.

The development of the Carbon in Pulp (CIP) process for gold recovery together with a rising gold price saw resurgence in interest in the Pine Creek Geosyncline in the late 1970s. With few exceptions, the new generation of mines were located in areas that had been previously worked in the original gold-rush.

The first new mine to operate in the region was the Mount Bonnie site. This mine did not use CIP but used the earlier Merrill-Crowe process. Mt Bonnie was a small operation that produced very high silver content bullion. There followed through the mid-1980s and into the early 2000s a series of new gold mine developments in the region all using the CIP process. The first of these was Renison Goldfields Consolidated's Enterprise Mine at Pine Creek, operated by its wholly owned subsidiary Pine Creek Goldfields Limited.

The larger mines developed during this period included Enterprise Mine and Union Reef in the Pine Creek area; Cosmo Howley, Brocks Creek, Fountain Head, Woolwonga, Zappopan, Iron Blow, Golden Dyke, North Point and Princess Louise in the Hayes Creek area; Goodall in the Adelaide River area; Moline in the Mary River area; Mt Todd in the Edith River area; and Tom's Gully, Rustlers Roost and Quest 29 in the Mt Bundy area.

In addition to these gold mines there have been a number of other commodities mined since the late 1950s, with one operation, Frances Creek (Iron), still in production. These

included Woodcutters (Lead and Zinc); Mt Diamond (Copper); Rum Jungle (Uranium and Copper); and Browns (Copper, Cobalt and Nickel).

All of these sites have developed AMD issues either during operation or subsequently. Successful, long-term management strategies for the management of AMD have not been developed and implemented to date at the great majority of the sites. Combined, they represent the majority of the unfunded legacy liability the Northern Territory (NT) Government is exposed to, with the exception of Rum Jungle. AMD legacy issues have presented themselves in three main areas:

- AMD drainage from waste rock dumps;
- AMD drainage from tailings storage facilities; and
- Open pits containing large volumes.

It is important to understand that whilst the term AMD has been used for some time it originally stood for Acid Mine Drainage, with the term Acid-rock Drainage (ARD) frequently substituted. The currently used terminology is Acid and Metalliferous Drainage that recognises metalliferous neutral and saline drainage can also have serious adverse long-term environmental impacts.

This legacy has accrued generally through a combination of factors such as a failure to recognise AMD issues, problems with geochemical characterisation, inadequate cover systems and performance, and quality control issues during construction. These factors are discussed further below.

In earlier mines there was a complete failure to recognise the potential for the mining wastes (tailings and waste rock) to generate AMD. As the problem was recognised, waste materials underwent geochemical characterisation. However, often there was an over-simplification of the processes of acid-generation and neutralisation that did not represent the actual kinetics of the reactions in the field. Operators used the following simple calculation to determine if there would be an issue with acid generation:

- Nett acid-producing potential (NAPP) equals the acid-producing potential (APP) minus the acid-neutralising capacity (ANC), i.e.; NAPP = APP – ANC.
- This calculation grossly simplifies the process and only occurs in the laboratory and not in the field. It is based on the assumption that acid-generation and acid neutralisation reactions will occur at the same rate and that all of the ANC will be available and that the particles are fine grained and mixed homogeneously within the waste containment. In reality none of these conditions occur. The heterogeneity of waste rock dumps (WRD's) in particular with regards to particle size distribution and geochemical properties leads to the formation of preferential flow pathways. Where this occurs, AMD produced may completely bypass any available neutralising materials.
- There are a number of examples where this was applied to operations in the Pine Creek Geosyncline and the sites are now significant ongoing sources of AMD entering the receiving environment. AMD prediction remains an evolving science and many operators still make fundamental mistakes in geochemical characterisation.

Cover systems (capping) were developed to protect problematic material from the environment. Unfortunately, cover systems when placed over WRDs have either not had sufficient engineering input into the specifications or they have been incorrectly designed. Cover system design is another evolving science with serious doubts

remaining within the industry as to whether cover systems alone will provide the long-term control of moisture infiltration and oxygen diffusion necessary to limit AMD generation and release to the receiving environment at acceptable levels.

A key issue has been the lack of quality control/quality assurance at some sites with the construction of engineered covers. This has led to covers not being constructed as designed with inadequate controls on compaction and moisture requirements in clay layers and under-specification thicknesses in placed layers. This has meant that regardless of whether the design is appropriate or not, there is little chance that the cover would work as it was not constructed to specifications.

Long-term performance of the covers was often not adequately considered during their design or construction, in particular the cover's ability to withstand the long-term impacts of erosion on its performance. At best, many of the covers only performed immediately after construction, with performance rapidly declining over a short period of time. Only one of the mines in the above list adequately considered performance life in its cover design. That design required that a performance life of a minimum of 200 years must be achieved. Modelling was undertaken to ensure that the design requirements would be met.

There have been a few examples where operations have completely or partially backfilled their open pits with waste rock, this has generally been a successful approach.

There are many examples within this group of mines where there are now significant legacy issues surrounding water that has collected in open pits. In these cases the pits now contain large volumes of acidic, metal-laden water, with some of them discharging to the receiving environment from time to time. There have been a couple of notable exceptions where open pits were rapidly flooded by partially diverting a river as a planned remediation strategy. To date, some 20 years later this still appears to have been a successful strategy.

4.1.2 History of the Mt Todd mine

The Mt Todd area has been the site of mining activity for over a century, with a range of minerals including gold, silver, lead, tin, wolfram, molybdenum, copper and bismuth mined at various times. Modern exploitation of the resource can be divided into three phases;

- Exploration & Mining (1986 to 2000);
- NT Government management (2000 to current); and
- Northern Territory Government Agreement with Vista Gold period (2006 to current).

First recorded mining activity in the area was around 1870 when alluvial gold was reportedly discovered in a post-hole dug for the Overland Telegraph Line. Rich gold reefs were reportedly worked by small miners north of the Mt Todd area in the early 1870s. By 1882 the Mt Todd area was being extensively worked by small miners. The Mt Todd gold field was discovered in 1889.

Historical records, although unclear, indicate that a mining operation called Jones Bros Mine (approximately 3km west of the Mt Todd Mine site) worked an area known as Jones Bros reef using Chinese labour under a tribute system in the early 1900s. By 1912 the Foote Mining Company is believed to have worked the loads and then reportedly ceased operations in 1936. However, a number of other companies are believed to have intermittently worked the Jones Bros reef area up to 1987.

Quigleys reef (approximately 2km north east of Jones Bros Mine) is believed to have been discovered in 1919 and extensively worked until the mid-1940s. Pacific Goldmines N.L. mined Quigleys reef in 1987 and 1988.

In May 1988, Billiton Australia Gold Pty Ltd discovered broad zones of mineralisation (Batman deposit) at Mt Todd. The Mt Todd project was initially part of a joint venture agreement formed in 1987 between Zapopan NL and Billiton Australia Gold Pty Ltd.

In March 1992, Pegasus Gold Australia Pty Ltd (Pegasus), a wholly owned subsidiary of Pegasus Gold Inc (USA) entered into an agreement to purchase shares in Zapopan NL thus giving it approximately a 35% interest in Zapopan NL's holdings. On 7 April 1992 Zapopan NL acquired Billiton Australia Gold Pty Ltd's 50% interest in the Mt Todd project.

In 1993 an Agreement for mine development was reached between Zapopan NL, the Jawoyn Association and the NT Government. The Agreement was considered ground breaking as it was the first mining agreement to be reached between a mining company and an Aboriginal group following the Australian High Court's historic Mabo ruling. The Agreement provided for significant participation by local Aboriginal people in the project and was ratified by the *Mount Todd Project Agreement Ratification Act 1993*. The Agreement came into operation on 5 March 1993 upon the NT Government granting Zapopan NL the Mt Todd Mine mineral leases.

At the time of its inception the Mt Todd Mine development was considered one of Australia's largest gold mine investments. Phase 1 of operations was commissioned in the first quarter of 1994 with an expansion of the processing plant commissioned in December 1994. Phase 1 was designed to process 6 Mtpa of ore and produce 85,000 ounces (oz) of gold per annum.

As a result of a corporate takeover, Zapopan NL became known as Pegasus on 23 January 1996. In 1996 Pegasus commenced construction of a $208M Phase 2 processing plant expansion at Mt Todd Mine. Phase 2 was designed to increase ore throughput to 8Mtpa for 260 000oz of gold per annum, secure Mt Todd Mine's ranking as one of Australia's Top 10 gold producers and lay the foundation for future growth for Pegasus Gold Inc.

Phase 2 construction at Mt Todd Mine was completed ahead of schedule by November 1996. First gold was poured on 6 January 1997. Based on known reserves at the time of Phase 2's implementation, the mine had an expected life to 2004.

Whilst Phase 2 increased the mines production levels during 1997 it did not meet the expectations of Pegasus. Production was hampered by power failures, and poor crushing and processing performance. Increased power, cyanide and contract mining costs resulted in operating costs exceeding feasibility levels. In addition, Pegasus maintained that an updated reserve model completed in the third quarter of 1997 indicated a reduction of 7% to 10% in the average ore grade compared to the original feasibility reserve model. These factors combined with a drop in the gold price were the rationale behind Pegasus suspending operations on 15 November 1997 and placing the mine on care and maintenance.

In mid-December 1997, an Administrator was appointed for Pegasus and a review of the operation was undertaken. Shortly thereafter Pegasus reported it was unable to bring Mt Todd Mine's production to expected levels and the project was no longer feasible. The mine was subsequently put up for sale. Pegasus spent approximately $300M on mine development.

At 31 January 1999 the mine reportedly had a mineral resource of 91.203Mt at 1.01g/t for 2.962 million oz gold (Batman pit) and 5.449Mt at 1.7g/t for 229 400oz gold (Quigleys deposit).

On 18 March 1999, General Gold Resources NL in joint venture with Multiplex Constructions Pty. Ltd. (Multiplex) and Pegasus, announced it had purchased Mt Todd and the Mine would be operated by General Gold Operations Pty. Ltd. (GGO), a wholly

owned subsidiary of General Gold Resources NL. Mt Todd Mine was purchased for approximately $30M. On 30 April 1999 Mt Todd Mine was renamed Yimuyn Manjerr Mine.

GGO believed it had developed an operating plan that overcame historical impediments associated with mining Yimuyn Manjerr Mine's low grade open pit resource. This included bulk mining and a simpler process flowsheet. The flowsheet offered the potential to extract a lower percentage of gold from ore at substantially reduced operating costs through reconfiguring equipment to reject a hard, coarse, low grade product from the milling circuit (scats).

GGO also proposed a smaller open pit than that of the Pegasus operation. The smaller pit focussed on a core zone approximately 500m long and 150m wide and open at depth. GGO considered bulk mining, as opposed to selective mining, allowed for an easier mining method and lower stripping ratio. The original Pegasus plant was more complex as it was designed to treat hard ore crushed to 3mm. GGO anticipated producing approximately 200 000oz of gold per year from a throughput of 5Mt of ore per year. This equated to approximately 750 000oz of gold over an initial 3.5 year mine life. A component of the Yimuyn Manjerr Mine operation involved heap leaching stockpiled ore.

GGO commenced mining in July 1999 progressing to full scale mining in September 1999. The Company began commissioning the processing plant in August 1999 and gold production commenced in October/November 1999. Ore was sourced solely from Batman ore body/open pit. However, repeated mechanical and equipment failures, and problems associated with heavy rain during the 1999/2000 Wet season resulted in significant set-backs to operating plans.

In April 2000, General Gold Resources NL and Multiplex entered into an agreement to acquire (on an equal basis - 2.26%) Pegasus' 4.52% equity (diluted from 5% during the first quarter of 2000) in Yimuyn Manjerr Mine. The agreement involved payment of three instalments to Pegasus. Allegedly under this sale agreement and existing agreements GGO would be the legal holder of Yimuyn Manjerr Mine's mineral rights and environmental responsibilities. Whilst the first two instalments of payment were made on the due dates, the third instalment was not completed.

On 6 July 2000 the Board of General Gold Resources NL advised that the directors of its wholly owned subsidiary, GGO, had on 5 July 2000 appointed an Administrator for GGO. The action was necessitated by Yimuyn Manjerr (Investments) Pty. Ltd. (formerly Multiplex Resources Pty. Ltd.) announcing on 5 July 2000 it would not contribute its share ($3.9M) of a cash call due on 5 July 2000 to further develop the mine. Yimuyn Manjerr (Investments) Pty. Ltd. also elected not to contribute further funds during the period commencing 1 July 2000 and ending 31 December 2000. This left GGO with insufficient funds to sustain operational activity.

Subsequently, on 8 July 2000, Pegasus took possession of the joint venture interests and assets, held by Yimuyn Manjerr (Investments) Pty Ltd and Vallance Holdings Pty Ltd in the Yimuyn Manjerr Mine joint venture. Possession of General Gold Resources NL's interests and assets followed on 18 August 2000.

On 13 July 2000 General Gold Resources NL appointed a Voluntary Administrator for the Company. Pegasus then commenced attempts to sell the mine as a going concern.

On 29 August 2000, shutdown was completed, Administrators of GGO vacated the site, and Pegasus stepped in to fund care and maintenance pending the outcome of the sale process. Pegasus stated it was occupying the site for the purposes of securing its interest in the plant and had not adopted in any way the obligations of GGO as "legal title holder", or the joint venture parties as the beneficial owners, of the mining tenements.

On 3 January 2001, Yimuyn Manjerr Mine officially closed following failed attempts to sell the mine as a going concern and in late June a three day public auction was held on site. Pegasus aimed to recoup approximately $10.5M owed to the Company by the Yimuyn Manjerr Mine joint venture arrangement.

In mid-2001 the NT Government assumed responsibility for management and maintenance of the site. Maintenance primarily involved the management of the poor quality water inventory on site. Additional minor works undertaken included erosion control, revegetation and fire and weed control.

In response to community and stakeholder interest in the site, the Mt Todd Mine Site Rehabilitation Reference Group was formed in April 2005 to inform the management and potential remediation of Mt Todd.

In April 2005 the Department responsible for the *Mining Management Act* (now the Department of Mines and Energy) commissioned a report entitled "Terms of Reference for Development of Rehabilitation Plan for the Mt Todd Gold Mine, NT" to identify studies and management activities required to plan for remediation at Mt Todd. Based on these recommendations, a $5 million works programme was implemented.

In June 2006, the Proponent acquired the Mineral Leases at Mt Todd and assumed the obligation to operate, care for and maintain assets held by the NT Government at the site in January 2007.

4.1.3 Water management at the Mt Todd mine site

The Mt Todd mine site is located in the Daly River catchment. The Edith River flows from east to west at the south of the mine site, intersecting MLN 1127. Several watercourses flow across the Mt Todd Mineral Leases as discussed in Section 3.1.3.

The perennial Edith River itself and the ephemeral watercourses on the Mineral Leases experience periods of no-flow in the Dry season and high flow and flood events in the Wet season.

Mining operations ceased at the site in July 2000 without adequate remediation (Section 4.1.2 above), leaving the site with large volumes of exposed ores and wastes (low grade and partially leached ores, scats, tailings, and waste rock across the site). The ores and wastes have reacted with rainwater and the atmosphere to generate AMD with low pH and elevated toxic metal concentrations.

There are a number of water storage structures or retention ponds at the site providing permanent or temporary storage of mine waters. The RWD was designed for the supply of clean (mine unaffected) waters for use at the site. The remaining storage facilities all receive or contain mine impacted waters:

- RP1 to the south of the site receives runoff from the WRD and the lower operational area. RP1 waters may discharge via siphon to Burrell Creek or overflow from a spillway to West Creek;
- RP7 to the north of the site was constructed as a tailings storage facility (TSF1) and is now being utilised as a water retention pond. RP7 receives runoff from the scat pile area and pumped flows from other retention ponds. Overflow and seepage from RP7 discharges to Horseshoe Creek;
- RP3 is the Batman Pit. It has a limited catchment area with the majority of its contents pumped from the other retention ponds. Treated water from RP3 discharges to Batman Creek;

- RP2 and RP5 in the centre of the site are comparatively small ponds that receive runoff from the low grade ore stockpile and from around the office and process area respectively. Overflow from these ponds enters Batman Creek;

- The HLP collection moat receives drainage from the large volume of partially leached ore on the HLP. Overflow from the HLP enters Batman Creek.

Water quality in the retention ponds is very poor, characterised by low pH and high metal levels as they serve as collection points for AMD from across the mine site. Key contaminants include Copper, Zinc, Aluminium and Cadmium. The levels of contamination vary between ponds and may vary seasonally in some ponds due to the increased dilution provided by rainfall that occurs during the Wet season. Of the larger ponds, RP7 contains the poorest quality water on site, followed by RP1. The treatment of RP3 waters, as discussed below, has improved water quality in that pond significantly. As an indication of the relative toxicity of the larger retention ponds, the most recently derived dilution ratios required for discharge from each pond to achieve an equivalent level of ecosystem protection in the Edith River (80% species protection) is 1:4545 for RP7 (one part RP7 water to 4545 parts Edith River water), 1:1100 for RP1 (GHD 2013a) and 1:132 for RP3 (GHD 2014a).

The management of surface waters to avoid impacting on the Edith River has historically been a challenge for the site. Water management strategies have generally involved a combination of pumping water to retention ponds for storage on-site and discharging to the Edith River under waste discharge licence conditions to avoid uncontrolled discharges.

RP3 has historically been the final destination of waters pumped from other retention ponds in an effort to mitigate uncontrolled discharges, while discharges of untreated water from RP1, either controlled to increase the holding capacity of RP1 or uncontrolled during heavy rainfall events, have historically been the largest source of mine water to the Edith River.

Uncontrolled discharges to the Edith River have occurred over the years, some resulting in localised fish kills (2005 and 2008). These events have generally occurred during periods of high river flow, reducing environmental impact.

Discharges from the Mt Todd mine site to the Edith River have been authorised and regulated via a series of waste discharge licences (WDLs) granted under the *Water Act* since 2001. WDLs granted between 2001 and 2007 were held by the Northern Territory Mines Department. Since 2007 WDLs have been held by Vista Gold. The WDLs issued prior to 2012 allowed discharges when the Edith River flowed at a certain height at a specified point, which was intended to ensure that discharge only occurred when adequate dilution of contaminants was provided by the receiving waters of the Edith River.

Engineering works have been undertaken by both the Department of Mines and Energy (DME) and Vista Gold to improve water management infrastructure. ‘Clean water’ diversion drains have been established at points around ponds and in 2011 the RP1 spillway was lifted to increase storage capacity and the RP7 spillway was plugged to reduce uncontrolled overflows.

In 2012 Vista Gold commenced treatment of RP3 waters with calcium carbonate and quicklime to improve water quality in RP3 by raising the pH and precipitating out metals. The treatment aimed to enable the dewatering of RP3 over a two year period and was accompanied by a significant increase in on-site pumping infrastructure.

The discharge of treated water from RP3 in the 2012-13 and 2013-14 Wet seasons was authorised by the current WDL for the site (WDL178-2) which was granted by the

Controller of Water Resources on 5 February 2013. WDL178-2 was designed to achieve three water management objectives:

- Protecting the Edith River from environmental harm;
- Reducing the risk of uncontrolled discharges during the Wet season due to higher than anticipated rainfall; and
- Dewatering the retention ponds to facilitate mining.

WDL178-2 authorised discharges from RP1, RP3 and RP7 to the Edith River. As an intermediate water quality target used specifically to address the three objectives, WDL178-2 required the achievement of an 80% species protection level at a monitoring point in the Edith River, as derived from the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC 2000).

Controlled discharges occurred from RP3 in the 2012-13 and 2013-14 Wet seasons in accordance with WDL178-2. Over the same period uncontrolled discharges occurred from RP1, RP2, RP5 and the HLP. Large scale dewatering has not been achieved, with the volume of water discharged from RP3 much less than initially anticipated. The inventory of mine impacted waters in RP3 and other retention ponds has been steadily increasing to a level nearing capacity.

Past biological and sediment monitoring has led the Proponent to conclude that discharges from the Mt Todd mine site have not had an adverse impact on the Edith River (draft EIS p. 10-11). The capacity of past monitoring to detect any impact was, however, questionable. Monitoring methodologies continue to improve, and monitoring conducted in the 2013 Dry season detected some statistical differences in downstream macroinvertebrate populations compared to reference sites. It is no longer possible to conclude with certainty that mine discharges have not impacted on the Edith River, but equally it is not possible to conclude mine discharges have impacted on the Edith River, with the magnitude of differences detected between downstream and reference sites within the range of natural annual variability witnessed across sites and the absence of studies to analyse possible ecological drivers of the statistical differences (Envirotech Monitoring Pty Ltd 2013).

WDL178-2 expires in September 2014 and a new licence will be required for future discharges from the Mt Todd mine site. A discussion of the appropriate water quality objectives for the Edith River receiving environment during mine operation phase is included in Section 5.6.2 of this Report.

5 Environmental Impact Assessment

5.1 Introduction

This Report has been prepared to inform decision makers. It does not provide an environmental approval and is not intended to. The purpose of this Report is to evaluate the Project and to present the view/s of the NT EPA on the acceptability of environmental impacts associated with the Project. 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 in this Report to add to or emphasise any commitments made by the Proponent.

The environmental acceptability of this 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.

Conclusions drawn and recommendations made in this Report are derived from comments from the review of the draft EIS by relevant government agencies and the public, and responses from the Proponent to those comments in the Supplement. Additionally, expert reviewers commissioned by the NT EPA provided advice on the EIS and further information provided by the Proponent as directed by the NT EPA.

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.

As changes are expected in the design and specifications of the proposal following the conclusion of the EIS 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 this project. Otherwise, further environmental assessment may be required.

Therefore, subject to decisions that permit the Project to proceed, the primary recommendations of this assessment are:

Recommendation 1

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

- **Identified in the Mt Todd Gold Project Environmental Impact Statement (draft EIS and Supplement);**
- **Identified in further information provided by the Proponent on the NT EPA's direction; and**
- **Recommended in this Assessment Report.**

All safeguards and mitigation measures outlined in the Environmental Impact Statement are considered commitments by the Proponent.

Recommendation 2

The Proponent shall advise the NT EPA and the responsible Minister of any changes to the proposed action, in accordance with clause 14A of the Environmental Assessment Administrative Procedures.

5.2 Summary of environmental issues

Analysis by the NT Government of the NOI for the Project identified a number of environmental risks. Additionally, the EIS process enhanced the understanding of potential issues associated with the Project. The principal environmental impacts are considered to be:

- Acid and Metalliferous Drainage (AMD) seepage and runoff from the waste rock dump, ore stockpiles and tailings storage facilities potentially contaminating surface and ground waters during mine operations and continuing long after the mine has ceased operation;
- Potential contamination of surface water from AMD causing adverse impacts on downstream water quality and ecology of the aquatic environment, and downstream users;
- Potential contamination of groundwater from AMD causing groundwater quality impacts outside of the mineral lease or release of contaminated groundwater expressing to surface water;
- The challenges of managing and treating large volumes of acidic and metal laden water currently existing on the site during construction to ensure AMD is adequately contained when mining commences;
- The proposed design of the WRD leading to risks of AMD seepage and runoff, erosion and failure both during construction and into the long term requiring active management post-closure;
- Potential impacts on the largest known population of the endangered Gouldian finch from clearing of foraging and breeding habitat, dust generated by mine activities during the breeding season, and cumulative impacts in the Yinberrie Hills;
- Challenges of successful mine closure and rehabilitation or management if the mine is forced into early care and maintenance; and
- The potential for failure of AMD containment and treatment strategies post-closure such that parts of the Daly River catchment downstream from the mine are significantly impacted.

5.3 Issues outside the scope of the EIA process

5.3.1 Care and maintenance

The Mt Todd mine site is currently under care and maintenance. The Proponent is responsible for water management at the site, which is governed by a site Water Management Plan and a WDL. As discussed in Section 4.1.3 above, the site has a number of ponds that contain acidic water high in dissolved salts. Significant AMD is generated during each Wet season from rainfall runoff and seepage from exposed sulfidic stockpiles. The challenge has been to minimise the volumes of uncontrolled AMD entering the receiving environment using the existing water management infrastructure. Uncontrolled discharges have been minimised at the expense of a net accumulation of onsite AMD, to a level nearing the storage capacity.

Batman Pit currently holds approximately 10 000ML of AMD water that would need to be treated and discharged to the environment to allow mining to recommence. The Proponent commenced a significant treatment strategy for onsite AMD in 2012 involving the in situ treatment of RP3 with the aim of enabling the release of significant volumes of treated pit water in future Wet seasons under a WDL. Further detail of current and historical water management practices at the site is included in Section 4.1.3 of this Report.

Although the current water management is outside the scope of the assessment, how the water is managed while the site remains in care and maintenance will impact on the mining schedule and proposed water management of an operating mine site. For example, commencement of mining activities in the Batman Pit could not occur without

significant reduction of the pit water volumes, with flow on effects for the entire site water inventory. Management of runoff and seepage from the expanding WRD could not occur without substantial works to the existing RP1. The water management strategy proposed by the Proponent for an authorised mining operation is discussed in Section 5.6 of this Report.

5.3.2 Limestone/clay sources

Lime was originally proposed in the NOI to be used in processing and water treatment for the Project. The Proponent proposed to establish and operate a limestone quarry at a nearby outcrop of the Katherine Limestone. The 300 – 500tpd quarry operation was to consist of a conventional open pit mining/quarry operation using a drill and blast, loader and truck operation.

Subsequent variations to the Project saw withdrawal of the limestone quarry as an option due to a miscalculation of the quantity that would be required. Initially it was proposed to source limestone from a variety of potential locations in the Mt Todd-Katherine-Mataranka area and process it to quick lime on site. However, the EIS indicated that quick lime would be brought to site in loose bulk.

Clay or other low permeability materials are required to control moisture retention and release properties of the store and release covers proposed to be used in rehabilitation of the waste storage structures. The original proposal included a clay borrow area to source clay on site in the vicinity of the previous borrow area, to the south-east of TSF1. The proposed footprint of this borrow area was 12ha with a depth of 15m. Subsequently, the EIS proposed to obtain clay from various sources including on site, given the uncertainty around the quantity and quality of clay available.

The Proponent indicated in the draft EIS that further investigations into the availability of clay in the local area had been conducted and there were numerous clay sources between Pine Creek and Katherine. Clay quarrying and delivery to the mine are proposed to be subcontracted to a local contractor.

The Proponent deferred this activity to a separate EIA and approval process. The NT EPA considers that this would add to the cumulative impacts of the proposal, which were not fully described in the EIS.

5.3.3 Impacts from previous mining

As detailed in Sections 4.1.2 and 4.1.3, the Mt Todd site has been impacted by previous mining activities with a significant legacy of AMD remaining. As such, the Proponent cannot be held responsible for the conditions at the site left over from the previous owner. The Proponent has been managing the site in the interim under an agreement with the NT Government. The agreement acknowledges the NT Government's commitment to rehabilitate the site and that the Proponent has no obligation for rehabilitation of pre-existing conditions until after it gives notice of its intention to commence mining operations. The Proponent has stated it will not give such notice until a production decision has been made, the project is fully permitted and the necessary financing for construction has been arranged (Vista Gold Corp. 2014).

The proposed Project presents an opportunity to manage and remediate the site and create improved outcomes for the site and the downstream environment. However, this will involve considerable expense and resources, which would impact on the economic margins of an operating mine.

A discussion of the cumulative and long term impacts and the economic risks is included in Section 5.10 of this Report.

5.4 Alternatives

5.4.1 Not proceeding with the Project

The Proponent considered the option of not proceeding with the Project in the draft EIS, which noted that the implications of not proceeding with the Project would include both lost opportunities and the avoidance of impacts to the environment and the community.

Chapter 5 of the draft EIS identified that not proceeding with the Project would result in the following:

- Avoidance of environmental and heritage impacts resulting from construction and operation including:
    - Disturbance to the MT26 heritage site and other potential heritage sites;
    - Dust from mining activities; and
    - Potential impacts on Gouldian finch habitat and the Yinberrie Hills Site of Conservation Significance.
- Rehabilitation of the site would not be carried out by Vista Gold and therefore direct and indirect environmental impacts resulting from legacy site issues (e.g. AMD seepage) would continue until rehabilitation is completed by other parties;
- The NT Government would retain liability for the legacy issues surrounding rehabilitation of the mine, estimated at $150 million, and indefinite ongoing legacy issues;
- The resource base of 7.6 million ounces of gold would remain undeveloped;
- Loss of economic benefit from construction of the Mt Todd Project of approximately $1.1 billion and around 450 construction jobs;
- Loss of economic benefit from operation of the Project and loss of around 350 jobs that will be created by the Project;
- Loss of estimated royalties over the life of the Project to the Commonwealth and NT Governments; and
- Financial benefits and training opportunities for the Jawoyn people, and the wider Community would not be realised.

A respondent to the draft EIS requested that alternatives should include a scenario of immediate rehabilitation of the site and that the Proponent should compare costs and likely outcomes of immediate rehabilitation to plans for rehabilitation after further mining. In addition, the respondent requested that ongoing liability for rehabilitation should have been more clearly defined. The Proponent provided no response to this request.

The NT EPA acknowledges that the case for immediate remediation is worth considering in terms of the reduction in the risk of long-term legacy issues; however, it is not considered reasonable or practical for a mining Proponent that has not yet commenced mining a site, or committed to mining it, to contemplate immediate remediation of that site.

5.4.2 Underground mining

One respondent to the draft EIS proposed that open cut mining operations would be untenable, considering the AMD liabilities at Mt Todd and similar geologies in the Pine

Creek Inlier, and the high regional rainfall environment. The respondent argued that underground mining operations and progressive backfilling and closure of the existing pits that represents an enduring liability at Mt Todd might be practicable.

The Proponent provided very brief consideration of alternative mining methods in the draft EIS, including underground mining, stating that underground mining was not economically feasible because average gold grades were too low to support the higher costs associated with underground mining. Further, underground mining would not support the production rate required to make the Project feasible.

The Proponent indicated that open cut mining was chosen as the mining method based on better economics and recovery of the mineralised resource, and known common practice in the mining industry.

The NT EPA acknowledges that an underground mining scenario has costs and benefits that will be different from open cut mining and accepts that the Proponent has opted to open cut mine the Batman deposit. This EIA process was based on the open cut methods and assessed whether or not the Proponent demonstrated that the risks associated with that method are acceptable and can be adequately managed.

5.4.3 Backfilling the Batman Pit

The final closure plan proposed for the Batman Pit is an open pit void with a lake.

Several respondents to the draft EIS were concerned with the long-term prospect of a poor quality pit lake and a very large waste rock dump on the site. It was suggested that the waste rock dump be deconstructed with all material returned to the pit at closure.

The Proponent undertook an analysis of the viability of backfilling the Batman Pit. The analysis considered the rehandling of waste dump material located adjacent to the south side of the pit and assumed that the backfilling would not begin until the end of mine life. Based on this analysis, the total backfill operating costs were estimated by the Proponent to be approximately $450 000 000 to $500 000 000 and would require approximately six to nine years to complete. Detail on the origin of the cost calculation was not provided but it is acknowledged that a major component would be related to transport and handling of the material.

Information provided in a document prepared by Tetra Tech for the Proponent's pre-feasibility study (NI 43-101 Technical Report: Resource Update Mt Todd Gold Project) indicated that over the life of the mine, net post-tax income could be approximately $514 000 000 ($591 000 000 reported in the draft EIS). Operating costs attributed to mining over the life of the mine were similar, estimated to be $610 000 000.

The NT EPA accepts that the high costs of removing all of the material from the WRD would significantly decrease project profitability.

However, the costs of retaining the proposed WRD on the surface in perpetuity were not considered in the EIS and some respondents were concerned that these costs could be significant. These potential costs and the implications for the community are considered further in Section 5.10.4 of this Report as is the consideration of immediate remediation. The NT EPA believes that further consideration should be given to disposal of at least some of the PAF material into the Batman Pit at closure as discussed in Section 5.9.2 of this Report.

5.4.4 Location of infrastructure

The Mt Todd mine site is relatively constrained with respect to locating infrastructure and waste repositories associated with an expansion. Alternative locations and designs of various Project components were not considered in great detail in the EIS and therefore reviewers were unable to consider the potential impacts of those alternatives to

biodiversity values. However, it is acknowledged that there would be trade-offs between any number of designs with respect to limiting the impact footprint.

For example, the EIS identified that Gouldian finch breeding and foraging habitat would be cleared for establishment of TSF2 and the LGO stockpile.

The draft EIS listed the criteria for selection for the location of TSF2 as follows:

- Avoid impact on sites of conservation, historical or heritage value (in particular the initial TSF2 location was moved to avoid Mt Todd (a sacred site);
- Maximise existing topography / minimise earthworks; and
- Locate as close as practicable to operations to minimise the cost of materials transport / transfer.

The draft EIS indicated that the proposed location of TSF2 focused development to the east of Batman Pit, avoiding impact on the Yinberrie Hills and West Creek and that the area south of the HLP was initially considered but is a drainage area for Horseshoe Creek and Stow Creek, is waterlogged in the Wet Season, and is not large enough for TSF2.

The WRD too, is an example of the trade-offs required in consideration of alternative options. WRD designs are considered in following sections; in summary, locating the proposed WRD over the existing dump and constructing high (350m) and steep (29 degrees) is likely to restrict the footprint to a smaller area and require less cover material thereby restricting the area of disturbance in the short term. A single WRD or multiple dumps with lower-profile design would create a much larger area of disturbance within the mineral leases but could potentially be significantly more stable into the longer term and possibly avoid creating a larger legacy of AMD issues.

5.4.5 WRD designs

The draft EIS indicated that two cover designs were considered for the WRD, a GCL cover and a store and release cover. The proposed GCL cover design was selected by the Proponent and claimed to minimise the potential for AMD seepage and mine waste exposure due to erosion.

The EIS stated that cover system options would be refined during the detailed design phase of the Project and throughout the life of the Project. The Proponent's Draft Reclamation Plan (draft EIS Appendix Y) recommended specific closure investigations necessary to address information gaps including the following in relation to the WRD:

- An analysis of waste and cover material hydraulic properties;
- A site-wide soils, closure cover and reclamation material inventory and characterisation study; and
- A waste and closure cover erosion and sediment control study.

The NT EPA was concerned that a sustainable and technically feasible design for the WRD had not been proposed. It was considered that the high and continuously sloping WRD profile design would elevate rather than minimise the risk of AMD. The NT EPA was not satisfied that the Proponent adequately evaluated and presented the most appropriate WRD and cover designs and required the Proponent to identify what alternative designs (including lower WRD profiles) were evaluated for the proposed WRD and the basis for selecting the proposed GCL-based cover system over other alternatives. The NT EPA also required that the WRD design be significantly advanced to provide confidence that the ultimate WRD would not be significantly different from that proposed in the draft EIS.

The Supplement explained that Vadose modelling had been conducted for the preferred design and no substantial changes were anticipated that would require further consideration. However, this raised further questions and a direction by the NT EPA for further information from the Proponent. The response from the Proponent was to reiterate that the design was shown to be suitable, the landform stable and there were no long-term geomorphic concerns.

The NT EPA remains unconvinced that the design presented in the EIS will be stable into the long term. Detailed discussion of the suitability and stability of the WRD in the context of the Mt Todd site is included in Section 5.5 of this Report.

5.4.6 Water containment strategies

Following a review of the draft EIS, the NT EPA requested that alternative water containment strategies during operations be discussed in relation to managing Wet season inventories to prevent or minimise untreated discharges of potentially contaminated water, particularly in more intense rainfall events.

The Supplement indicated that more detailed consideration of alternative water containment strategies was undertaken as a product of modelling to determine appropriate water treatment plant capacity using the GoldSim model, referring to detailed information in Attachment D of the Supplement. However, upon review of Attachment D, only introductory information on the model and some assumptions used in data inputs were provided. No alternative containment strategies appeared to be included.

The Proponent concluded in the Supplement by stating that the operation of the water treatment plant (WTP) would ensure that no residual impact on the downstream water courses would be likely and that the 80% species protection regime would be complied with in accordance with the established WDL process. The proposed WTP and appropriateness of the discharge water quality for an operating mine are discussed in detail in Section 5.6 of this Report.

The NT EPA also requested a discussion of alternative options/contingencies that were considered or that may be available should the Batman pit and key retention ponds (RP1 and RP7) still contain significant volumes of water by the end of the 2013/2014 Wet season or at the point that mining was scheduled to commence. The requirement to lower the current pit volume is pivotal in the Proponent's plans to commence mining and, as discussed in Sections 4.1.3 and 5.6 of this Report, uncontrolled discharges of water from retention ponds continue to be a key concern for stakeholders in terms of ongoing contamination risk for the downstream environment.

The response provided by the Proponent in the Supplement divested responsibility for water management of the site to the NT Government and did not include any alternative options or contingencies. The Proponent was directed by the NT EPA to provide the information previously requested and was also required to consider the implications of the removal of Batman Pit as a water repository option from the site's water management capacity.

The Proponent's subsequent response focused on modelling of retention pond scenarios and contingencies. The adequacy of the Proponent's water management strategy including water balance modelling and water retention and treatment capacity is considered further in Section 5.6 of this Report.

5.5 Acid and metalliferous drainage (AMD)

One of the most significant issues at the Mt Todd mine site is the potential for AMD to be generated from mined waste materials. As previously discussed in this Report, AMD is already a key issue in the management of the current site as a result of previous mining activities.

The NT EPA commissioned an independent expert in mine geochemistry and mine water management, Dr David Jones, to review the EIS and provide advice on the geochemical, water management and waste management issues associated with the Project. Dr Jones' advice is at Appendix B.

The following Project objectives for AMD management were outlined in the framework environmental management plan:

- The footprint, intensity and duration of AMD impacts associated with waste rock and tailings disposal is minimised; and
- Prevent, mitigate or manage AMD so that it does not create off-site environmental impact during mine operations and legacy issues both on and off site after mine closure.

The Proponent undertook relatively extensive geochemical test work to characterise the waste rock types associated with the Project. The test work confirmed what is typical for the waste rock produced by most mine sites in the Pine Creek Geosyncline – very little or no neutralising capacity to offset the acid generating capacity of relatively low levels of sulfide contained in the mineralised waste. Essentially, the waste from expansion of the Batman pit would have the same characteristics as that which comprises the existing waste rock dump, with approximately 60-70% categorised as either net acid producing or uncertain.

Preliminary sulphur cutoff criteria were proposed based on results from acid base accounting (ABA) and Net Acid Generation (NAG) pH, to assist with waste rock management and closure planning.

Whilst this focus on the acid generating potential of waste has been followed as standard in most routine mine waste assessment programs, it typically fails to appropriately identify the level of risk that is posed by non-acid generating waste, and in particular, the category of drainage that is described as circum-neutral (pH between 6 and 8). Such drainage can contain elevated levels of salinity and metals such as cobalt, nickel, manganese, and the oxyanions arsenic, antimony, molybdenum and selenium. In this context, waste characterisation for the Project should have focused on the broader issue of potential solute load rather than just acidic drainage, to prevent the functional mis-classification of the environmental risk posed by a given waste type.

Information in the draft EIS highlighted the need for this broader assessment with the findings from the humidity cell tests: "*Cells producing neutral pH leachate showed comparatively high levels of arsenic and antimony suggesting meteoric water contact could result in release of these constituents*."

Given the fundamental role that material classified as NAF (or non-PAG) is proposed to play in the foundation and outer cladding of the WRD and other structures, the NT EPA requested that the geochemical assessment include the solute generation potential of the NAF waste.

The Proponent did not undertake additional kinetic testing of the NAF material and simply reiterated that, '*based on the available kinetic testing data, NAF material showed no propensity to generate metal leachate without the onset of acid generation. All NAF samples that produced circum-neutral pH values also produced low concentrations of metal leachate*.'

The NT EPA directed the Proponent to provide further information as assurance that NAF material used on the site would not contribute to unacceptable water quality outcomes from mine runoff. The further information provided did not contain any additional information; however, a review of the long-term kinetic testing results noted that the metal leachate from samples was consistent in concentration and temporal

release trends regardless of the PAF material sulfur content. Hence, the Proponent considered the values derived from kinetic testing to be suitable as surrogates for the NAF material evaluation and concluded that the NAF cover rock would have the potential to generate metal leachate.

The potential to produce AMD from NAF material increases the risks of the Proponent's waste rock management strategy. Waste rock management is discussed in Section 5.5.1 of this Report.

In addition to waste rock from the Batman Pit, the large volumes of tailings that would be generated through the processing plant will be PAF. During operation, alkaline process water would be pumped into TSF1 potentially lowering dissolved metal concentrations in leachate. The alkaline water from the process circuit was anticipated by the Proponent to provide significant buffering capacity for TSF1 during mining and as a buffering treatment for existing AMD in TSF1.

Appendix L of the draft EIS noted that fluctuations in pH and metal loads of the tailings were influenced by seasonal variability. In general, high pH values and low metal loads were observed during the Dry season due to salt formation. The rise in water level and saturation conditions in the Wet season caused a decrease in pH and an increase in the dissolved metal load. It was also observed in the current tailings facility that the deeper tailings were continually saturated limiting oxidation and acidity but if left unmanaged, the available neutralization capacity would likely be exhausted at increasing depths leading to the onset of acidic conditions and higher metal loads in leachate.

Kinetic testing indicated that tailings leachate is likely to have concentrations of metals (Aluminium, Copper, Molybdenum, Silver), metalloids (Arsenic, Antimony), non-metals (Chlorine), total cyanide (CN), and sulphate above regulatory limits. After 32 weeks of testing, abundant sulfide sulfur content remained (95%) while only an estimated 18% of the neutralisation potential remained in the test samples.

As expected, the tailings would need to be carefully managed well into the long term to minimise unacceptable AMD risks, which places a significant reliance on the cover design and structural integrity of the TSFs. This is discussed later in the Report.

The existing Batman pit is both a source of and, since 2005, storage for AMD. As discussed in Section 4.1.3, the stored AMD must be reduced prior to production to facilitate mining of the pit. Post-closure, the pit lake is likely to be of poor quality in the long term. This is discussed in Section 5.9.

Other potential AMD sources include the HLP and moat, LGO1 and LGO2, the existing scats stockpiles, the existing and proposed ROM pads, and the existing and proposed process plant. The HLP and moat are proposed to be rehabilitated, LGO1 and LGO2 are proposed to be processed, and the existing scats stockpiles and ROM pad are proposed to be relocated to the expanded WRD at closure. Mine roads and diversion drains could also be potential AMD sources.

These AMD sources would all need to be managed through the Proponent's proposed water management plan for the site. Site water management is discussed in Section 5.6.

5.5.1 Waste rock management

The block modelling for the Batman Pit included in the EIS suggested that:

- Phase 1 of the pit expansion would be excavated largely in PAF rock, with the remaining 10% or so excavated in uncertain rock;
- Approximately 70% of Phase 2 would be excavated in PAF rock, with the remainder split between uncertain and NAF rock at approximately 15% each;

- Approximately 60% of Phase 3 would be excavated in PAF rock, 30% in NAF rock, and 10% in uncertain rock; and
- Approximately 50% of Phase 4 would be excavated in PAF rock, 40% in NAF rock, and 10% in uncertain rock.

The waste rock is proposed to be dumped into an expansion of the existing WRD footprint, which will be buried within the new WRD. The expanded WRD would extend upgradient between RP1 and the Pit. In this context it should be noted that the WRD will be built over the alluvial channel of a former creek alignment. The existence of this lateral under-draining path is likely to be one of the pathways facilitating transport of AMD to RP1.

Further, the proposed expanded WRD footprint would inevitably cover other existing surface drainage channels. No allowance appeared to have been made for these flow paths to be filled with NAF waste rock to avoid contact between the flow-through beneath the WRD and the placed PAF waste rock. The NT EPA made two observations in this respect:

- The planned staging of the pit expansion indicates that the vast majority of material removed in Phase 1 is expected to be PAF or uncertain. This does not appear to make allowance for the retrieval of adequate NAF material to construct the WRD base; and
- The NAF material is likely to produce metalliferous drainage and therefore it could be considered unsuitable as a base material.

The NT EPA noted that reducing the potential for AMD to be generated through these flow pathways would need to be addressed as part of the design for the proposed WRD. A stockpile of suitable NAF would also need to be established during subsequent phases of mining to ensure that adequate material for cover systems was available when required.

The EIS indicated that NAF waste rock storage would be established within the footprint of the expanded WRD. The staging of WRD construction would need careful consideration to ensure that PAF and uncertain material are properly encapsulated with appropriately benign material, including at the base.

It is now well known that the technique of end dumping for building up a waste rock dump increases the likelihood of AMD generation and transport, by virtue of the creation of preferred pathways for the transport of both oxygen and water (INAP 2009). The ingress of air and water can be greatly reduced and by constructing the WRD from the bottom up by paddock dumping and periodically compacting the material to limit infiltration (Miller 2014, DITR 2006). The NT EPA requested that the planned dump construction methods be described in the Supplement including demonstration that wetting up of the dump and exposure to oxygen would be minimised during its construction. Further and related to this, the NT EPA requested information on how the flow of water across and down the faces of the dump would be managed during construction as this would substantively impact on the water management and treatment system and therefore the objectives of preventing, mitigating and managing AMD impacts.

Another concern for the NT EPA is the proposed WRD's height and predominance of steep slopes, which the Proponent claims is based on the limited area available for the WRD footprint. A key issue is the proven difficulty of sealing the side slopes of WRDs from rainfall infiltration and oxygen ingress and therefore the risks posed in the placement of PAF material beneath such slopes. The design is reliant on the presence of the interbench GCL liners to minimise the infiltration of water and air to the PAF

material that would be encapsulated beneath these slopes. If these liners fail, as discussed in Section 5.5.2, the AMD objectives will not be met.

The key to the management of waste rock to minimise AMD is to minimise the exposure of PAF waste rock to oxygen and water (Williams, 2014). For surface WRDs, limiting exposure to atmospheric oxygen is difficult, particularly in dry periods. Hence, the focus must be on the identification, segregation and selective placement of PAF waste rock and its encapsulation in NAF (or alkaline, if available) waste rock continuously during the construction of the WRD.

5.5.2 WRD cover design

The performance of the WRD cover system will be critical to the long term environmental performance of the closed-out site. The objective of a cover is to minimise the ingress of water and oxygen to PAF material encapsulated in the WRD and therefore to limit the generation of AMD and seepage to the environment. It should also be resistant to erosion to ensure long-term protection of underlying PAF rock. A minimum expectation would be for the proposed WRD to be effectively sealed, both during construction and at closure, so that the potential for AMD to contaminate the receiving environment would be prevented or minimised into the long term.

In the EIS, the Proponent proposed to use a GCL-based cover for the surface of the WRD, which was a significant change from the originally proposed store and release cover (Tetra Tech 2011). The NT EPA requested that the Proponent provide the reason for this change as it would have a substantive bearing on the cover interaction with both the physical and biological environment. In particular, it was considered by the NT EPA that the implementation of a store and release cover on the proposed benches could better accommodate the effects of differential vertical settlement, which is likely to be substantial through a 350m profile of uncompacted waste rock. The performance of a store and release cover relies on evaporation via the roots of vegetation. In contrast the performance of a GCL-based cover could be substantively compromised by root penetration. The Proponent was requested to provide evidence of the successful, long term implementation of a GCL-based cover system in a similar climate regime and undertake predictive performance modelling incorporating the effects of climate variability.

The Proponent responded that Vadose modelling had dictated the design of the WRD and no substantial changes were anticipated that would require further consideration. Additionally, the Supplement indicated that '*GCL's are used all over the world and are standard practice. GCL's were selected in contrast to clay, which was evaluated, because it does not have the characteristic of shrinking and cracking that clay exhibits in environments that exist in the NT*.'

No empirical (as distinct from predictive modelling) evidence was provided to support the use of the proposed GCL-based cover system in the wet-dry cycling environment characteristic of the NT. The assertion that GCLs, as distinct from a compacted clay layer, would be immune from the problems of wetting and drying appeared to demonstrate a lack of theoretical or practical experience with such materials in the wet/dry tropics. The NT EPA was not satisfied that the use of the term "standard practice" provided sufficient *a priori* assurance of long-term environmental performance under all climate scenarios. In fact, as discussed previously in Section 4.1.1 of this Report, standard practice in the Pine Creek Geosyncline appears to have led to many problems following mine closure or during care and maintenance.

The GCL is intended to promote runoff and avoid contact between water and any underlying PAF waste rock. However, the low hydraulic conductivity which is required of a GCL relies on the thin, sandwiched layer of bentonite remaining saturated.

The NT EPA was concerned that the limited thickness of coarse-grained cover and finely crushed rock would not ensure that the bentonite remained saturated during the long Dry season, when it would likely desiccate and crack. The GCL would then be rendered ineffective when the subsequent Wet season arrived, allowing water to percolate through the layer and into the PAF material.

The NT EPA consequently directed the Proponent to provide, at a minimum, a well-researched technical review of the actual performance over the intermediate term of GCL cover systems in wet-dry environments to support the proposed use of such a cover system at Mt Todd. In requiring this information, however, it must be noted that the NT EPA is not aware of the existence of any long-term (i.e. multi-decadal) performance data for GCL-based mine waste covers anywhere in the world given the relatively recent use of GCL materials for application in mining, as distinct from landfill covers.

A key concern was the lack of time series data for the predicted moisture content of both the fines covering layer and the GCL through a range of wetting and drying cycles that could provide some confidence that these layers would preserve their functional integrity.

Time series modelling was subsequently undertaken for the moisture content at the interface between the fines and the GCL layer (Tetra Tech 2014). The interpreted data concluded that the GCL and fines layer would remain adequately hydrated through multiple wetting and drying cycles. However, the NT EPA remains unconvinced that a 0.3m thick cover layer of fines over the GCL would be sufficient over the long term to maintain saturation. The proposed cover is a “theoretical” starting point with no provision having been made for biophysical issues that will inevitably affect performance. For example, burrowing termites were one of the major causes for deterioration in performance of the thin covers at Rum Jungle. Sustained performance of the cover in this Project was also based on the assumption that no vegetation would be planted on the WRD. Even if this condition was to be accepted as an appropriate closure condition, it is highly unlikely that voluntary recruitment of vegetation species through time could be prevented. Other factors that could compromise the proposed WRD cover over time include differential settlement of waste rock across the dump and erosion, ultimately leading to GCL breakage or desaturation of the bentonite in the GCL, and the formation of preferential flow pathways for ingress of water and oxygen through to underlying PAF material.

The NT EPA is not satisfied that the proposed cover design as documented in the EIS can currently meet the objectives. The NT EPA considers that alternative cover systems, such as a store and release cover, in conjunction with alternative WRD designs, should be investigated to provide more certainty that the WRD can be adequately sealed into the long term at this site. WRD design issues are discussed further in the following sections of this Report.

Recommendation 3

The Proponent must undertake a rigorous evaluation of alternative WRD cover designs prior to authorisation of the Project. Modelling work underpinning the design of covers, and subsequent monitored trial covers, must demonstrate that the covers can meet the required cover objectives within the context of the wet-dry cycling environment of the Top End and other biophysical factors that have the potential to affect cover integrity in the long term.

The modelling must be subject to rigorous peer review by an independent party with practical experience with the issues that affect the real world performance of the modelled cover system/s.

5.5.3 WRD geotechnical stability

The overall objective of mine completion is to prevent or minimise adverse long-term environmental impacts and to create a stable landform suitable for some agreed subsequent land use. It is imperative that the WRD is constructed in the short to intermediate term to meet this objective.

The issues associated with geotechnical stability of the WRD were identified by the NT EPA's independent expert as the impact of vertical settlement and/or slope failures on the integrity of the structure, and the possibility of failure at the toes of the benches.

The possible effect of vertical settlement has already been referred to with the assessment of surface cover layer performance (Section 5.5.2). Settlement would occur as a result of the weight of the rock pile itself, collapse of material on wetting and longer-term degradation of the waste rock. As well as a critical consideration for integrity of the final cover, it could also be an important issue for the effectiveness of the planned inter-bench GCL layer, since this is very dependent on the maintenance of a slight downward slope to direct seepage to the outer dump face as previously described. Any variation in that slope due to settlement could cause runoff to be intercepted and concentrated leading to higher erosion risk. Substantial settlement over a short distance, which could occur as the WRD is constructed, would also damage the underlying GCL. Whilst the proposed design appeared sound in static 2D cross section in the EIS, the potential for failure of this important control strategy was considered to warrant further analysis. Modelling to predict the effects of differential settlement on the interbench GCL was recommended.

The use of a GCL layer to intercept and direct seepage along the inter-bench plain was considered to substantively increase the risk of failure at the toes of the benches. As such, slope failure modelling under saturated conditions (along the surface of the interbench GCL) was requested to assess the factor of safety of the proposed design.

In response, the Proponent indicated that settlement analysis would be included in the detailed feasibility study phase of the Project. Instead, the Proponent solicited its rock mechanics expert who related his experience with a steep waste rock dump at Newmont's Batu Hijau mine on Sumbawa Island, Indonesia. Batu Hijau is in the Wet tropics in an area of high topographical relief with different conditions to the Mt Todd mine site. The mine would not experience the long Dry season that is characteristic of the Top End and, in that respect, was not considered a particularly relevant example.

Further comments from the Proponent's expert were prefaced with "*The high, steep WRD at Mt Todd, once established, should remain stable in the overall sense*" but included the following caveats:

- "*The challenges arise from the details of the inter-lift liners, and these are critical to the performance of the dump, both in terms of stability and the ability to inhibit the development of acidic drainage*."
- "*In an active waste rock dump (i.e. during mining operations), the materials continue to shift to some degree as the loading environment changes and percolation moves particles around, leading to settlement*."
- "*At Mt Todd, the liners, along with the bedding and cover layers must accommodate such displacement while ensuring that percolating waters are forever directed outward, rather than inward. As the liners slope outward at 2 degrees, or 5%, they represent potential sliding surfaces for the overlying materials*".
- "*The engineering of this design will require consideration of many factors, including deformation tolerance, stability over a range of temperatures, puncture resistance,*

frictional characteristics, and developing an understanding of behaviour under intense precipitation events (in perpetuity)."

- "*Numerical modelling should resolve some of the issues associated with the design and point towards optimisation*."

These qualifying statements served only to amplify concerns regarding the multiple factors requiring management during construction and the many sources of uncertainty in current information.

The NT EPA directed the Proponent to provide further information focusing on the key concerns that the proposed GCL requires specific conditions for it to be effective into the long term and that these conditions might not be met at Mt Todd due to:

- possible large differential settlements (collapse) over short distances that could occur during and after construction, compromising the GCL integrity;
- potential for desaturation and hence cracking of the GCL;
- the shallow (1 m) layer of NAF material proposed which was considered insufficient to prevent desaturation and cracking of the GCL during Dry seasons; and
- potential for NAF material to be unavailable for encapsulation of the WRD when required .

A technical memorandum from Tetra Tech provided as part of the further information from the Proponent included further clarifications regarding the design. The slope stability analysis conducted by Golder (2012) was cited in the information. This analysis was conducted for a lower WRD (310m). The Golder report suggested that the WRD would likely be geotechnically stable from the point of view of catastrophic structural failure. However, there was some implied concern regarding factors of safety[2] in the Golder report that suggested these factors could be considered marginal, and required further validation. These included the following:

- Golder assumed that the Proponent would confirm appropriate limitations considered to be acceptable for the Factors of Safety of the WRD;
- With the assumed geometry, instability of any given bench was likely to regress upslope after a slide because the consequent surface slope above would be steeper than the design slope. This implied a requirement for ongoing maintenance of the slopes;
- The scale of the dump and the consequences of a 30m high slope failure (and effects on the stability of the slopes above it) or failure of the whole side of the dump, the potential volumes of materials and impacts would need to be considered in adopting an acceptable limiting Factor of Safety.

The Proponent indicated that the overall design of the WRD would likely remain unchanged, but that additional aspects of the design would be evaluated during further project development including:

[2] Factors of safety are used in engineering design to reduce the probability of failure and can be defined as F=C/D where F is failure; C is the structural capacity to resist a force; and D is the stress or disturbing force. Failure is assumed to occur when F is less than unity (http://www.rocscience.com/hoek/corner/8_Factor_of_safety_and_probability_of_failure.pdf).

- Assessment of other liner materials such as LDPE and bituminous geomembranes; and
- Potentially completely sealing several of the upper lifts of the WRD.

There remain unresolved risks in terms of the geotechnical stability of the WRD and therefore the ability of the structure to meet AMD and closure objectives. Further numerical modelling would be needed to determine the likely stability of the WRD during and following construction. Construction of the proposed WRD design to function as proposed would be heavily reliant on competent mine planning and the implementation of a very sound quality assurance / quality control program. The NT EPA considers that this presents substantial risk for the Project.

5.5.4 WRD geomorphic stability

The above-ground structures on the mine site must be able to withstand the natural forces that are likely to impact on it in perpetuity such as seismic events, extreme weather events that may erode the structure and long-term weathering.

The long term geomorphic stability of the WRD landform was not sufficiently addressed in the draft EIS or in any of the precedent material. Longevity against the erosive forces of intense rainfall events would perhaps be the most critical determinant of the structural lifetime of the proposed waste rock dump, especially the efficacy of the drainage system.

For this reason the Proponent was advised to rigorously test the proposed design (including catchment and drainage structures) with a well-regarded and tested, 3D, event-based, computer geomorphic model such as CAESAR.

The Proponent indicated in the Supplement that additional modelling work had been committed to in the detailed stage of design, which would be undertaken after completion of the EIA process.

The NT EPA directed the Proponent to provide further information on the geomorphic (erosion and weathering) stability of the WRD. The Proponent provided preliminary estimates of soil erosion rates from the WRD based on the existing WRD using the Revised Universal Soil Loss Equation (RUSLE) approach. The findings indicated that erosion rates off durable NAF waste rock were low and this was supported with 10-year field evidence from the existing dump. The NT EPA were concerned that RUSLE was developed for low-profile, flat, vegetated slopes and was not a predictor of gully and rill erosion, the likely dominant erosion processes for the proposed steep WRD slopes. There was also concern that the field evidence could not be extended to the proposed 350m high WRD given that the existing WRD was 24m high and had been exposed to only 10 years of weathering, a very short timeframe when considering the proposed WRD would be expected to remain in perpetuity.

Additional comment was made in the further information that the WRD material would only need to resist weathering and erosion until closure of the facility when a vegetative cover would be employed. This statement contradicted the NT EPA's understanding of the Proponent's intention to maintain the final landform as a non-vegetated structure.

Significant concerns remain about the long-term geomorphic stability of the WRD in the context of managing large water flows across the surfaces, and especially at interbench breaks of slope. The key to the geotechnical and ultimately the erosional stability of WRDs is to limit the length of slopes, and the catchment area that drains over the slope, to minimise the potential for rainfall runoff to overload the capacity of drainage structures. The current WRD design does not accomplish this and therefore is unlikely to meet the stated objectives for AMD management.

Management of the drainage would be critical to the stability and maintenance of functional integrity for the landform. There was no substantive discussion in the EIS

about this aspect for such a high structure. There are many examples in the monsoonal tropics where initially constructed drop down structures and/or bench drains have failed a short time period after construction.

There remains substantial unresolved risks associated with the long term geomorphic (landform integrity) and geochemical (water quality) post-closure objectives of the WRD.

Recommendation 4

In designing and constructing waste rock facilities for the Project, the following principles must be adhered to:

- **Lining of the surface drainage channels that are to be covered by the WRD with NAF waste rock to ensure that any clean natural flow-through does not come into contact with PAF or uncertain waste rock;**
- **No PAF or uncertain waste rock to be placed beneath operational or final WRD slopes;**
- **NAF waste rock or soil is required over the relatively flat top and any benches of the WRD to form a low net percolation cover, which should preferably be based on the store and release principle to avoid shedding excessive rainfall runoff over the side slopes.**

For the high PAF waste rock proportion expected at Mt Todd this will necessitate a relatively low level WRD covering a large area, rather than the high pyramid shape proposed.

5.5.5 Tailings management

Apart from the WRD, the TSFs would occupy the biggest legacy footprint on the site. These two structures would contain fine-grained net acid producing material. The existing TSF would be raised to accommodate an additional 60Mt. The second would be purpose built to contain approximately 100Mt of tailings from year 6 onwards.

The key issues to consider for the TSFs are their designs as they relate to operational, closure and post-closure performance and stability. In contrast to the WRD, substantive detail was provided regarding the TSFs.

5.5.5.1 Structural Stability

The NT EPA was satisfied that a sufficient level of analysis, including identification of residual risk factors, was undertaken to support the proposed TSF concepts. However, there were concerns that a greater than 100 year annual recurrence interval (ARI) flood event would encroach on the toe of TSF2 and possibly affect longer-term integrity. There were also concerns for the engineered diversion channels of Stow and Horseshoe Creeks in larger flood events.

The Proponent indicated that the downstream shell of TSF2 would be constructed using NAF waste rock material. Selectively sized waste rock would be used for embankment construction based on a scour analysis to prevent erosion, which would be performed during the feasibility study phase of the Project. Additionally, the EIS stated that an erosion protection bund would be constructed at the downstream toe adjacent to the Horseshoe and Stow Creek diversions, if required.

The NT EPA considers that protection toe bunds would likely be sufficient if adequately engineered and their implementation would need to be seriously considered.

5.5.5.2 Design for Operation and Closure

TSF1

All of the presented evidence indicates that this structure was well designed and soundly built for the purpose of storing tailings. In particular, it possesses an extensive underdrainage system that is considered to be extremely beneficial for both operations and closure. Although this facility is not lined, the presence of the underdrainage system means that a substantial proportion of the vertical drainage could be captured and returned to the process via the decant tower system. The underdrainage system also means that the tailings mass may consolidate more quickly through the operational period and thus facilitate capping and closure.

The NT EPA agrees with the Proponent that the performance of TSF1 would significantly improve if operated as a tailings facility rather than a retention pond.

TSF2

The concept proposed for TSF2 is considered to be best practice and arguably leading practice. The twin liner system would prevent vertical seepage, whilst the overdrain and decant tower system would facilitate vertical drainage and enhance consolidation. If the overdrain was not present, the lined facility would act as an undrained bathtub with little opportunity for enhancing consolidation of the tailings and hence expeditious capping and closure.

The Proponent indicated that it would provide design details of the TSF2 and further evaluation and development of engineering controls for seepage management during the design phase of the project. The NT EPA considers that any significant departure from the TSF concepts in the EIS would require additional environmental assessment to re-evaluate their acceptability.

5.5.5.3 Covering for Closure

The greatest potential environmental risk posed by the TSFs will likely be post closure, assuming that the water management and treatment system is operated appropriately during the operations period, and that no structural failure of the walls occurred.

During operations the acid generating tails would be saturated, essentially preventing oxidation. However, following cessation of operations the phreatic head would fall in a vertically-drained, unlined system such as TSF1, allowing the entry of oxygen into the pore space and thus initiating oxidation. The placement of an effective cover system would minimise entry of water into the tails as well as increasing the diffusion path length for oxygen. Therefore, the design of the cover system, including sufficient contingency for surface erosion through time, is critical.

A number of challenges were identified during the EIS review with respect to covering the TSFs for closure.

The Proponent proposes to spread a 1m layer of NAF crushed rock over the thixotropic tailings to provide a stable platform for placement of the final cover. However, the practicability of this would depend entirely on the extent of prior consolidation of the tailings. As noted above the presence of an under blanket drainage system would favour more rapid consolidation but it could not be assumed that sufficient consolidation would have occurred to permit the proposed strategy to proceed.

Additionally, there would inevitably be substantial differential consolidation across the tailings surface. Differential consolidation is an important issue in cover design, particularly for such large TSFs, since failure to address this could result in a depression developing in the middle of the structure, with consequent Wet season ponding of water and vertical infiltration and transport of reaction products. Consolidation modelling is

needed to determine the additional surcharge volume required for the placement of a cover system. It should be noted that addition of the 1m rock layer surcharge will likely result in the vertical expression of pore water that could intrude upwards into the cover. This possibility would need to be factored into the risk assessment for closure of the TSFs, noting that it would have a higher likelihood of occurring for the lined TSF2.

In the case of TSF2, the liner system should at least minimise the downward leaching of solutes through the base of the TSF for some time. However, ultimately these liners would fail, and the environmental performance of TSF2 into the long-term would depend on the performance of the overlying cover system.

The EIS proposed that the downstream face and crest of the TSF walls would be covered by a store and release layer and overlain with a growth medium. A dedicated store and release cover system is not intended to generate rainfall runoff and therefore would not normally be used on slopes, since runoff from a slope would reduce vegetation-supporting infiltration and promote erosion of the growth medium. A rocky growth medium would have to be considered to limit erosion of the face of the TSFs.

The current extent of modelling of the proposed store and release cover system is considered insufficient to provide a robust assessment of long term cover performance. The NT EPA is not able to adequately assess the long term integrity of the proposed cover design. The performance will need to be assessed using dynamic climate data, specifically addressing the issue of extended periods of high rainfall.

Recommendation 5

The Proponent must undertake modelling of the proposed store and release cover system for the TSFs using dynamic climate data to assess the long-term integrity of the design under conditions of extended, high rainfall periods. Monitored trial covers should subsequently be constructed to demonstrate that the cover designs achieve acceptably low net percolation.

5.5.5.4 Other Closure Options

Closure of the tailings in place in the TSFs was the only option pursued in the EIS. In this context it should be noted that covering of the above-grade TSFs and ongoing management and monitoring is the single most costly item ($55M+) in the closure plan. Above grade facilities also constitute an indefinite term risk to the environment.

The Proponent investigated the option of in-pit disposal of waste rock as discussed in Section 5.4.3 and determined that it would render the Project uneconomic. However, this was based on the transfer of much larger quantities of material. Little consideration was given in the EIS to in-pit tailings disposal except a statement that tailings would need to be re-fluidised and pumped into the pit and that the current closure option for the tailings storage facilities would ensure protection of the environment.

In-pit tailings disposal is increasingly being regarded as best practice by the industry when all factors, economic, environment, and social are taken into account (Appendix B of this Report; DITR 2007). Given that the Batman Pit is proposed to be a pit lake at the end of mine life, in-pit disposal would likely provide a more secure water cover for the perpetual containment of this reactive material.

It is possible that residual cyanide could be considered to be an issue in this context. However, unlike metals, cyanide rapidly degrades in the environment. Management of cyanide is discussed further in Section 5.5.6 of this Report.

5.5.6 Cyanide management

Cyanide is used in mining to extract gold (and silver) from ores, particularly low-grade ores and ores that cannot be readily treated through simple physical processes such as

crushing and gravity separation. Gold mining operations use very dilute solutions of sodium cyanide, typically in the range of 0.01% and 0.05% cyanide (100 to 500 parts per million) (Logsdon *et al.* 1999). The sodium cyanide dissolves in water where, under mildly oxidizing conditions, it dissolves the gold contained in the ore.

A residual slurry is left behind which contains the fine ore particles, as well as toxic cyanide residues in various forms. The slurry is made alkaline and the alkalinity ensures that free cyanide ions, which combine selectively with the gold, are not lost as free cyanide gas. This slurry is pumped to the tailings storage where the particles settle out and the supernatant water is recycled for various processes.

A number of respondents to the draft EIS were concerned about cyanide concentrations in the tailings and how cyanide would be managed to minimise impacts to the environment, in particular the Gouldian finch.

The Proponent acknowledged that temporary ponds of standing water attract wildlife, particularly birds, and where water is contaminated, has led to reported mortality and affected a range of taxa (Donato *et al*. 2007). A discussion provided by the Proponent of the potential affects and mechanisms of poisoning from WAD cyanide, which is considered to be one of the measures of the more toxic forms of cyanide, was included in the Supplement (Reference 3).

The Proponent has committed to treating the majority of WAD cyanide in tailings water prior to release using the air-sulfur dioxide (SO_2) process. In the SO_2/Air process, free and WAD cyanide are oxidised and iron cyanide is rapidly precipitated as an insoluble solid with the process applicable to either solutions or slurries (Logsdon *et al* 1999).

Cyanide can also be treated through:

- Other forms of chemical oxidation such as the hydrogen peroxide treatment process;
- Natural degradation, principally through volatilisation to less toxic substances in the atmosphere;
- Precipitation through the deliberate addition of complexing agents such as iron; and
- Biodegradation through aerobic or anaerobic passive biological treatment systems.

Through these treatments and natural degradation, only the less toxic and strongly complexed forms remain in the long term (DRET 2008).

Trial treatments using the SO_2/Air process have reportedly yielded WAD cyanide concentrations of 39.8 mg/L at the Mt Todd Project site (Tetra Tech 2013). A standard, safe no discharge level of 50 mg/L weak acid dissociable (WAD) cyanide is widely accepted to be a safe level for water accessible to wildlife (DRET 2008). This cyanide would be expected to naturally degrade in the TSF to much lower concentrations. It has been reported that in typical situations, total cyanide could be reduced by half in less than three weeks through natural degradation in a tailings impoundment (Logsdon *et al* 1999). The Proponent claims that cyanide would not enter the tailings at levels considered harmful i.e. >10ppm WAD.

Additionally, the draft EIS stated that operations would comply with the International Cyanide Management Code (ICMC). The NT EPA requested that an indication be provided of what it entails to be a signatory to the ICMC, whether the Proponent intended to become a signatory and an outline of what management measures would be implemented to ensure that the ICMC would be complied with.

The Supplement provided a website address describing the requirements http://www.cyanidecode.org/about-cyanide-code/cyanide-code. Although the

Supplement indicated that Mt Todd would need to progress to certification in the early phase of operations, there was no explicit commitment to become a signatory, only that the Proponent had adopted the guidelines as design criteria for Project facilities.

Recommendation 6

The Proponent must become a signatory to the International Cyanide Management Code.

The water quality monitoring program must include monitoring of cyanide in tailings supernatant and include the parameters of WAD, free and total cyanide. The standard, safe no-discharge level of 50mg/L WAD cyanide is to be set as the threshold to trigger corrective action.

5.6 Water management

The northern monsoon tropics are characterised by distinct wet and dry seasons which provide substantial challenges for both operations and closure. In particular the Wet season is characterised by periods of intense rainfall, the duration and intensity of which are highly variable. This variation provides a major challenge for operational water management and underpins the sizing of onsite water storages, the design capacity of the proposed water treatment plant, and the design of mine landforms and post-closure cover systems.

Past and current water management have been briefly discussed in Section 4.1.3 of this Report. Given the history of contamination and discharge of water (controlled and uncontrolled) from the Mt Todd Mine site, the impact of discharges on the Edith River and further downstream have attracted considerable community interest in recent years and is a key concern raised by most respondents to the draft EIS.

Proposed water management

Proposed site water management includes the drainage of clean stormwater from the WRD into West Creek, and from the process plant area to Batman Creek. During operations a new WTP will treat contaminated waters from RP1, RP2, TSF1, TSF2 and Batman Pit throughout the year following collection in an equalisation pond lined with a LLDPE or equivalent (the suitability of this would need to be further investigated). During the mine life, approximately 62Mm^3 of AMD is projected to be treated in the WTP.

The proposed WTP will utilise a standard and well proven treatment process based on lime precipitation conducted in a high-rate solids contact clarifier. Sludge from the WTP would be continuously recycled back to the reactor turbines, and periodically discharged, and pumped to the TSFs. Treated water is proposed to be used in the process plant, for dust suppression or discharged to the environment (Edith River).

Water management, including capacity of the WTP, has been informed by water balance modelling for the site. Water balance modelling indicated that a WTP with a capacity of 300m^3/h WTP for years 1 to 3 of operations and 500m^3/h for years 4 to 12, combined with a 30 000m^3 equalisation pond would be sufficient to prevent overflows from water retention ponds during 'normal operating conditions'.

During periods of 'extreme' or 'high intensity' rainfall the water balance model predicts uncontrolled overflows from RP1, RP2, HLP and RP5 during the Wet season, particularly in the first three years of operation. This is explained in the draft EIS as the result of insufficient pump capacity on pipelines to the equalisation pond in the model.

While the model used a smaller WTP in the first three years, elsewhere in the EIS the WTP capacity is stated to be 500m^3/h and it is the NT EPA's understanding that a 500m^3/h plant is proposed from the commencement of operations. Installing the larger

capacity plant from commencement would reduce the risk of overflows in the first three years compared to that predicted by the model.

Proposed operating procedures to reduce the risk of overflows during extreme rainfall events include:

- A requirement to minimise the volume of water stored on-site in retention ponds at the end of the Dry season (maximising available storage at the start of the Wet season);
- Redirecting water to the TSFs for temporary storage if all water storages are at or near capacity; and
- The use of additional stand-by pumps to transfer between affected ponds and the TSFs;
- Increased rate of treatment and discharge if uncontrolled release is likely; and
- Proactive management of water levels to ensure adequate storage capacity.

Water retention ponds are designed to overflow as a last resort to preserve their structural integrity and the Proponent argued that the dilution ratio at these times would be such that no measurable impact to the environment would be expected.

A number of respondents to the draft EIS expressed the view that water management infrastructure should be designed to ensure that overflows from water storage bodies do not occur, even during high intensity rainfall events, and that only treated water should be released from the site.

Water balance model

The WTP, the associated equalisation pond, and the pump and pipe transfer systems are considered to be the critical components that would enable the site to operate with zero discharge for all but the most extreme of rainfall event conditions. For this reason it is essential that the climate drivers for the water balance, including prolonged events, have been appropriately modelled.

The model makes a number of assumptions, including no net groundwater inflows to Batman Pit (recent work indicates that groundwater inflow could vary between a few litres per second up to 31L/s during operations), using the ultimate pit configuration from the alternative 33 000tpd production case, 1799ML of water would be present in Batman Pit at commencement of operations (approximately 15% of its maximum volume), and year-round discharge to the Edith River would be permitted. The draft EIS notes discrepancies between modelled and reported areas of development footprints for the LGO stockpiles, Batman Pit and to a lesser extent the WRD that could impact on assumptions regarding the rate of transfers to the WTP.

These issues contributed to the NT EPA holding substantive uncertainty in the robustness and reliability of the water balance modelling that has been done for the EIS. The NT EPA requested that an up-to-date water balance model be produced that addressed the revised project scope and that incorporated the probability of occurrence of extreme weather events. The Proponent was requested to review the water management and treatment system based on the revised water balance modelling to ensure it would be capable of accounting for the updated predictions.

There was no indication from the response provided that the Proponent had revised the model for the Supplement, although the Proponent is committed to further modelling as part of a definitive feasibility study (DFS).

The NT EPA queried the transition between pre-mining water management at the site and commencement of mining, given that the water balance model assumed Batman pit was substantially dewatered by the commencement of operations. The Proponent was directed to provide further information on the risks and contingencies in the event that the AMD inventory had not been reduced to the required extent when mining is due to commence. The Proponent's response did not address the request, stating incorrectly that 'the management of water during the current "Care and Maintenance" phase is controlled by the DME and not Vista Gold'.

Water quality objectives

Under the *Water Act*, the declared beneficial use of surface water from the Edith River and its tributaries is to sustain aquatic ecosystems.

The critical question to be asked in this context is whether the environmental values and appropriate water quality objectives (WQOs) defined in the EIS have been developed according to the framework defined in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC 2000). The reason for this is that the ultimate performance targets for the management and mitigation of water quality risks for discharges from the site during operations and the closure period depends on the numeric values of the defined WQOs. In the NT these performance targets may be pursued as water quality discharge criteria through waste discharge licences granted under the *Water Act*.

The draft EIS was equivocal about the proposed water quality of discharges to the Edith River from the site, with statements varying from an intention to meet the requirements of the WDL to discharge water being of a better quality than that discharged to date. In the Supplement the Proponent stated that an 80% species protection level had been selected (as exists under the current WDL for discharge from the site) and that that the weight of empirical data did not support the need to target a higher 95% level of protection.

Whilst it is accepted that an 80% protection criterion is contained as an intermediate water quality target in the current WDL for the site given its present state and recognising the objectives of WDL178-2 (refer 4.1.3), this is not considered an acceptable default regime for a long term operating project.

The NT EPA considers that the most appropriate level of protection for an operating Mt Todd mine to sustain the aquatic ecosystems of the Edith River and its tributaries is a 95% species protection level. This level of protection should apply to all licensed discharges entering the Edith River from the mine site.

The NT EPA expressed this view to the Proponent in its direction for further information. In its response (email from Brent Murdoch, 20 January 2014), the Proponent committed to a 95% species protection regime, stating that '*Vista will accept the change to 95% for the non-legacy water*'. The NT EPA interprets this statement as a commitment to a 95% species protection regime once Batman pit has been sufficiently dewatered to allow the commencement of mining.

A further consideration related to sustaining the aquatic ecosystems of the Edith River and its tributaries is the possibility raised in the draft EIS that discharge of treated water may occur throughout the year, including in the Dry season during periods of low flow. Such discharges could pose a risk to the Edith River ecosystem given the change in natural flows and would require approval under a WDL at the appropriate time. Given the water demands of the mine and proposed use of treated water as one source to meet these demands, it seems unlikely that Dry season discharges would be a common occurrence. However, any decision to allow discharges during periods of low flow would need to be based on a robust risk assessment and supported by sound scientific advice on potential impacts and appropriate monitoring requirements.

Conclusions

The NT EPA considers that there are substantial unresolved risks associated with the site water balance and the extent of uncontrolled discharges to the Edith River. However, the NT EPA is of the opinion that provided the water management and treatment system is appropriately sized to ensure that water management capacity is sufficient to reduce overflows to only the most extreme rainfall events, the risks associated with the discharge of water from the proposed mine could be managed to an acceptable level that represents an improvement on the past and current situations. The NT EPA recognises that further modelling will be carried out during the DFS stage to finalise sizing of infrastructure and that this modelling will be able to take into account revised assumptions that more closely reflect final mine plans (e.g. the increased footprint of Batman Pit and inflows to the pit). The Proponent will need to ensure that determination of appropriate capacity of the WTP and supporting infrastructure is based on updated modelling with revised input data and assumptions that fit with regulatory expectations, including appropriate discharge water quality.

Recommendation 7

The Proponent must undertake revised water balance modelling prior to authorisation of the Project using the most up-to-date data and assumptions based on regulatory requirements. The water balance modelling is to be peer reviewed by an appropriately qualified independent expert and the review provided to the regulator.

Revised modelling outputs will be used to inform the water management and treatment options for the site, including the water treatment plant capacity.

Recommendation 8

The 95% species protection level, determined in accordance with ANZECC 2000, is to apply to the immediate receiving waters for mine site discharge at, or prior to, the commencement of mining. This level must not be exceeded as a result of licensed discharges from the mine site.

5.6.1 Groundwater

Based on the EIS review, the NT EPA considers that a sufficient level of modelling has been done to provide confidence that interaction between water in the pit post closure and the surrounding groundwater would not be significant from a contamination perspective and that significant impact on flows in the Edith River from the ultimate cone of depression would be unlikely.

However, as is apparent from several other legacy locations in the Top End of the Northern Territory, it is the shallow groundwater originating from underneath mine landforms that typically contributes the majority of contaminant load to surface water that exits the site. Particularly pertinent in this context is the following excerpt from the EIS: "*The weathering profile is hydro-geologically significant in the project area. Based on examination of numerous boring logs, the top 3m of material is generally completely weathered, very highly fractured, or unconsolidated. Alluvium often extends somewhat deeper than 3m below streambeds. Weathering of the bedrock is generally observed down to approximately 25 to 30m below land surface*."

This aspect of shallow seepage reporting to surface drainage lines was not sufficiently addressed in the groundwater hydrology part of the EIS. In particular the statement is made under groundwater management measures that "*the WRD extension will be constructed such that it does not result in significant change to the local groundwater regime.*" How this was to be achieved in practice was not explained.

Whilst it may have been considered by the Proponent that the majority of near surface seepage would be effectively intercepted by the proposed passive treatment systems,

the NT EPA requested evidence that potential disseminated fugitive near-surface seepage (especially in relation to post closure risk mitigation) had been addressed.

The Proponent responded that passive interception systems are planned for both the mining and closure phases. Depending on the stage of the project these systems would constitute a mixture of wetlands, drains and sumps to capture any potential contamination via seepage or runoff. The Proponent contended that although the geological surface layers of the Mt Todd area are highly weathered, the hydraulic conductivities of this zone are considered to be generally very low as shown by the lack of any significant spatial groundwater contaminant transport over the preceding history since suspension of operations.

The Proponent also stated that the low conductivities, as well as reducing the risks, would also permit time to monitor and manage any contamination movement and that mining-phase groundwater monitoring infrastructure and associated groundwater monitoring programs would be identified and quantified in detail in the DFS.

The NT EPA is satisfied with this approach. Improved groundwater monitoring data would need to be included in subsequent updates of water balance modelling to improve the understanding of likely water management requirements at the site post-closure.

5.6.2 Water quality monitoring

The draft EIS provides details on a proposed surface water monitoring program that is closely aligned with the monitoring program required by the current WDL. Several additional sampling points are proposed to help differentiate between contaminant point sources.

The proposed surface water quality monitoring is generally adequate. There will be opportunities to revise the monitoring program as required through the issue of a WDL at the appropriate time.

The Proponent proposes to monitor potential impacts on aquatic fauna by continuing macroinvertebrate and fish structure surveys. The Proponent has recently improved the macroinvertebrate monitoring program and its capacity to detect impacts, or at least statistical differences between reference sites and sites downstream of the mine. As a result, monitoring in 2013 detected a significant difference in pelagic community composition between downstream Edith River sites and reference sites on the Edith and Fergusson Rivers. A re-review of 2012 community composition data using the improved statistical methodology employed in 2013 also showed that reference and downstream sites differed in their pelagic community composition. The conclusion in annual analyses prior to 2012 that there was no difference in composition between reference and downstream sites is most likely due to an absence of statistical power in the sampling design during those years. The results of these monitoring programs have been used to conclude that mine discharge does not have an adverse impact on macroinvertebrate populations in the Edith River

This illustrates the importance of robust monitoring program design to enable the detection of impacts. Recent advances in the methodology introduced by the Proponent are welcome, but the NT EPA believes that consideration should be given to whether additional improvements can be made. Ideally this would occur prior to the construction phase of the Project.

A further issue with the current (and proposed) macroinvertebrate monitoring program identified by the NT EPAs independent expert is that the surveys are often undertaken well after a discharge occurs, and hence the system has had a chance to substantively recover (via recruitment from upstream) from the impact of an acute discharge (Appendix B of this Report). The macroinvertebrate methodology is better suited to detecting longer duration chronic impacts. It was suggested that the Proponent consider

implementing a form of in situ biological monitoring so that time series of upstream-downstream difference data could be produced. An example of a leading practice implementation of in situ biological monitoring was the in situ deployment of aquatic snails by the Supervising Scientist at the Ranger Mine.

The Proponent did not consider that in situ biological monitoring would be appropriate for the Project site, claiming that variations in water flows during the Wet season would create risks for monitoring personnel and the likelihood of monitoring equipment being dislodged and washed away. The EIS also indicated that previous biological monitoring had not detected any adverse impacts on macroinvertebrates living downstream of the mine discharge site during previous poor quality water discharges (although note previous discussion on past monitoring). As the water to be discharged from the mine in future would be of a higher quality, the Proponent argued that detection of adverse impacts in downstream populations would be unlikely.

As explained previously in this section, conclusions regarding impact could not be drawn from the biological monitoring data that has been acquired to date, which is precisely why the possible use of in situ biological monitoring was suggested.

This type of monitoring was developed and implemented by the Australian Government Department of the Environment, Supervising Scientist Division and has been successfully maintained for many years in Magela Creek, despite its wide range of flows. If in situ monitoring is considered too dangerous then ex situ monitoring can be done using flow-through tanks with water pumped from the river. At a minimum, continuous in situ or ex situ physicochemical monitoring is expected to enable tracking of what is happening during releases. Given the potential risks associated with AMD discharges from the site, once a day sampling is not considered sufficient to provide a reliable indication of what is happening in such a dynamically changing flow environment.

Although outside of the scope of the Project, the implementation of in situ or ex situ physicochemical and biological monitoring program ahead of commencement of mining should be considered as a baseline for improving the detection of impacts and providing greater capacity to determine the causes of those impacts.

Recommendation 9

An appropriately qualified, independent party is to review the macroinvertebrate monitoring plan to determine its adequacy in detecting impacts and determining the cause of any impacts to inform implementation of an appropriate monitoring program prior to commencement of construction.

5.7 Matters of National Environmental Significance

On 30 June 2011, the Australian Government decided that the Mt Todd Gold Project was a controlled action under the EPBC Act and would require assessment and a decision on approval before it could proceed. The relevant controlling provisions were:

- Listed threatened species and communities (sections 18 and 18A); and
- Listed migratory species (sections 20 and 20A).

5.7.1 Listed Threatened Species and Communities (sections 18 & 18A)

A search on the Australian Government's Environmental Reporting Tool (with a 10km buffer) identified the potential presence of the following nine threatened species listed under the EPBC Act:

(a) Northern quoll (*Dasyurus hallucatus*) – Endangered;

(b) Gouldian finch (*Erythrura gouldiae*) – Endangered;

(c) Crested shrike-tit (*Falcunculus frontatus whitei*) – Vulnerable; Migratory;

(d) Partridge pigeon (*Geophaps smithii smithii*) – Vulnerable;

(e) Masked Owl (northern) (*Tyto novaehollandiae kimberli*)- Vulnerable

(f) Red goshawk (*Erythrotriorchis radiatus*)- vulnerable;

(g) Brush-tailed rabbit rat (*Conilurus penicillatus*) – vulnerable;

(h) Northern brush-tailed phascogale (*Phascogale pirata*) – vulnerable;

(i) Bare-rumped sheathtail bat (*Saccolaimus saccolaimus nudicluniatus*) – critically endangered;

(j) Freshwater sawfish (*Pristis pristis*) [previously listed as *Pristis microdon*] – vulnerable;

Surveys undertaken for the Project identified the Gouldian finch (*Erythrura gouldiae*) and the Crested shrike-tit (*Falcunculus frontatus whitei*) occurring on or near the Project site. The Northern quoll (*Dasyurus hallucatus*) has been identified occurring on the site previously (see Lane *et al*., 1990) and has been included in this report. Populations of the Freshwater sawfish (*Pristis pristis*) occur in riverine environments downstream of the mine. Suitable habitat and populations of the Red goshawk (*Erythrotriorchis radiatus*), the Northern brush-tailed phascogale (*Phascogale pirata*), the Masked owl (*Tyto novaehollandiae kimberli*) and the Brush-tailed rabbit-rat (*Conilurus penicillatus*) are unlikely to occur on the site and are not considered to be at risk from the Project.

The EIS Guidelines set out the information requirements with respect to threatened species. The NT EPA requested that the draft EIS provide a detailed assessment and quantify the Project's risks to the threatened 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.

Broadly, the framework Environmental Management Plan (EMP) in the draft EIS states an objective for biodiversity as: 'To avoid, minimise or control potential for significant impact on native flora and fauna and the conservation significance of the Yinberrie Hills Site of Conservation Significance (SOCS)'.

The following section includes a detailed discussion and assessment of the likely impacts of the Project and the acceptability of the residual risks to the listed threatened species considered likely to occur on the site.

5.7.2 Gouldian finch (*Erythrura gouldiae*)

The Gouldian finch (*Erythrura gouldiae*) is an iconic, granivorous, bird species endemic to Australia and is listed as endangered under the EPBC Act and the *Territory Parks and Wildlife Conservation Act* (TPWC Act) (O'Malley, 2006).

The National Recovery Plan for the Gouldian finch states that the overall objective for the species is to improve its conservation status through population increases (O'Malley, 2006). The significance of the population in the Yinberrie Hills SOCS suggests that preservation of this population is a key to meeting the objective, as discussed further in this Report.

In the Yinberrie Hills area, Gouldian finches breed in the stony hill woodlands dominated by *Eucalyptus tintinnans* and disperse locally in the post-breeding season (late Dry season and early Wet season) to the surrounding lowlands to feed (Tidemann *et al*. 1992a, 1999; Collins and McNee 1992; Dostine *et al*. 2001; Lewis 2007; Liedloff *et al*. 2008).

The key threats to this species are land use change and inappropriate fire regimes. Parasitisation by air sac mites and disease were thought to have led to declines as well (O'Malley 2006). The potential sources of impact of most concern from the Project are direct clearing or disturbance of potential breeding habitat (*E. tintinnans* woodland) and potential foraging habitat (lowland woodland) and dust levels generated by proposed mining activities, which have the potential to affect habitat as well as individual birds. Cumulative impacts associated with wildfire, vehicle strike, contaminated water sources, noise and light are considered in Section 5.7.2.7 of this Report.

The Proponent provided the following statements with respect to the potential for Project impacts on the Gouldian finch in the draft EIS:

- The residual risk to the Yinberrie Hills population of the Gouldian finch is 'High'. A risk of 'High' was assessed for the potential for dust to cause population decline, interfere with the recovery of the species and adversely affecting habitat critical to the survival of this species.

- The predicted quantity of ground level dust is high but based on a conservative scenario of possibly a higher generation of dust than may occur. Together with uncertainties about the potential effects of high dust levels on individual finches, the varying effects of various levels of dust concentration, possible pattern of dust distribution through the breeding habitats and the limited knowledge of other potential breeding areas in the Yinberrie Hills indicate that a precautionary approach be taken.

The NT EPA commissioned an independent expert ecologist, Professor John Woinarski, to undertake an assessment of the Gouldian finch information provided in the EIS. The detailed findings of Professor Woinarski are included in Appendix C of this Report.

5.7.2.1 Yinberrie Hills population size

The draft EIS understates the potential significance of the Yinberrie Hills as the largest known breeding population of the Gouldian finch. In order to gauge the significance of potential impacts from the Project on the Gouldian finch, it is important to discuss the significance of the Yinberrie Hills population. It is also worth discussing the population trends for the species in the Yinberrie Hills to obtain a better understanding of the species stability or otherwise.

The population size of Gouldian finches at Yinberrie Hills is typically reported as 150-250 individuals, based largely on population estimates by O'Malley (2006). However, O'Malley was explicit that these figures were for the number of mature individuals rather than the total number of individuals.

An analysis of other counts and ecological studies on the finch population in the Yinberrie Hills concluded that the estimate for population size of Gouldian finches in the Yinberrie Hills given by O'Malley (2006), and subsequently, was not considered tenable (Appendix C of this Report). Based on two very different approaches and data sets (i.e. Woinarski and Tidemann, 1991; and Woinarski and Tidemann, 1992 and Lewis, 2007), it is likely that the total population of Gouldian finches in the Yinberrie Hills area was, at the time when those studies were conducted, at least an order of magnitude larger than the estimate used in the draft EIS (Appendix N pp. v, 5, 75), and lay in the range of 1500 to 10 000 individuals (and hence adult population probably ranged between 600 to 4000 individuals).

Following the provision of advice from the NT EPA's consultant, the Proponent indicated in the Supplement that the range of population sizes given in the various studies was 'confidently incontestable', the population was likely to be quite variable over time and that the population in the Yinberrie Hills was likely to be large and consistently present.

Appendix K of the Supplement conceded that the population is likely to number many thousands rather than hundreds of birds.

The higher population estimate for the Yinberrie Hills than presented in early studies and the draft EIS, implies that the Yinberrie Hills area could have more importance (i.e. constituting a higher proportion of the total population) for the overall conservation of this species than previously recognised. Whilst the data for total Australian population size are imprecise and of limited reliability (Appendix C of this Report), the NT EPA accepts that, in the absence of evidence to suggest otherwise and on the advice of the independent expert, the Yinberrie Hills Gouldian finch population likely comprises a high proportion of the total Australian population and that this proportion is likely to be higher than previously recognised.

5.7.2.2 Population stability

The draft EIS concluded that the Gouldian finch population seems to have been unaffected by previous mining and its dust levels as the population remained relatively stable during previous mining and there has been no noticeable population decline attributable to the previous mining activity (Chapter 14 draft EIS).

Although several references note that ongoing monitoring has shown that the population size of Gouldian finches at the Yinberrie Hills is stable (e.g. O'Malley 2006; Woinarski *et al*. 2007; Garnett *et al*. 2011), the conclusion was based primarily on a report by Price *et al*. (unpublished). The report is explicit that the counts did not provide an absolute measure of the population size in the Yinberrie Hills and were highly variable between days, years and sites, implying that the monitoring program had little statistical power.

It is generally acknowledged that the current monitoring program referred to in the draft EIS is insensitive to changes in the population, and cannot readily be used to conclude the population is stable. The Proponent conceded in the Supplement that there was little reason to predict that populations would remain stable into the future and that the population would likely change in response to environmental changes (natural and anthropogenic).

Respondents to the draft EIS, including the NT EPA's independent expert and the DLRM, argued that previous and ongoing monitoring programs provided very little evidence to assess the impacts upon Gouldian finch populations of previous mining activity and that an assumption that previous mining activity had no impact, as reported in the draft EIS, was unjustified. The challenges of a robust monitoring program for the species are discussed further in Section 5.7.2.6 of this Report.

5.7.2.3 Core Breeding Habitat

The draft EIS considered the impacts from mining activities on Gouldian finches by assessing the extent of woodlands co-dominated by *E. tintinnans* to be directly disturbed by the mine as a proportion of the extent of potentially suitable habitat in the entire Yinberrie Hills SOCS (34 650ha) or the extent of the entire SOCS (90 294.28ha). The site boundaries of the SOCS are defined in part by additional features other than the significance of Gouldian finches. Therefore, this approach was considered inappropriate as much of the Yinberrie Hills SOCS includes areas unused by Gouldian finches (or at least areas in which no Gouldian finches have ever been reported[3]).

The approach taken by the Proponent in predicting the proportion of habitat potentially impacted was identified as potentially overestimating the area of suitable breeding

[3] It is possible that Gouldian finches breed more widely across the entire SOCS, but there is no evidence to support this assumption.

habitat and therefore underestimating the portion of actual breeding habitat that would be subject to direct or indirect impact from the Project.

The NT EPA and the DLRM consider that the most appropriate reference point for the assessment of proportionate loss of nesting habitat is the breeding aggregation area within the SOCS as this is the known 'core breeding habitat' for the finch population in the Yinberrie Hills. The locations of all known breeding sites in the Yinberrie Hills area were collated by Liedloff *et al* (2008). These sites are concentrated in a much smaller area than the Yinberrie Hills SOCS, abutting and to the immediate west of the existing disturbance area from previous mining and overlapping parts of the proposed new mining development.

Subsequent work done by the Proponent and presented in the Supplement included mapping of core breeding habitat in the Yinberrie Hills area on the basis of work by Liedloff *et al*. (2009) with a 500 metre buffer. This boundary appeared to be approximately correct within the limitations of available data, although individual nest localities were not shown and there appeared to have been some "smoothing" to derive the (mostly straight-line) boundary. It was not clear if any more-recent records, including any located during the EIS process, were used in delineating the core habitat.

Despite the approximate delineation, the Supplement and further information provided by the Proponent in response to a direction from the NT EPA continued to describe the significance of potential impacts to the finch on the basis of "all possible breeding habitat" across the Yinberrie Hills SOCS.

The NT EPA is not satisfied that the Proponent has understood the importance of accurate delineation of the core breeding habitat as a focus of impact assessment and the majority of monitoring activity around the Gouldian finch population and habitat. Further analysis of the Proponent's approach and the implications of habitat clearing and disturbance to the Gouldian finch are discussed in the following sections of this Report.

5.7.2.4 Habitat clearing

The EIS variously described the proportions of clearing on the mineral lease as follows:

- A cumulative loss (including previous loss of 884.54ha and proposed mining loss of 608.72ha) of 1497.26ha of breeding/foraging habitat (all habitats) or 2.09% of these habitats in the Yinberrie Hills SOCS (Appendix N draft EIS);
- A total cumulative loss (previously and proposed) of 295.68ha or 0.75% of the original undisturbed *E. tintinnans* woodland in the Yinberrie Hills SOCS (Chapter 14 draft EIS);
- A cumulative loss of 1201.57ha or 3.24% of the original undisturbed lowland woodland in the Yinberrie Hills SOCS (Chapter 14 draft EIS).
- 0.5ha of known breeding habitat and 157.47ha of possible breeding or foraging habitat will be cleared. This clearing will impact 0.21% of all possible Gouldian finch breeding habitat (i.e. *E. tintinnans* communities) and 0.03% of all possible foraging habitat (non *E. tintinnans* communities). 451.85ha of possible wet season foraging habitat will be cleared (Appendix K of the Supplement).
- The total area of 609.33ha to be cleared represents 0.68% of the total Yinberrie Hills SOCS (total area of 90 294.28ha).

In the previous section of this report, it was established that the approach adopted by the Proponent in determining the impact from clearing (clearing of habitat as a proportion of

the total SOCS area) was considered inappropriate and that focusing on core breeding habitat was the key factor in determining more realistic risks to the population.

The Supplement, more appropriately, related the area proposed for clearing to the known distribution of Gouldian finch nesting sites in the Yinberrie Hills area. Less than 1ha of clearing was identified as proposed within the boundary of the delineated core breeding habitat; however, the circumscription of known breeding range in the Yinberrie Hills given in the Supplement was not definitive nor based on comprehensive sampling.

No systematic assessment of the number of Gouldian finches currently breeding in the area that is proposed to be cleared (or of the number indirectly affected by other factors associated with the development) was undertaken for the EIS. The NT EPA was concerned that the Proponent's projections of proportional loss in relation to core breeding extent could underestimate the likelihood and consequences of the direct loss of breeding sites and breeding individuals. Such information was deemed necessary to make a robust, evidence-based assessment of risks to the population.

Consequently, the NT EPA directed the Proponent to undertake a systematic and comprehensive assessment of the number of Gouldian finches currently breeding in the area to be cleared, and within a 200m buffer of that area, to inform the environmental impact assessment. This was later refined following a workshop with the Proponent and consideration of the Proponent's business timeframe requirements. The final survey requirement was for a robust survey of potential finch nesting sites to be cleared and within a reasonable adjacent area, specifying the date for the survey as March/April 2014 to roughly correspond with the beginning of the breeding season.

The sampling undertaken in the subsequent study (Kutt and Holmes 2014) provided some progress towards a more rigorous and evidence-based assessment of likely impacts of the proposed Mt Todd Gold Project on this important Gouldian finch population. The basic methodology adopted was considered to be appropriate.

The supplementary study provided the results of surveys on 11-16 April 2014 by four zoologists inspecting potential nesting hollows in the identified areas of breeding habitat adjacent to the mine area. All individuals of the most important tree species for Gouldian finch nesting (*E. tintinnans*) within 15 one-hectare plots were measured and all possible nesting holes were inspected. The area surveyed represents 9% of the total 160ha of mapped breeding area adjacent to the mine site. Morphometric data on 308 trees examined, 118 of which had potential Gouldian finch nesting hollows (based on previously-established parameters), were provided.

No Gouldian finches were reported nesting in the sampled area during the March/April study.

The report draws two conclusions: i) the availability of hollows is not a factor limiting Gouldian finch breeding in the Yinberrie Hills, a conclusion consistent with previous studies of the species; and ii) the finches had probably not started their annual breeding season at the time of the survey. Unfortunately, as the timing of the breeding season appears to have been delayed in 2014, the results of the survey were inconclusive and therefore provided little further basis on which to fully assess the risks to the critical breeding habitat from the proposed mine works.

Previous studies in this area (Lawson 1993; Tidemann *et al*. 1999) noted that Gouldian finches typically breed several times per year (and rarely at the same point) and have a long breeding season. The onset of the breeding season is determined by the timing of rainfall in the preceding Wet season with a later Wet season delaying breeding onset. Hence, to locate all Gouldian finches breeding in any area, at least two searches spaced across the extent of the breeding season would be required. It is likely that this survey would have sampled only the first nesting attempt of some Gouldian finches that would

use the area for breeding in any one year and, in this case, it was too early for breeding due to the later Wet season.

The Proponent proposed to conduct a further survey in June /July to record the later season nesting birds within the area to be cleared and within a reasonable adjacent area. The NT EPA agrees that further survey effort is now essential to resolve the extent of breeding occurring in the area to be cleared, and to serve as a baseline of further breeding habitat for a future monitoring program.

Recommendation 10

A survey of potential Gouldian finch nesting sites to be cleared and within a reasonable adjacent area must be conducted in the 2015 breeding season as agreed with and to the satisfaction of the NT EPA prior to commencement of Project works to ascertain the potential direct impacts of clearing.

5.7.2.5 Dust

The draft EIS noted that the mine would generate large amounts of dust, and that much of the spread and deposition of this dust would occur to the proposed mine's immediate west and north-west (due to the prevalent south-easterly winds in the Dry season). This coincides or overlaps substantially with the main area used by breeding Gouldian finches and indeed the Supplement identified that all or most of the "core breeding habitat" would be subject to elevated dust levels, at levels that exceed the upper safe limit for humans.

Predicted levels of dust exceeding the impact assessment criterion upper safe limit for humans (>50µg/m^3) are expected to cover at least 7162ha of Gouldian finch breeding habitat in the Yinberrie Hills SOCS.

The Yinberrie Hills area to the west of the Batman Pit (the main breeding habitat) was predicted in the draft EIS to have the highest concentrations of dust, with the potential to be exposed to predicted maximum 24-hour ground level concentrations of PM_{10} of greater than 200µg/m^3. The same area was predicted to have the highest deposition rates of dust, due to the prevailing south-east trade winds.

Modelling for the draft EIS indicated that the predicted maximum 24-hour ground level concentrations of PM_{10} exceeding 50µg/m^3 incorporated all of the known finch breeding habitat with some areas of this known habitat receiving greater than 1000µg/m^3, and almost all of the area receiving greater than 200µg/m^3.

Modelling of average dust levels during the Dry season breeding months of April to July indicated that dust would impact the breeding habitat at much lower levels than the predicted maximum but still more than half of the area was predicted to exceed the upper safe limit for humans.

A workshop was held on 13 January 2014 between the Proponent, the NT EPA and the NT EPA's independent expert. The meeting discussed air quality and the lack of data relating to trigger values for dust in small birds. The Proponent resolved to rely on 'best practice' industry methods to protect the Gouldian finch through mitigation (reducing dust production), monitoring (of the finch population) and adaptive changes to operations if monitoring indicates distress. These measures are discussed further in this Report (Section 5.7.2.6).

The possibility of conducting laboratory testing to establish trigger levels for dust in small bird populations was discussed. The Proponent queried whether the results of such testing would have any scientific validity, and whether in fact the Regulators would accept such results being adopted as legitimate trigger values for operational mining at Mt Todd (GHD 2014b). However, the Proponent indicated a willingness to '*conduct experimental laboratory testing once construction is underway*'.

The levels of dust that could be of concern for Gouldian finches specifically are unknown. However, there is abundant scientific evidence that small birds have high metabolic rates, high respiration rates and have respiratory systems specialised for efficient oxygen transfer. These factors all indicate that finches are likely to have greater sensitivity to dust levels than humans. Furthermore, individual Gouldian finches are relatively short-lived birds. Consequently, any disruption to a single breeding season (for example, from peak dust levels in Year 3 of the Project) is likely to have profound influences on population sizes in subsequent years.

Assuming that the upper safe threshold for dust in finches is much lower than humans, it is likely that the area of concern for dust impact on breeding (and foraging) habitat for Gouldian finch would cover a much larger area than modelled using the >50µg/m^3 threshold, and the threshold of concern to be exceeded more often.

Based on these factors, it would be prudent to apply trigger levels for Project dust mitigation that are more conservative than those applied to humans, to reduce the risk to the long-term viability of the local Gouldian finch breeding population.

Additional dust modelling was commissioned by the Proponent in response to the workshop and subsequent discussions between the NT EPA and the Proponent.

The updated modelling of likely dust production and spatial distribution over the first ten years of the re-opened mine concluded that the original modelling of dust levels in the EIS was conservative (possibly double what is likely to occur if dust control measures are implemented). The modelling showed the major dust source would be from vehicles on the haul roads (49.7%), followed by the screening at the processing plant (12.8%) and loading at the waste rock dump (10.9%). Dust levels were predicted to be highest in Year 3 of production at Mt Todd with an Annual Average PM_{10} level of 40µg/m^3 across the breeding area immediately west of the mine in that year. Modelling of the temporal distribution of dust for Year 3 showed near-zero dust production over much of the Wet season but regular daily peaks above 50µg/m^3 in the Dry season and at least six days with peaks over 100µg/m^3. At least half of the peaks above 100µg/m^3 were predicted to occur in the breeding season when finches would be concentrated in the breeding area.

The above modelled peak dust values are averaged across the breeding area immediately west of the mine. Modelling in the original EIS showed five-fold differences in Year 3 annual average dust levels across the breeding area and up to thirty-fold differences within individual months. This suggests that some points in the breeding area would receive frequent peaks of dust levels well in excess of 100µg/m^3 during the breeding season when finches are concentrated in this area. Extrapolation of the results of the modelling indicates that several locations within the breeding habitat would be considered unsafe for humans under the impact assessment criterion, at least in Year 3 of production. As the finches are likely to be more susceptible to high dust levels than humans, dust production from the Project is considered to be a significant risk to the Gouldian finch population in the Yinberrie Hills.

The Proponent concluded in further information provided to the NT EPA that '*Given the proximity of known Gouldian finch breeding habitat to the existing mine pit, and the extent of the mineral resource at Mt Todd, dust generated from the proposed mine operation recommissioning may impact on the Gouldian finch and it's habitat. The extent and severity of the potential impact will be reduced through avoidance and mitigation, but given the proposed mine operation and the lack of scientific information about dust effects on small birds, it is unlikely that the impact can be completely mitigated'* (GHD 2014b).

The NT EPA finds that there are substantial unresolved risks to the known Gouldian finch breeding population in the Yinberrie Hills. These risks may be mitigated through the implementation of a robust and responsive monitoring program with effective dust

control strategies that can be applied reactively to minimise impacts before irreversible harm to the breeding population can occur. This is discussed further in Section 5.7.2.6.

5.7.2.6 Mitigation and monitoring program

The draft EIS stated that the uncertainties of potential effects of high dust levels on individual finches, the effects of variable levels of dust concentration, the possible pattern of dust distribution through the Gouldian finch breeding habitats, and the limited knowledge of other potential breeding areas in the Yinberrie Hills indicated that a precautionary approach would be taken.

The Proponent's approach to protecting the Gouldian finch (GHD 2014b) comprises:

- Mitigation by reducing the amount of dust produced;
- Monitoring of the Gouldian finch population; and
- Adaptive changes to operations if monitoring indicates distresses.

The draft EIS provided standard dust mitigation measures that would be implemented on the site, including:

- Chemical treatment of roads to reduce dust generation;
- Use of water sprays;
- Wetting of ore prior to crushing;
- Use of hooded crushers; and
- Use of enclosed high pressure grinding rollers (HPGRs).

The Proponent committed to implementing additional mitigation measures should dust levels prove excessive. These measures were not specified in the draft EIS. It was also noted that some mitigation measures were accompanied by the statement "where practicable", suggesting that other considerations could preclude implementation.

Standard mitigation strategies for other impacts such as land clearing, noise, wildfire, exotic flora and fauna, and artificial light were included in the EIS.

The draft EIS stated that monitoring would focus on dealing with uncertainties surrounding the highest recorded risk to the Yinberrie Hills fauna; the potential impact of dust on the Yinberrie Hills Gouldian finch population. The uncertainties were listed as follows:

- The levels of near ground dust concentration and dust deposition in the breeding habitat adjacent to the Mt Todd mine before and during mine operation;
- The effects of dust levels on the intensity of Gouldian finch nesting and nesting success;
- The future population levels of the Gouldian finch in the Yinberrie Hills;
- The status of other potential breeding areas in the Yinberrie Hills and the Mt Todd to Pine Creek region; and
- Fire management in the whole of the Yinberrie Hills.

A number of monitoring programs relating to the local Gouldian finch populations and associated habitat were proposed in the Supplement, including:

- A carefully constructed and appropriately designed dust monitoring program to allow assessment of the effects of distance from the mine and habitat features on dust levels;

- Monitoring of nesting frequency and success using large numbers of artificial nest boxes throughout the area potentially subject to >50ug/m^3 levels of dust concentration. It is critical that the plan of establishment be soundly statistically designed prior to establishment. This should be done in conjunction with the design of the dust monitoring and allow analysis of the effects on habitat, dust levels and distance from the mine on nesting frequency and success; and

- Continuation and expansion of the long term monitoring conducted by DLRM (formerly NRETAS) to determine presence and size of populations adjacent to large areas of suitable breeding habitat in the Yinberrie Hills and / or Mt Todd to Pine Creek region, following desk-top examination of the attributes of these other possible breeding areas in comparison with the known area adjacent to the mine.

The NT EPA considers adequate monitoring to be one key method for ensuring that impacts from the development are within acceptable limits. The Supplement appropriately stated that the program would need to be robustly designed, peer reviewed and undertaken on at least a bi-annual basis (accepted by the NT EPA as meaning at least twice per year); and would need to be linked to key trigger points for changed or remedial actions in relation to clearing, dust, water quality, vehicle traffic and fire impacts. The Supplementary information proposed that such a program would include waterhole counts, use of camera traps, feeding habitat condition assessment, nest counts and population monitoring. Monitoring in relation to dust impacts would also include indicators of Gouldian finch health; and monitoring of vegetation condition (particularly relating to food plants and nesting trees).

The NT EPA expressed support for the Proponent's concept of a rigorous adaptive monitoring program, but neither details of the potential design of these monitoring programs nor information on how trigger points would be determined and implemented were provided.

The NT EPA directed the Proponent to provide further discussion around a number of issues as follows:

- Rigorous statistical design would need to consider what amount of pre-impact monitoring data is required and/or what approaches are available to compensate for a paucity of pre-impact data. A paucity of pre-impact data should not be later used to argue that post-impact changes (e. g. Gouldian finch population size), cannot be confidently attributed to the effects of the mine development and therefore do not require an adaptive response;

- As discussed in the Supplement, some features of the ecology of Gouldian finch make monitoring challenging, particularly if there is a requirement for the program to be sensitive to impact-related change over short time-frames. Detailed discussion of the expected power of the monitoring program is required, including identifying unacceptable levels of change, and appropriate levels of both Type I and Type II error. The implication is that an intensive program with a high level of resource commitment is likely to be required;

- There have been previous attempts to design a robust monitoring program for Gouldian finch associated with earlier mining development at Mt Todd, which were not successfully implemented. The lessons from that program should be considered in developing any new approach (discussed further in Appendix C of this Report);

- The key parameters to be monitored need to be clearly defined, amenable to measurement and meaningful for the long-term viability of the Gouldian finch population;
- Issues associated with a potential lag between mine-related impacts and detection of those impacts in the population need to be carefully considered. This will influence decisions about the frequency of monitoring and the level of change that will trigger a management response;
- The geographic scope of monitoring is not described, other than as being in the "area adjacent to the current mine..." This warrants further discussion, and it is likely that monitoring should include the entire area identified as core breeding habitat; representative areas of feeding habitat; and possibly some other populations as controls or comparisons;
- Assuming that an adequate monitoring program can be designed and implemented, management responses associated with trigger levels should be clearly defined. It is noted that conflict may arise if the required management responses reduce the financial viability of mining operations.

No details were provided by the Proponent in response. The NT EPA provided the Proponent a further opportunity to respond in a letter dated 4 February 2014, directing the Proponent to '*demonstrate as part of the assessment that an adequate monitoring program can be designed and implemented that includes management responses associated with clearly defined trigger levels'*.

To date, the Proponent has not yet provided any details. The further information from the Proponent noted that the Gouldian finch population would be monitored, but did not state how this would be done and at what sensitivity and frequency (GHD 2014b). It also noted that mining operations would be adaptively changed if monitoring indicated 'distresses'. However, it did not (i) provide a listing of the types, extent and practicability of changes that would be made, (ii) assess the likely reduction in impact associated with such adaptive change, (iii) stipulate the response time for such changes to be implemented, or (iv) provide any threshold values of Gouldian finch response that would trigger such operational review. As such, the information provided by the Proponent contains little assurance that impacts would be kept within acceptable levels, and did not provide a clear and comprehensively detailed pathway for monitoring and appropriate management responses.

It is now essential that the Proponent commence a robust baseline sampling effort that is ongoing until mining commences. The baseline program would benefit from two or more years of data to enable pre-mining variations in the population to be distinguished from mining impacts.

Given the substantial unresolved risks associated with the Yinberrie Hills Gouldian finch population and re-opening of the mine, the Proponent must now demonstrate its commitment to mine without unacceptable impacts to the Gouldian finch population.

Recommendation 11

In the absence of an appropriate threshold for the Gouldian finch with respect to safe levels of ground level PM_{10} dust, the upper safe limit for human health of 50µg/m³ is to be applied to the Yinberrie Hills SOCS core breeding habitat in the first instance as a trigger for mitigative action.

Recommendation 12

The Proponent must conduct laboratory studies to develop a more appropriate threshold limit for inspirable dust impacts on representative finch species and

evaluate the feasibility and value of a sentinel bird program that is responsive to mine-related impacts.

Results from the sentinel bird program evaluation must be provided to the DME and the NT EPA prior to the commencement of construction and serious consideration given to implementing the program subject to the results.

Recommendation 13

A baseline (pre-mining) and ongoing (during construction and mining) Gouldian finch population monitoring program must be established and implemented prior to the construction phase of the Project. The program must:

- **Allow for a substantial baseline survey effort to be undertaken;**
- **Have sufficient rigour to detect short-term changes in the Gouldian finch breeding population;**
- **Distinguish between natural variation in the population and mine-related impacts;**
- **Establish appropriate trigger levels and management responses to enable reactive and effective impact minimisation.**

The program design must be peer reviewed by an appropriately qualified, independent person, to the satisfaction of DME and the NT EPA prior to survey commencement. The baseline survey report is to be provided to the DME and the NT EPA prior to authorisation of the Project.

Recommendation 14

In recognition of the difficulty in establishing a reactive monitoring program that can establish causal effects of dust on Gouldian finches, the Proponent shall ensure that dust levels within the Gouldian finch nesting aggregation area or 'core breeding habitat' are maintained below the threshold stated in Recommendation 11 unless a more appropriate threshold is determined in accordance with Recommendation 12.

A baseline (pre-mining) and ongoing (during construction and mining) program to monitor the extent of dust deposition over Gouldian finch habitat must be established and implemented to the satisfaction of the NT EPA and the DME prior to the construction phase of the Project. The program must:

- **Be capable of detecting Project-related ground level PM10 dust (above baseline);**
- **Be capable of monitoring the range and extent of Project-related dust;**
- **Ensure that 98% of Gouldian finch core breeding habitat remains below the default Project-related PM10 dust level; and**
- **Include annual reporting of monitoring results and allow for program review.**

A baseline monitoring report is to be provided to the DME and the NT EPA prior to authorisation of the Project.

5.7.2.7 Cumulative impacts on Gouldian finch

There are a number of potential impacts that could, cumulatively, lead to population-level changes in the Gouldian finch breeding population. These are:

- Loss of breeding habitat
- Loss of foraging habitat;

- Poisoning from drinking at contaminated water sources;
- Mortality or reduced fitness due to inhalation or ingestion of dust;
- Mortality from traffic strike;
- Reduced habitat quality and food availability due to changed fire regimes;
- Reduced breeding success due to light and noise impacts;
- Increased competition from more resilient granivorous bird species.

Vegetation clearing and dust impacts have been discussed previously. The NT EPA's independent expert considers that the risk assessment undertaken by the Proponent on the additional risks listed above under-estimated their individual significance and therefore the potential cumulative impacts that could arise as a result of the Project. These arguments are presented in Appendix C of this Report.

Given the significance of the Yinberrie Hills Gouldian finch population, the potential serious risks to the population presented by dust-related impacts from re-opening mining operations, and the potential overall risk to the population when considering the accumulation of other risk sources, whether mine-related or not, the NT EPA considers that an offsets program is necessary. This is considered further in Section 5.7.10 of this Report.

The NT EPA is concerned that further mining impacts in the Yinberrie Hills would place additional pressure on the population and considers that, at a minimum, no further mining activity or related disturbance to the Yinberrie Hills SOCS outside of the current proposed Project footprint, should be authorised for the Mt Todd mine until production associated with the current Project is at an end.

Recommendation 15

Any authorisation of further mining or related activities associated with the Mt Todd mineral leases should not be considered until the NT EPA has been notified and consideration has been given to the activities under clause 14A of the Environmental Assessment Administrative Procedures in accordance with Recommendation 2 of this Report.

5.7.3 Northern quoll

The Northern quoll is a medium sized dasyurid that historically occurred across much of northern Australia. The range extends from Maleny in Queensland through the Northern Territory to the Pilbara region of Western Australia (DSEWPaC, 2011a, Oakwood 2008). The species has undergone severe declines which have been attributed to the spread of the cane toad (*Rhinella marina*) across northern Australia The rate of decline in most areas has been so severe that the species has become locally extinct except for some populations in Queensland which appear to be persisting (Burnett, 1997, Woinarski *et al*., 2008).

The Northern quoll is a generalist in terms of its habitat preference and has been recorded in rocky areas, eucalypt forest and woodlands, rainforest, sandy lowlands and beaches, shrubland, grassland and desert (TSSC 2005). The species does occur in urban areas and is known to occasionally den in built infrastructure (Oakwood, 2008). Former surveys of the site by Lane *et al.* (1990) identified 'scats and active animals' in a variety of habitats during surveys for the Mount Todd EIS in 1990. For the purposes of the EPBC Act, the Australian Government considers that a site contains a population of the species if there is recent evidence (post 1980) of an individual on the site. The capture of a single individual by Lane *et al*. (1990) and the observation of a number of

active animals across five sampling sites confirm that the site did previously hold a population of the species.

Other studies occurring within the Pine Creek area suggest that cane toads colonised the region between 2001 and 2003 (see Doody *et al*., 2009). Previous studies have linked the localised extinction of the species with the arrival of cane toads into suitable habitat (Woinarski, 2004). There is evidence however, that some populations continue to persist in the presence of toads (Woinarski, 2004). Fauna surveys were undertaken on site by GHD between May 2011 and September 2012 using a range of trapping, night-time spotlighting and motion-sensitive cameras. The NT EPA has reviewed the survey methodology and agrees that it is consistent with the Australian Government's Survey Guidelines for Threatened Mammals (DSEWPaC, 2011). While no individual northern quolls were located during the surveys, the species is secretive and can remain undetected despite considerable survey effort (see Woinarski *et al*., 2008).

The draft EIS has identified that the total footprint of the Project will cover 1267.13ha, of this, 608.72ha is undisturbed vegetation with an additional 28.83ha being degraded or modified vegetation. The draft EIS concludes that the Project will not impact any suitable habitat for the Northern quoll due to the site not having any rocky outcrops (GHD 2013b). Consistent with the Australian Government's description of habitat for the species (DSEWPaC, 2011), the NT EPA considers that the Project will remove suitable denning habitat for the species (tree hollows, hollow logs, termite mounds, goanna burrows etc.). While the species is unlikely to still occur on the site due to the presence of toads, the NT EPA acknowledges that there is still potential for it to occur and be impacted. To mitigate the risk to individuals, the NT EPA recommends that the Proponent prepare and implement a pre-clearance procedure which includes measures for salvaging individuals found prior to any clearance of vegetation. The procedure should be implemented by persons experienced in the identification and handling of vertebrate fauna.

The NT EPA acknowledges that there is still a remaining risk to individual northern quolls associated with the clearance of vegetation and operation of the Project. Provided the Proponent implements the commitments identified in its draft EIS and the Supplement, the NT EPA considers that any impact from the Project on the Northern quoll will not be unacceptable.

Recommendation 16

Prior to commencement of activities likely to disturb potential Northern quoll habitat, the Proponent is to conduct pre-clearance procedures to salvage any individual quolls that may be affected and relocate to a pre-arranged recovery area.

5.7.4 Crested shrike tit

The threatened Crested shrike-tit (northern) is the northern sub-species of the Crested shrike-tit complex. The subspecies is endemic to north-western Australia and occurs from the Kimberley division of Western Australia and the north of the Northern Territory (Higgins and Peter, 2002). Current knowledge of the species is limited and is based on the few published location records since the mid-1970s (Woinarski, 2004). Published observations suggest that the subspecies occurs at very low densities and may persist in the landscape as many isolated sub populations (Garnett and Crowley, 2000; Woinarski, 2004).

The majority of the records of the species in the Northern Territory have come from the Mt Todd and the Edith River area, the area south of the Motejinni Station, from Timber Creek east to Old Elsey Station and Mataranka (Higgins and Peter, 2002). Further to this, the draft EIS identified three records of the species occurring within five kilometres of the Project site. Surveys undertaken by the Proponent were consistent with the methods developed by Ward (2009) and the Australian Survey Guidelines for

Threatened Birds (DSEWPaC, 2011b). During the surveys, calls were heard on two separate occasions at two sites (north of the Batman Pit and one possible call from the species to the west of the Batman Pit). GHD (2013b) note that the calls may not have been those of the species and could have been misidentified due to the environment being noisy. The identification of the subspecies on the site previously suggests that it does occur on-site or visits occasionally. Suitable habitat for the species occurs across the Yinberrie Hills which includes the Mount Todd to Pine Creek region (GHD, 2013).

The draft EIS has identified that the mine is likely to result in a cumulative loss of 1497.26ha (including the previous loss of 884.54 and proposed clearing of 608.72ha). The Proponent concluded that the area to be cleared represents only 2.09% of the available habitat for the species in the Yinberrie Hills SOCS and as such, the impacts are not significant. The NT EPA notes that there is no quantified information on the extent of habitat usage by sub-populations of the subspecies within the Yinberrie Hills and it is incorrect to conclude that only 2.09% of the available habitat will be cleared.

The NT EPA notes that the clearing of vegetation presents a significant risk to individuals during nesting. To mitigate the potential risks the NT EPA recommends that the Proponent develop a pre-clearance protocol which includes procedures for identifying and avoiding vegetation where the species is nesting. If the nesting individual is detected during surveys, it is recommended that the Proponent cease works and avoid the area until such time as the nest is abandoned due to natural processes or the young fledge. Given the rarity of this species and its presence in the Yinberrie Hills and possibly on the Project site, the NT EPA recommends that the Proponent consider its possible obligation for offsetting the significant residual impact consistent with the Australian Government's Offset Policy.

Recommendation 17

Prior to commencement of activities that would directly disturb suitable habitat for the Crested shrike-tit, surveys should be conducted and the area avoided if active nesting is found, until such time as the nest is abandoned or any young fledge.

5.7.5 Partridge Pigeon (eastern)

The vulnerable Partridge pigeon is a terrestrial, generally dull-coloured dumpy medium-small pigeon (weight approximately 200g), and is identified by the brightly-coloured red patch of bare skin around the eye. The partridge pigeon is largely restricted to the north-west Top End of the Northern Territory in an area bounded by the Yinberrie Hills in the south, Litchfield National Park in the West, Kakadu National Park in the East and the Tiwi Islands. A number of scattered populations occur elsewhere in the Top End (Woinarski, 2004).

The Partridge pigeon is threatened by changed fire regimes, invasion by exotic grasses as well as livestock. The effect of fire on the species is exacerbated by the nesting period for the species (early dry season) which in the Top End is a time when fires are prevalent (Woinarski, 2004). While the species is highly susceptible to fire, the absence of fire in particular habitats can also affect the movement of the species as well as reducing access to food resources (Woinarski, 1990). Targeted surveys undertaken by the Proponent (GHD, 2013) failed to identify the species on site but noted that it may occur within the MLA on occasions. The species was not identified in previous surveys conducted by Lane *et al*. (1990). The draft EIS states that the Project will result in a cumulative loss of 1497.26ha of habitat for the Partridge pigeon foraging/breeding habitat (*Eucalyptus tintinnans* and lowland woodland habitat).

The Proponent is proposing to undertake fire management on the site by conducting controlled burns during the early dry season. The controlled burns will be conducted in a manner that will create a mosaic of burnt and unburnt patches through the landscape to maintain grass diversity. This approach is consistent with the recommendations of Fraser (2000, 2003) for maintaining/creating suitable habitat for the species. The NT

EPA supports the proposal to undertake patch mosaic burning but notes that the timing of the controlled burns will coincide with the nesting period for the species which could potentially resulting in the loss of individuals.

The Project may introduce new or increase the spread of weeds into suitable habitat for the Partridge pigeon. Depending on the species, weeds can create a monoculture resulting in a reduction of available food for species. Some weed species can also increase fuel load, leading to higher fire intensities. The NT EPA notes that the Proponent has committed to implementing a pest and weed management program to reduce the spread and/or introduction of weeds to the site. Provided this management program is implemented effectively, the NT EPA considers that the Project will not introduce or result in the spread of weeds throughout the site.

5.7.6 Bare-rumped Sheathtail Bat

The Bare-rumped sheathtail Bat occurs across open tropical woodland from Queensland through to western Northern Territory. Observations of individuals from Humpty Doo in the Northern Territory suggest that the species is an obligate hollow-roosting species (Milne *et al*., 2009). The species appears to occur over a range of different habitats and has been observed or collected from swamps, coastal dunes, escarpments and gorges.

Anabat surveys were conducted across the Project site (16 nights during the Dry season, 12 nights during the Wet season) with the aim of establishing a baseline count of bats within the area. The surveys involved the placement of units for one night at each site. The surveys conducted by GHD did not specifically target the Bare-rumped sheathtail bat and concluded that the species was unlikely to occur within the project area as it only occurs in coastal areas. Further to this, wet weather resulted in several periods of failed anabat sampling during the Wet season.

Given the conservation status of the species and the current poor understanding of the distribution and habitat preferences, the NT EPA recommends as a precautionary measure, that the Proponent undertake pre-clearance surveys for any sites that are proposed to be cleared. The surveys should be undertaken by trained experts that are familiar with the accurate identification of microbats.

Recommendation 18

Prior to commencement of vegetation clearing activities, surveys should be conducted by trained experts in the accurate identification of microbats to identify and relocate any Bare-rumped sheathtail bats in the area to be cleared.

5.7.7 Freshwater Sawfish

The Freshwater sawfish is a medium to large elasmobranch that occurs within freshwater drainages and the upper reaches of estuaries in northern Australia. The species is known from several drainages in northern Australia from Western Australia to Queensland. In the Northern Territory, individuals have been recorded from the Keep, Victoria, Darwin, Adelaide, East and South Alligator, Daly, Goomadeer, Wearyan, McArthur and Robinson Rivers (Larson *et al.,* 2006). The species prefers riverine areas, embayments and upper estuaries that comprise muddy or sandy bottoms (Pogonoski *et al*., 2002; Larson *et al*., 2006).

The populations in northern Australia are considered the last viable populations of the freshwater sawfish globally, despite once being distributed widely throughout the Indo-west Pacific region (Last and Stevens, 2009). The species is currently threatened largely through fishing practices and is particularly susceptible to gillnet fishing. Habitat loss and degradation has resulted in the species declining globally (Larson *et al* 2006). The life history of the species also makes it vulnerable to human disturbances (large body size, relatively late maturity and low reproductive output) (Last and Stevens, 2009).

While the freshwater sawfish has not been identified from the Edith or Fergusson Rivers, significant habitat for the species does occur in the Daly River downstream from the Project (Price *et al*., 2002). The closest occupied habitat for the species is located approximately 60 km downstream from the Project where the Fergusson River flows into the Daly River.

The Proponent intends on discharging treated waste water from the mine into the Edith River. If not managed correctly, the discharge or release of waste water from the Project has the potential to degrade the environment in the Edith and Fergusson Rivers. Previous monitoring suggests that the mine site may already be impacting on fish community health in the Edith River (Welch, 2010). The study found that there were higher concentrations of metals in the tissues of fish caught downstream of the mine than upstream. The study concluded that there was a high likelihood that the increased metal concentrations were a result of mining activities on the site (refer to Section 5.8.2). The NT EPA notes that the distance of the sawfish habitat from the Project means that discharges are unlikely to adversely affect populations, habitat or prey for the species.

The NT EPA does have concerns about the eventual closure of the Project and the continued management and discharge of waste water. If closure and maintenance activities are not undertaken correctly there is potential for ongoing contamination of the Edith and Fergusson Rivers and disturbance to habitat for the species in the Daly River if there was a catastrophic failure of waste storage areas. These issues are discussed further in Sections 5.5 and 5.9.

5.7.8 Conclusions

The NT EPA believes that the issuing of an approval for the Project could potentially be inconsistent with Australia's obligations under the Biodiversity Convention, the Apia Convention and the Convention on International Trade in Endangered Species (CITES) with respect to the Gouldian finch. This would largely depend on the ability of the Proponent to demonstrate that monitoring and reactive management measures for protection of the largest known population of the species can be effectively implemented, as discussed in Section 5.7.2. The NT EPA also considers that there is a degree of risk associated with recovery objectives for the Freshwater sawfish and therefore a precautionary approach should be adopted.

Provided the recommendations are implemented by the Proponent for the other species considered in this Report, the NT EPA believes that an authorisation of the Project would generally not be inconsistent with the recovery objectives identified in the following recovery plans:

- National Multi-species Recovery plan for the Partridge Pigeon [eastern subspecies] *Geophaps smithii smithii*, Crested Shrike-tit [northern (sub)species] *Falcunculus (frontatus) whitei*, Masked Owl [north Australian mainland subspecies] *Tyto novaehollandiae kimberli*; and Masked Owl [Tiwi Islands subspecies] *Tyto novaehollandiae melvillensis*;
- National Recovery Plan for the Northern Quoll;
- Recovery Plan for the Bare-rumped Sheathtail Bat; and
- National Recovery Plan for the Red Goshawk.

5.7.9 Listed Migratory Species (Sections 20 & 20A EPBC Act)

A search on the Australian Government's Environmental Reporting Tool (with a 10km buffer) identified the potential presence of the following migratory species listed under the EPBC Act:

(a) Fork-tailed swift (*Apus pacificus*);

(b) Melville cicadabird (*Coracina tenuirostris melvillensis*);

(c) Derby white-browed robin (*Poecilodryas superciliosa cerviniventris*);

(d) Rufous fantail (*Rhipidura rufifrons*);

(e) Oriental pratincole (*Glareola maldivarium*);

(f) Oriental plover (*Charadrius veredu*s);

(g) White-bellied sea-eagle (*Haliaeetus leucogaster*);

(h) Rainbow bee eater (*Merops ornatus*);

(i) Eastern great egret (*Ardea alba*);

(j) Cattle egret (*Ardea ibis*).

The NT EPA has considered the above listed migratory species and notes that while individuals may occur on site on occasions, the numbers would not be considered to represent an ecologically significant proportion and it is unlikely that the mining footprint would contain important habitat. The NT EPA notes that the Project may result in the occasional mortality or injury to individuals of the above species, however these impacts are not considered likely to have population-level effects.

5.7.10 Offsets

The draft EIS concluded in its assessment of risks to the Gouldian finch that the risks were high with respect to the Significant Impact Guidelines. The consequences considered to be of high risk included:

- Long-term decrease in the size of a population;
- Reduction in the area of occupancy of the species;
- Adverse effects on habitat critical to the survival of a species;
- Interference with the recovery of the species.

An additional consequence in the guidelines – modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline – was ascribed a medium risk in the Proponent's risk assessment.

The NT EPA's independent expert included a further consequence – Disrupt the breeding cycle of a population, which was omitted from Table 14-8 in Chapter 14 of the draft EIS (but was present in Appendix N), and considered that the risks of impacts to the Gouldian finch from the Project were not likely to be acceptable.

However, despite the substantial unresolved risks to the Gouldian finch, the NT EPA believes that the Proponent should have the opportunity to demonstrate that it can operate the mine without unacceptably impacting the population. If this can be achieved prior to commencement of mining, then the NT EPA considers that any residual significant impacts to this and other listed species at risk from the Project should be met with appropriate offsets.

Offsets must be considered by the Proponent in the context of meeting the requirements of the Australian Government's *EPBC Act Environmental Offsets Policy, October 2012*.

Recommendation 19

Appropriate offsets for potentially significant impacts to the Gouldian finch population of the Yinberrie Hills must be implemented by the Proponent in

accordance with the Australian Government's *EPBC Act Environmental Offsets Policy, October 2012.*

5.8 Biodiversity and species of conservation significance

5.8.1 Adverse impacts from lighting

There is potential for artificial light, noise and vibration from operations to result in adverse impacts to some species occurring on the site. These may include nocturnal mammals such as rodents, marsupials and bats. The draft EIS has stated that it will mitigate the potential impacts of artificial light by implementing the following measures:

- Limiting artificial light to areas actively required at any given time, and turning off lights not required;
- Ensuring that artificial lighting does not point upwards or laterally;
- Use of lower rather than higher lighting installations;
- Avoid the use of light into natural habitats;
- Using lighting intensities that are as low as possible without affecting safety or efficiency; and
- Avoid painting large structures bright colours.

The NT EPA has considered the above measures with respect to general biodiversity and agrees that for most species they would be adequate for ensuring that lighting from the mining operation would not result in adverse impacts. However, there remains some concern that lighting could impact on the adjacent Gouldian finch nesting area. Although this is unlikely to be significant on its own, cumulative impacts to the largest known population of the finch must be considered as discussed previously.

5.8.2 Impacts to the aquatic environment

The Daly River catchment is a significant area for its aquatic biodiversity. The catchment comprises a diverse variety of habitats ranging from gorges, spring fed rivers and creeks to significant areas of estuarine and mangrove systems (Schult and Townsend, 2012). The catchment boasts the highest diversity of freshwater turtles in Australia and provides important habitat for several locally significant species, including the Strawman (*Quirichthys stramineus*), Freshwater whipray (*Himantura dalyensis*) and Freshwater sawfish (*Pristis pristis*).

As discussed previously in this Report, historic operation of the Mount Todd site has resulted in the discharge of metal-laden, acidic water to the Edith River:

The draft EIS notes that trace metals such as Zinc, Cadmium and Copper from AMD are toxic at extremely low concentrations and could suppress algal growth subsequently affecting fish and benthos (see Hoehn and Sizemore, 1977). It is the toxicity of these metals that determines the dilution rates required for discharge from RP1, RP3 and RP7 to achieve an 80% species protection under the current WDL.

Monitoring shows some influence of mine discharge on Zinc, Copper and Manganese levels in sediments. An impact on macroinvertebrates has not been detected, although as noted in Section 4.1.3, past monitoring programs may not have been capable of detecting any impact. Improved monitoring conducted in the 2013 Dry season detected some statistical differences in downstream macroinvertebrate populations compared to reference sites, but conclusions on the causes of such differences cannot be made with certainty.

The draft EIS concluded that the potential impacts of activities that have occurred in the past have been very short-term and do not indicate a long-term effect.

A study by Welch (2010) along the Edith River concluded that previous mining operations at Mt Todd were influencing the presence of metals in the tissue composition of fish samples. The report concluded that metal levels were higher in fish sampled from below the mine when compared to those above. The report notes that further studies would be required to determine the implications of elevated levels of metals on fish physiology and recommends that further studies be undertaken to identify the potential mechanisms for metals to transfer from the water column to fish tissues (i.e. the bioavailability and biotransfer up the food chain).

Proposed water management, including the treatment of AMD prior to discharge, is discussed in Section 5.6. The effective management of the site water inventory to avoid uncontrolled overflow from retention ponds and controlled discharges that meet appropriate water quality criteria is expected to mitigate impacts on the aquatic environment to an acceptable level. Monitoring will need to be maintained to ensure that this remains the case (refer section 5.6.2).

The Proponent stated that the WTP would remain in-situ following the cessation of mining activities until such time as waste streams originating on-site could be treated through passive wetlands (discussed in Section 5.9.3). The NT EPA has concerns that further detail of the design, expected level of treatment or contingency measures for failure have not been provided in the EIS. If the Proponent is unable to successfully implement the required measures post-closure to contain or treat waste water from the site there is a risk of long-term environmental degradation to the ecosystem within the Edith River and downstream.

5.8.3 Risks to semi-aquatic threatened species

A number of species of conservation significance have been identified during surveys by GHD (2013b) and Lane *et al*., (1990). Of note is the presence on the site of three species of semi-aquatic monitor lizards listed as vulnerable under the TPWC Act, in particular: the Floodplain monitor (*Varanus panoptes*), Merten's water monitor (*Varanus mertensi*) and the Mitchell's water monitor (*Varanus mitchelli*). These species are threatened through lethal toxic ingestion by toads. The NT EPA notes that their presence at a particular site may not necessarily reflect the health of the environment given that all three species historically occurred in degraded, urbanised and modified landscapes (see Doody *et al*., 2014; Griffiths and McKay, 2008, Schultz and Doody, 2004). Provided adequate prey, refugia as well as the aquatic health and diversity within adjacent riverine and floodplain areas can be maintained during the Project then impacts to Merten's water monitor and Mitchell's water monitor are not considered likely. The absence of *V. panoptes* from recent surveys (GHD 2013b) suggests that the species has been extirpated from the site most likely in response to the colonisation by toads. Studies by Doody *et al.* (2009) suggest that declines would have occurred between 2001 and 2003 when toads arrived in the Pine Creek region, which would have occurred after the initial survey by Lane *et al*. (1990). Should the floodplain monitor recover and occupy the site in future, the NT EPA notes that there may be a risk of operational impacts on individuals but those impacts will not be significant for the species in the Northern Territory.

5.8.4 Hydraulic connectivity

The Project will alter the existing hydrologic conditions in Stow and Horseshoe Creeks. The draft EIS has identified that a diversion channel will be placed within Stow Creek and could potentially impact on fish passage to a section of creek 20km upstream. The draft EIS has raised concern about connectivity and notes that the hydraulic assessment has only provided modelling for a 100yr, 24hr event. No information was provided on the 'normal' flow conditions. Further to this, the NT EPA notes that construction of the

channel may result in a loss of in-stream habitat for aquatic fauna. This includes the removal of riparian vegetation which is important for riverine processes, habitat creation and bank stabilisation.

To mitigate the potential impacts from the channel diversion, the Proponent is proposing to implement the avoidance, mitigation and rehabilitation measures outlined in Tables 14-18 to 14-23 of the draft EIS. The NT EPA has reviewed the measures outlined in the draft EIS and considers that they will be adequate to avoid impacts, maintain aquatic health or rehabilitate disturbed areas. The NT EPA supports the development and implementation of a Stow Creek and Horseshoe Creek Revegetation Plan and recommends that it be implemented until disturbed sites have been adequately rehabilitated.

In addition, the NT EPA supports the approach by the Proponent to implement an appropriate macroinvertebrate monitoring plan which includes measures to monitor the surface water mine impacts on biological communities of the Edith River. This plan should include Stow Creek, Horseshoe Creek and other tributaries adversely affected by mining activities. The monitoring plan should include measures that are consistent with best practice and allow for comparison over the life of the mine.

5.8.5 Noise generated by mining and processing activities

The draft EIS acknowledges that the Project will generate noise during construction and operational activities and has identified that there is potential for levels to exceed noise and vibration criteria at the nearest sensitive receptor. The sources of noise for the Project are likely to come from plant and machinery as well as pile driving during construction activities. Other noise on the site will be produced by vehicles, the power station and plant (crushers, screening plants, conveyors, HPGR mills etc.). A significant source of noise and vibration is likely to come from in-pit blasting.

The NT EPA notes that the impact of noise and vibration on the site is likely to vary depending on the activity being undertaken at the time. The draft EIS states that noise and vibration produced during construction and operation are expected to comply with nominated criteria. The Proponent has undertaken a literature review of the potential impacts of noise and vibration on native fauna. The summary of the review suggests that initially fauna may avoid the area or alter behaviour in response to new or increased noise/vibration but will return and adapt to increased activity and noise on the site. While the draft EIS has not addressed taxa most likely to be affected by noise and vibration (i.e. frogs and birds), the responses of birds to intense noise varies greatly with some species declining whilst others remaining in high densities. The response of the bird assemblage within the Project area to construction and operational noise was not quantified in the draft EIS, however, the Proponent has concluded that fauna on-site are unlikely to suffer significant impacts.

The NT EPA considers that there may be some risk to Gouldian finches in breeding habitat adjacent to the mine from mine-generated noise levels and would potentially contribute to cumulative impacts on the population as discussed in Section 5.7.2.7.

The NT EPA notes that anurans are the other taxa affected by construction and road related noise in some areas (Hoskin and Goosem 2010). The NT EPA has reviewed the results of the fauna surveys (see Appendix 10 of Lane *et al*, 1990 and GHD, 2013) and notes that the anurans identified in the surveys are widespread and common in the Top End and therefore population level effects would be unlikely.

5.8.6 Risks from fires on biodiversity

The draft EIS notes that there has been no analysis of the effect of wildfire on areas of habitat in the Project area or the greater Yinberrie Hills. The Proponent notes that currently controlled burning is carried out during the early Dry Season. This regime has

been adopted in the Project area since the initiation of mining at Mt Todd. The Proponent intends on maintaining this burning regime.

The draft EIS identified the presence of the Pale field-rat on-site in low numbers (n=6). The species is listed as a vulnerable species under the *Territory Parks and Wildlife Conservation Act* and has declined in the Northern Territory through what is thought to be inappropriate fire regimes and predation by cats (Young and Hill, 2012). The draft EIS suggested that the low numbers of Pale field rat on site is a response to inappropriate fire regimes on the site. The Proponent has stated that with better planning with regards to asset protection and management the need to conduct controlled burns may be reduced. The Proponent has suggested that this may favour the Pale field rat.

The draft EIS claims that the existing burning regime appears to be sufficient for the Gouldian finch on-site and may increase the habitat suitability for species such as the Australian bustard, which prefers open areas. However, the difficulties of determining the success or otherwise of fire regimes on fauna such as the Gouldian finch are noted previously in this Report. Inappropriate burns are likely to affect Gouldian finch foraging habitat and possibly nesting trees with consequences for this population. This would require careful management to ensure any wildfires did not originate as a result of mining activities. Contributions to fire management in the larger Yinberrie Hills SOCS could be considered as an offset for the Project (Section 5.7.10).

5.8.7 Invasive Fauna

Surveys undertaken by Lane *et al* (1990) and GHD (2013b) identified the following threatened species occurring either in or around the Project site:

- feral cat (*Felis catus*);
- cane toad (*Rhinella marina*) [previously *Bufo marinus*];
- feral donkey (*Equus asinus*);
- feral horse (*Equus caballus*);
- house mouse (*Mus musculus*);
- feral pig (*Sus scrofa*); and
- Dog (*Canis lupus*).

The Proponent notes in the draft EIS that the study area has relatively minor feral animal problems but notes that there is potential for significant impacts from pigs in lowland and riparian areas. Given that the site is disturbed from previous mining operations, the Proponent concluded that future mining activity would be unlikely to result in greater feral animal populations or increases in the number of animal species on the site.

To reduce the incursion of species such as the black rat (*Rattus rattus*), the Proponent has stated that it will be implementing standard waste management measures on the site. The Proponent has stated that future incursions by additional exotic species will be regularly monitored and incursions eradicated. The NT EPA supports this approach to managing invasive species but would prefer that the Proponent attempt to monitor numbers of invasive species in the Project area. If invasive fauna reaches a density where they become harmful to aspects of the environment, the NT EPA recommends that the Proponent implement feral pest management/eradication programs.

Recommendation 20

The Proponent is to undertake regular monitoring of the mineral leases for exotic fauna species and implement control measures should the densities become a risk to biodiversity.

5.8.8 Invasive Flora

The draft EIS notes that 17 species of introduced flora have been recorded from the mineral lease. Of the species found, eight are listed as either class A or B species under the *Weeds Management Act* and therefore require management. Construction and operation activities on the site may result in the introduction of new species or lead to the spread of existing infestations around the mine site.

Of the species identified on the site, Gamba Grass (*Andropogon gayanus*) and mission grass (*Pennisetum polystachion*) pose the greatest risk to the biodiversity both within and around the site. These species increase the available fuel load resulting in a higher fire risk and intensity. More frequent and intense fires have been reported to cause significant changes to the diversity and structure of vegetation (Csurhes and Hannan-Jones, 2008).

The draft EIS notes that current infestations of weeds occur along the interface between cleared areas and bushland with intact vegetation mostly weed free. The Proponent has stated that it will develop a Weed Management Plan which will include measures for preventing and controlling introduced flora from being brought to the mine site or colonising un-infested areas. This will include:

- protocols for the movement of people and machinery around the mine site and to and from the mine site;
- management of soil stockpiles to prevent sediment and / or weed transfer into adjacent areas of vegetation;
- management of water and sediment movement across the site;
- protocols for sourcing soil and other earthen materials from offsite (where required);
- vehicle washing and inspection protocols for vehicles coming onto the mine site;
- quarantining of materials (e.g. clay) imported to the site known or likely to contain seeds of introduced flora;
- continuation of active weed control measures at the mine site; and
- surveillance of the greater mine area for newly established infestations.

The NT EPA has considered the proposed mitigation measures and the management strategies outlined in the draft EIS and agrees with the development and implementation of a Weed Management Plan. The Plan should be prepared in consultation with the DLRM and be consistent with all relevant policies and procedures. Provided the Proponent implements the avoidance, mitigation and control measures outlined in the management plan, the potential risks of weeds on biodiversity can be suitably addressed.

5.9 Mine closure and rehabilitation

5.9.1 Climate (rainfall regime)

The climate regime is not only the determinant for operational water management, but most particularly for designing mine site waste management structures that will be sufficiently stable over the long term. The latter is especially important in the current context given that these structures will be expected to sustainably encapsulate reactive

sulfidic waste in perpetuity. The key consideration is that of the design lifetime of a structure. The design lifetime in the monsoonal tropics will be largely dictated by the time over which a structure can withstand the erosive forces of the seasonal rain, before it fails. A design lifetime of 200 years is typically considered for mine landforms, with this period having precedence for closure planning in the Northern Territory.

In this context structures are generally designed to withstand an extreme event with a certain probability of occurrence. In the Mt Todd EIS a 1 in 100 year ARI was selected as the "design event" and this was specified as the event that needed to be accommodated, for example, by the creek diversion channel and other structures on site. In particular the proposed TSF2 would encroach on the 100-year ARI design flood extent, with the design including diversion channels and levees along Horseshoe Creek and Stow Creek to protect the embankment from flooding and erosion.

The critical question is whether a 1 in 100 year ARI event is appropriate to use for both the operational period and beyond. Whilst substantial post-event repairs to structures may be possible whilst the site is operating, this would not be the case post-closure. A recent analysis (Logsdon, 2013) showed that in order to have a greater than 90% confidence in an extreme event not occurring in any one year for a proposed engineering design life of 200 years, a 1 in 2500 year ARI event would need to be factored into the design process.

The NT EPA considers that the Mt Todd mine site presents a serious risk to the environment in the long term and a more appropriate ARI would need to be specified for structures such as the WRD, the TSFs and creek diversions that must endure and maintain functional integrity long into the future. In adopting a more robust design life for these structures, climate change uncertainties would need to be factored in, as discussed in Section 3.1.2 of this Report.

Recommendation 21

The Proponent must factor into the design of its above-ground waste structures an appropriate design lifetime to the satisfaction of the DME to ensure that structures will be sustainable into the long term, taking into account the uncertainties of climate variability.

5.9.2 Closure of Batman Pit

The EIS and pre-feasibility studies have stated variously that a poor-quality pit lake is not predicted and that active dewatering of the pit water would be unnecessary.

The draft EIS (Chapter 11), however, predicted that a pit lake would form in the Batman Pit after mine dewatering ceases based on post-mining groundwater flow modelling. The predicted water balance for the pit lake through the 500-year simulation period showed that the simulated pit lake water level would rise relatively rapidly following cessation of pit dewatering and after 345 years would reach approximate steady-state, at an elevation of approximately 15m AHD, approximately 170m below the pit crest and approximately 420m deep. The extent of the equilibrated pit lake water surface was predicted to be 66ha and the volume predicted as 83.8ML.

However, the modelling that was reported in the main draft EIS document stated that groundwater inflows and outflows would be negligible, and therefore groundwater inflows were not included in the model. More recent work indicates that groundwater inflow could vary between a few litres per second and 31L/s over the operational phase of the mine. Further it was stated in Appendix I that discrepancies were noted to exist between modelled and reported areas of development footprints for the pit. The mine plan has been altered since modelling was undertaken and the pit dimensions have changed substantially, particularly with respect to depth. It was stated in Appendix I that "*The underestimation of pit area by the Goldsim model may result in an underestimate of the pit wall area and ponded water area whilst overestimating the area of catchment runoff.*

This will result in a significant underestimate of pit inflow due to the differences in unit runoff depth. Therefore a water balance on an expanded pit is likely to change the assumptions regarding required transfer rates to the WTP from the pit and possibly transfers from other areas of the mine".

The apparently contradictory information that was presented in the draft EIS chapters and the supporting Appendices about what was or was not included in the water balance for the pit increased the uncertainty about the proposal. The NT EPA requested that the final version of the model presented in the Supplement represent in full the critical drivers that would apply to the development scenario.

In response, the Proponent confirmed that the critical drivers for the pit closure water balance included groundwater inflow to or outflow from the pit as well as direct precipitation, runoff from the pit walls, evaporation from the water surface in the pit, and evaporation from the pit walls. The Proponent indicated that an updated site-wide water balance model would include the increased footprint of the Batman Pit and the resultant stormwater and groundwater inflows as part of the DFS.

It would be beneficial if the Proponent could demonstrate that it has genuinely considered and evaluated other options for the pit, rather than presenting the poor quality pit lake as the only alternative. For example, the pit could serve as a final repository for tailings (as discussed previously), which, although probably still leaving a pit lake, would remove some of the surface issues on the site. Rapid flooding of the pit (by catchment diversion), if this was hydrologically feasible, would likely produce a quality of water that was better in the shorter term, but which would subsequently deteriorate via wash in of leachate from the sulfidic wall rock.

The placement of potentially acid forming material in the base of the pit where it will be submerged under metres of water to stop oxidation reactions will be a superior outcome compared with construction of an engineered soil cover that may fail in the future (DITR 2006).

The Proponent considered the economics of backfilling the pit post-closure and determined it to be uneconomic, which is briefly discussed in Section 5.4.3.

The NT EPA considers that changes to the pit dimensions as a result of alterations to the mine plan, and a predicted increase to ground water inflows, would likely change the pit lake volumes at equilibrium and the time to equilibrium. The EIS did not clarify the impacts of these changes and deferred further modelling to the DFS (see comment 67 in the Supplement).The NT EPA considers that further options to improve water quality in the pit should be considered if the pit cannot be backfilled. However, backfilling of the pit with at least some of the waste rock and/or tailings should be considered further by the Proponent.

Recommendation 22

The Proponent must consider in detail the costs and the benefits of backfilling the pit with PAF waste rock and/or tailings and an appropriate cover at mine closure in accordance with leading practice mine closure principles. The benefit/cost analysis should include partial backfilling scenarios through disposal of the more reactive material as well as the full backfilling option. Details should be provided to the DME.

Recommendation 23

Consideration must be given in the conceptual closure plan to methods for improving the water quality of the pit lake after closure if backfilling cannot be achieved.

5.9.3 Post-closure water treatment

Water Treatment – Active

It is stated upfront in the EIS that the total project life will be 19 years, of which the final 4-5 years will be devoted to closure. However, upon reading the details of active water treatment requirements at the end of operations it is apparent that this may require 10 years or more before the proposed passive treatment systems will be able to cope with the volumes and nature of water requiring treatment.

The NT EPA requested the Proponent clarify the active water decommissioning as it could substantively increase the length of active management of the site and thus the full project life.

The Proponent indicated that the active water treatment system was predicted to be operational for four years following the end of mine operations but would further refine this once seepage analysis was available from the DFS. Additionally, the Proponent committed to continuing active waste treatment until the effectiveness of the passive water treatment was proven.

The NT EPA considers this an acceptable approach.

Water Treatment – Passive

It is proposed that up to three passive treatment systems will be phased in during the later stages of operations and into the closure period. Passive treatment systems can be attractive but there are some substantive limitations. The draft EIS failed to provide reassurance that the proposed treatment wetlands would likely be viable, especially after the site was decommissioned. From a biogeochemical and biological perspective, the current international “state of the art” for use of wetlands to treat minewaters indicates a good probability of intermediate term (i.e. 5-10 year) success for surface flow wetlands treating water with starting pH values in excess of 6; so called “circumneutral” mine waters. The drawdown seepage from the TSFs could meet this criterion.

However, the use of passive treatment systems for the sustainable treatment of high intensity (pH < 3.5) AMD over long periods of time has been problematic, based on experience over the last 2-3 decades in the United States where much of the development and testing of passive treatment technology for minewater has been done. The reason for this is that the sulfate-reducing systems on which these systems are based require periodic re-charging with large amounts of organic carbon, typically in combination with added limestone to raise the pH sufficiently so that the sulfate-reducing bacteria can survive. Subsurface or vertical flow systems are also prone to hydraulic clogging as a result of the precipitation of iron and aluminium hydroxides.

Another major factor that must be considered is the availability of sufficient water to sustain the operational footprint area of a wetland. Given that evaporation substantially exceeds rainfall for all but a few months in the northern monsoonal tropics, it is essential that any wetland can be sustained through the long Dry season. No evidence was presented in the EIS to suggest that wetlands would be hydrologically viable. If a wetland dries out then not only will its biological assemblage be damaged but there is a high probability of re-oxidation of diagenetic sufides in the wetland bed, resulting in an acidic and metalliferous first flush the following Wet season. Subsurface wetlands could potentially be more viable if located immediately downstream of a seepage source, noting the geochemical issues raised above.

The NT EPA requested that a more technically convincing case for the viability of passive treatment systems as a sustainable post-closure seepage treatment option be presented, given the critical importance of this strategy for mitigating post-closure water quality issues.

In the Supplement, the Proponent responded that passive treatment is an acceptable method for the treatment of AMD and successes were well documented at the recent International Mine Water Association conference (IMWA) 2013.

The NT EPA's independent expert, Dr David Jones, advised that passive treatment wetland systems have proven to be problematic for lower pH waters (below pH 4) of the type likely to be produced at Mt Todd. Dr Jones had personally attended all of the wetland treatment presentations at the IMWA 2013 conference in Golden Colorado during the EIS review period. The reports of longer term treatment success stories were all for circum-neutral pH mine drainage. At the conference, Dr Jones had out of session discussions with both the leading developers of wetland technology and with regulators. The consensus was that both groups had significant reservations about the use of passive treatment systems to sustainably treat low pH mine water.

Substantially more evidence was subsequently provided by the Proponent to support the potential efficacy of passive or semi-passive wetland treatment for the Mt Todd type of AMD (Tetra Tech 2014), in particular, the consideration of likely acid loading as a critical factor affecting the potential use of a microbiologically-based passive treatment system. The water quality for RP1 in November 2011was used as the "worst case" loading for the analysis. This was claimed by the Proponent to be below the 300mg/L total equivalent acidity considered to be the upper limit for successful implementation of passive treatment technology. However, the NT EPA advised caution in assuming that this was the worst case for seepage from the WRD as reference to the RP1 water quality summary statistics between 2008 and 2011 for various locations in RP1 (Appendix J of the draft EIS) suggested that substantially higher loadings could occur.

The concentrations that are found in seepage will depend on antecedent rainfall conditions, noting that there was a succession of well above average Wet seasons in recent years, with associated dilution. Additionally, caution should be applied given the low seepage rates that were predicted to occur from the WRD post-closure. If this was validated, solutes would potentially become more concentrated during the long passage of seepage water through the dump. This latter effect is not necessarily well simulated by kinetic leach testing (humidity cells or columns), depending on the liquid loading that is used.

It should be noted that the use of initial post-closure seepage to "prove" treatment capability can be very misleading as the quality of such seepage typically deteriorates substantially following emergence of a breakthrough front from the toes of WRD's etc. There are many examples of this having occurred at decommissioned mine sites in the Pine Creek Geosyncline.

Several case studies for implementation and testing of passive treatment methods with similar likely rates of seepage were provided by the Proponent. Whilst this was considered useful, the likely problems to be posed for passive treatment in the NT, with its very pronounced wet and dry annual cycles, could have been more specifically addressed.

Given the potential for significant issues to develop over time with the magnitude of long-term sources of AMD at the site, there remains considerable unresolved risk of the development of post-closure issues and the NT EPA cannot be confident that this would be manageable under the currently proposed scenario. Further analyses will be needed of the options that would be available and likely to succeed in the Mt Todd site context at decommissioning. Active treatment of mine water will need to continue until such time as a viable, long-term passive treatment option is identified.

Recommendation 24

The Proponent must undertake further analyses and trials of options for passive water treatment during mining to ensure that such treatment options can meet the

95% species protection level for the receiving environment into the long term without periodic assistance.

Recommendation 25

Active water treatment is to continue at the mine site until such time as it can be demonstrated that successful treatment of all site AMD using passive treatment options is occurring in accordance with Recommendation 24.

5.10 Socio-economic impacts

5.10.1 Economic impacts

The Project is likely to create economic benefits for the regional community. Some of the benefits described in the EIS included:

- Rehabilitation/remediation of the existing problems on the mine site;
- Supply of skills to the Katherine region through education and training;
- Increase in worker lifestyle opportunities associated with financial benefits;
- Local businesses benefit from flow-on effects associated with accommodation demand, services, trades etc. with additional spending in Katherine and Pine Creek;
- Increased demand for long-term housing leading to additional housing in Katherine with creation of construction jobs; and
- Increased employment opportunities.

The projections of economic benefits are of course subject to the gold price, which at the time of the economic assessment was US$1400 an ounce. In the Proponent's own words, "*The mine economics are very dependent on the spot price of gold. Before a decision is made to proceed with the project, economics will need to be robust*". The gold price has since declined and has been hovering between $1200 and $1300 an ounce, a level that has the Project sitting on an economic threshold.

There have been many instances of mining companies in the Pine Creek Geosyncline, particularly the smaller miners, being forced into early closure or care and maintenance due to gold prices, with the Mt Todd mine itself having experienced this previously. This suggests that the projected benefits for a project such as this could be overstated and the implications to potential beneficiaries such as Katherine businesses and the Jawoyn people due to unforeseen early closure could outweigh the short-term benefits.

Even if the gold price improved and remained high enough to maintain the economic viability of the mine throughout the projected mine life, the potential costs of the mine site post-closure would still need to be accounted for into the long term.

The NLC provided an interesting analysis on behalf of the Jawoyn Association of the potential costs associated with retaining the WRD as a feature on the landscape in perpetuity as opposed to returning waste rock to the pit. The NLC acknowledged that the immediate costs of backfilling the pit at the end of mine life would be uneconomically high, as claimed by the Proponent. However, there appeared to be little consideration in the EIS of the costs to the community, government and the environment of retaining the WRD, which were indicated by the NLC to typically include:

- 'Opportunity costs' associated with the loss of potential future usage or productivity of land and water affected by the presence of the WRD and the impacts of any releases of AMD;

- ‘Maintenance costs’ relating to ongoing management and maintenance of the WRD and systems constructed to manage, control and treat any releases of AMD, which would likely escalate with time as the WRD began to deteriorate; and
- ‘Future rehabilitation costs’ associated with investigation, repair and cleanup of the surrounding environment should it be affected by chronic AMD or other contamination in the long-term, which would also escalate with time.

The high variability of these costs, which would be dependent on the impacts and the value of the land and waters impacted, represent a considerable source of uncertainty and would be transferred from the Proponent to the community and/or Government once the mine was closed and the closure certificate issued.

The potential costs following closure are difficult to define and represent an ‘open-ended’ problem. This makes them difficult to manage. The Proponent appropriately indicated that it would be impractical to apply financial resources indefinitely to address rehabilitation matters. However, this presupposes that all potential options for design and construction of the site during the feasibility and planning stages were considered. The NT EPA contends that alternative options for the WRD design were not properly considered and this represents one of the largest sources of uncertainty for the environment into the long term.

In the absence of alternative and potentially more ecologically sustainable designs, compromises would be required if the WRD is to remain on the surface in perpetuity. This could include increasing the rehabilitation bond, although a more thorough appraisal of opportunity, maintenance and future rehabilitation costs would be required to inform the likely economic impact of retaining such a structure.

One respondent to the EIS suggested that the lower production scenario should be considered by the Proponent. The draft EIS considered two scenarios; a 30 000 / 33 000tpd ore processing facility and a 50 000tpd ore processing facility; one with a 13 year mine life and the preferred option with a 17 to 19 year life. It was suggested that the lower levels of ore processing would generate less waste and requirements for TSF capacity and water processing, as well as provide maximised returns and operating margins.

Another scenario was considered by the NT Government with the preparation of a document outlining strategies for the remediation of the Mt Todd mine site in the event that the site was not reactivated by a new operator and the NT Government was fully liable (DoR, 2011). The remediation strategies were costed with the preferred strategy involving water treatment, backfilling of the Batman Pit with most waste material and in-situ remediation of the remaining lower risk material. This strategy would reportedly provide higher levels of long-term environmental protection and the greatest likelihood of returning the site to its pre-mining condition while also potentially having the lowest ongoing maintenance and monitoring cost. It was estimated at that time to cost $141 million over 6 – 7 years.

Although the costs appear to be high, they can be contrasted with the calculations undertaken by the Proponent with respect to the backfilling of the Batman Pit at the end of the projected mine life (Section 5.4.3) or the uncertainty regarding the longer-term implications of leaving the mine site with large, above-ground structures of uncertain geomorphic stability (Section 5.5). The down-side of this proposal could be considered the opportunity cost for future mining proponents of sterilising the gold resource.

The Proponent and Government would need to carefully consider the economics of commencing an expansion of the Mt Todd mine and weigh up the potential short term economic benefits against the potential for longer-term costs as a result of mine design and economic issues.

5.10.2 Human health

The draft EIS identified that contaminated surface water from the mine could lead to the bioaccumulation of heavy metals up the food chain and attributed a rating of 'High' to this risk (possible occurrence with major consequence).

As discussed in Section 5.8.2 of this Report, a study by Welch (2010) found that the concentration of some metals (Cadmium, Copper and Zinc) in the tissue samples of fish caught in the Edith River downstream of the Mt Todd mine site were higher than levels found in fish caught in the Edith River upstream of the mine. Metal levels exceeded the human consumption guideline levels in several cases; however, the author noted that "*the actual risk to humans consuming these foods would need to be put into context of the specific dietary intakes, gender, age and lifestyles of people who would regularly consume fish from the area*". Further to this, "[t]*he likelihood that the amounts of fish tissue required to consistently exceed the guidelines are achievable also needs to be considered, as capture rates required may not be sustainable in a system such as the Edith River*".

Welch (2010) concluded that while low, there was some risk to human consumption of fish livers sourced from downstream of the mine site but noted that the amount of liver tissue required to exceed tolerable weekly intakes was unlikely given the small size of the livers (<5 grams (g) each). The lowest threshold was cadmium at 38g per week; however, the author noted that this was unlikely to be reached due to the remoteness of the site and the need for an individual to consume the livers from at least 6-8 fish every week. The report recommended that fish surveys and tissue metal analyses should continue along the Edith River at a frequency of every 2-3 years, or more often if there were any substantial increases in concentrations/loads of metals entering the river from the mine site.

A subsequent report by Food Standards Australia New Zealand (FSANZ) assessed results from fish sampled from the Edith and Daly Rivers in January and February 2012, with the Daly River used as a control site. The objective of the FSANZ assessment was to determine whether consumption of fish from the two rivers might pose a risk to human health. Samples from the Edith River showed elevated levels of some metals in fish flesh and livers, but when calculating the amounts of fish flesh or fish liver that would need to be consumed on a daily basis to exceed health based guidelines, the report concluded that these amounts would be in excess of the amounts likely to be consumed (FSANZ 2012).

Several respondents to the draft EIS highlighted concerns regarding the potential impact of bioaccumulation of metals in fish and related risks to human consumption, with one respondent highlighting the need for reassurance on the safety of local fish stocks to avoid the erosion of local Aboriginal hunting and fishing practices. Respondents recommended that the Proponent commit to establishing, or contributing to, a monitoring program that informed the community on the risk of consuming fish and other aquatic from the Edith River.

The Proponent responded to these concerns in the Supplement by discussing the findings of the FSANZ report but did not commit to further studies. The Proponent did not acknowledge the existing public commitment it made to conduct a fish study following the 2012-13 Wet season.

The NT EPA recognises the challenges involved in undertaking such studies and communicating their results. To be most informative, studies need to be aimed at species that are actually consumed, but obtaining a sufficient sample size of such species may be challenging. Care is required in interpreting results and expressing conclusions regarding the source of any heavy metal levels found given the difficulties in establishing true reference and impact sites for comparative purposes (due to the

mobility of fish and other species) and the absence of a good understanding of regional metal levels in fish as a guide to what levels fall within expected concentrations.

The NT EPA accepts, however, that this risk is of significant concern to the community, particularly those who rely on the Edith and Daly Rivers as a food source or for recreational and commercial fishing. There is a genuine need to maintain public confidence that the food we consume is healthy. This is not solely the responsibility of the Proponent as there is a role for government to play.

Studies to determine the risks to human health from consuming fish and other aquatic species caught in the Edith and Daly Rivers would therefore be best pursued on a collaborative basis between the Proponent and relevant government and non-government stakeholders, drawing together the necessary expertise and resources.

Recommendation 26

As part of the Project aquatic monitoring program, the Proponent must contribute to periodic tissue sampling of fish and other species from the Edith and Daly Rivers to monitor edible species and inform human health risk assessments.

5.10.3 Amenity

This issue is primarily associated with the 350m high (approximately 470m AHD) WRD that would be, as described by some respondents, as high as Uluru (Ayer's Rock). In the context of the topography of the Mt Todd mine site and surrounds, where the highest feature is Mt Todd itself rising approximately 100m (230m AHD) from the surrounding lowlands, this 'unvegetated' WRD would be a significant feature on the landscape.

The final design of the WRD based on further investigation, as discussed and recommended previously in this Report, must take into account tourist values of the region as well as the sentiments of the local community and Jawoyn people.

5.10.4 Inter-generational equity issues

The NT EPA considers that with an authorisation of this Project, there is a risk that the Mt Todd site will either return to care and maintenance or close ahead of schedule.

However, the DME would impose a security bond requirement on the Proponent, calculated on an annual basis and required up front. This bond is likely to be significant. The purpose of the security bond is to manage the risk to government and the community in the event that remediation and rehabilitation would be required due to an early closure. The security bond is not an alternative to mitigating the environmental risks of the Project.

It should be noted that once the Proponent has been issued a closure certificate, no claim against the company to recover costs associated with future maintenance of waste structures or rehabilitation following environmental impacts would be possible. If, after closure, environmental issues created by the mine expansion were not fully resolved and were to continue or worsen, the environmental and economic risks would transfer to the public and government. It is incumbent upon the regulator to ensure that residual issues associated with the site have been adequately addressed prior to relinquishment of the security.

It should also be noted that the legacy issues at the current site have improved since the water management was transferred to the Proponent. It is usually preferable for the costs of remediation and rehabilitation to be carried by industry as opposed to government and the community. However, the NT EPA, regulators and the community must be confident that further mining at the site would not create larger problems that continued to impact the environment and stakeholders for years to come and in fact would lead to improved outcomes for management and remediation of the site.

The uncertainties associated with the long-term stability of waste structures on the site and the risks of ongoing, long-term impact to the downstream environment from contaminated leachate and runoff are considered significant issues for the Project. In contrast, there is considerably more certainty presented by the potential for remediation of the site in the short to medium term without serious risk of exacerbating current issues.

The potential impacts to the Yinberrie Hills Gouldian finch population is a key consideration for government and the community. As stated previously in this Report, the mine has the potential to affect not only individual birds but the entire known Yinberrie Hills population.

The Proponent must demonstrate that impacts to this population can be managed to an acceptable level. The value of this population and possibly the species as a whole to the community, not just regionally but internationally, must be considered. Irreversible declines of the species attributed to the mining operation would reflect badly on the Proponent and the NT Government decision makers and ultimately the recovery of one of Australia's iconic bird species could be seriously jeopardised.

The key issue associated with the Mt Todd Project is one of uncertainty. For some aspects of the Project, the Proponent is yet to adequately demonstrate that the mine can be expanded while reducing the risk of long-term impacts to important receptors.

In this context, the Proponent needs to demonstrate that the principles of ESD, that are, inter- and intra-generational equity, conservation of biological diversity and ecological integrity, and improved valuation, pricing and incentive mechanisms, can be met in re-opening the Mt Todd mine site. The NT EPA has included recommendations within this Report that it considers will enable the Proponent to enhance the outcomes of the Project while reducing adverse impacts and in so doing, improve ESD outcomes.

5.11 Environmental Management Plan (EMP)

5.11.1 Environmental Management Plans proposed by the Proponent

The draft EIS included a framework EMP (draft EIS Appendix Z). The framework 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 framework EMP is divided into sub-plans for the broad risk sources or areas of impact identified for the project. Each sub-plan contains the following information:

- Environmental management objectives, targets, actions and performance indicators to be implemented to mitigate impacts;
- Monitoring and reporting requirements;
- Responsibility for actions; and
- Contingencies if monitoring indicates that performance requirements have not been met.

The Proponent has committed to regular auditing and review of the EMP.

Provided the Proponent implements the management plans included in the EIS, the NT EPA considers that many of 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.

5.11.2 Proponent's commitments

Chapter 23 of the draft EIS includes the initial commitments provided by the Proponent. The commitments are derived from the mitigation measures referred to in the draft EIS and the framework EMP.

The NT EPA considers that the EMP can provide the mechanism to adequately avoid, mitigate and manage the potential environmental risks of the Project provided that the EMP is updated to include commitments and recommendations arising from the Supplement, further information and this Assessment Report. 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 27

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

Recommendation 28

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

- **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 are to be submitted to the DME and the NT EPA. The results of the audit must be made available on the Proponent's website.

6 Conclusion

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. A number of unresolved issues require substantial effort by the Proponent to address through the Proponent's Mining Management Plan (MMP) under the *Mining Management Act,* through waste discharge licensing under the *Water Act* and, where changes to the design as a result of the EIA process are necessary, notification of such alterations to the NT EPA for consideration under clause 14A of the Environmental Assessment Administrative Procedures.

The NT EPA considers that there remain substantial unresolved risks to key receptors from the Project. It is possible that these risks may be managed in a manner that avoids

unacceptable environmental impacts provided that the commitments, safeguards and recommendations detailed in the EIS and this Report, are implemented.

In particular, there remain significant challenges with respect to the stabilisation and closure of structural components, and treatment of AMD on the Project site. Whether the mine continues to the end of its scheduled life or is forced into early care and maintenance or closure, the uncertainties associated with the WRD design, TSF covers and the post-closure water treatment into the long term must be reduced to provide comfort that these aspects can be designed and constructed, and can function to be ecologically sustainable into the long term. Careful planning and leading practice design should be incorporated during the definitive feasibility phase of the Project. If it is found during the production phase that the final design or treatment options selected are unlikely to be successful in the long term, it may be very difficult to reconfigure these components retrospectively given the limitations of the site.

Accordingly, the NT EPA has provided recommendations that it considers will improve the long-term outcomes of these aspects of the Project including the requirement for alternative WRD design consideration, refinement of modelling to assess cover systems and continued research, development and trials of passive water treatment systems during production with active treatment ceasing only when passive systems are demonstrably successful.

The uncertainties associated with the Gouldian finch population in the Yinberrie Hills are substantial and the development of an effective reactive monitoring and management program to effectively protect 98% of the core breeding habitat from dust levels exceeding 50µg/m^{3}will be necessary. It is essential that such a program is accompanied by measures to offset cumulative impacts on finches to ensure the mine can co-exist with a healthy finch population.

The MMP for the Project will be subject to review to the satisfaction of the DME. It is recommended that management plans be developed in consultation with key stakeholders, including the Jawoyn Association. 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.

Information gaps remaining from the EIA process require the Proponent, government and the regional community to rely on intensive, post-assessment data collection, analyses and monitoring to determine the significance of, and appropriate responses to, potential impacts. These requirements are largely captured in the commitments made by the Proponent and recommendations in this Report. Where data indicates that alterations are required to aspects of the Project and the alterations change the environmental significance of the Project, the Proponent will need to notify the NT EPA. The ongoing consideration of design, 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 and for key risks, substantially less.

7 References

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Appendix A

Summary of comments arising from the review of the Mount Todd Gold Project draft EIS

Public Submissions

Issue - Impacts	Raised By
Legacy concerns • Acid mine drainage in Edith River, which flows into the Daly River. • Early and incomplete closure or if material not well managed in perpetuity could lead to outcomes worse than Rum Jungle. • Management of surface water contaminants will remain one of the most significant legacies.	AFANT ECNT Ian Hollingsworth NLC
Water	
Groundwater impacts • Concerns that contaminated water from the mine will impact shallow groundwater systems into the long term. • Drawdown of local groundwater. • Alteration of regional groundwater flows during operations and following closure. • Groundwater contamination will increase and endure. • Significant natural groundwater recharge eliminated by placement of new mine components.	AFANT ECNT NLC
Surface Water • Impacts to natural flow requirements in creeks/rivers through excessive discharge of treated water.	

Issue - Impacts	Raised By
• AMD generated by extreme rainfall events. • Contamination of surface waters from spills. • Failure and overflows of water management structures.	
Risk	
General • Risk management has not been scaled up to the extent of the expanded mine components. • Current and future water and pollution risks should be removed or reduced. • Site infrastructure planning and layout too risky in terms of mine assets in or adjacent to waterways. • Risks of site highlighted by recent uncontrolled discharges due to high rainfall events. • Risk controls should be implemented to manage discharge risks from medium to low and if not, approval should not be granted. • In its current form, the proposal poses more serious risks than the benefits identified. • Considerable expansion of the mine will create much larger environmental risks. • Risk mitigation measures' applicability post-closure is questioned.	AFANT ECNT Ian Hollingsworth NLC
Financial Risk • Risk of failure of project with downturn in economic factors. • Risk to government and taxpayers must be included in bond. • Relying on new proponent to clean up site is risky and inappropriate (see Redbank & Rum Jungle).	
Risk to the environment • Emergency mine shut down. • Discharge from TSFs to downstream environment. • Risk to groundwater from TSFs is unacceptable.	

Issue - Impacts	Raised By
• Low risk conclusions for effects of clearing on fauna are not reflected by high risks for particular species. • Impacts of TSF failure are considered extreme and so the risk should be reduced from medium to low with proper engineering solutions. • Residual risks from increased capacity of TSFs are too high and demonstrate that the risks cannot be adequately addressed in the expansion. • Lower production scenario would have less environmental impact and if project is approved it should be for this lower capacity. • Residual risks for closure and rehabilitation too high. • Biosecurity is principal secondary risk. • Degradation of NAF materials on WRD will gradually increase PAF exposure risk and chronic AMD. • Unacceptable risk to downstream water uses from discharge to groundwater from TSFs.	
Causes of Risk • Gold price is volatile. • Inadequate management. • Climate change.	
Biodiversity Impacts	
Terrestrial • Threats to local fauna from contaminated water in mine pit and other onsite ponds. • Clearing habitat will have a known, serious impact. • Clearing is likely to have significant impact on threatened species and populations.	AFANT ECNT NLC
Aquatic • Impacts from decrease in water quality. • Impacts from contaminated water to birds.	

Issue - Impacts	Raised By
• Impacts on edible fish.	
Socio- Economic Impacts	
Generic • Proponent should demonstrate strong commitment to becoming a 'no pollution mine' to earn a social licence to operate. • Open cut mining operations are likely to be untenable. • If impacts cannot be managed adequately, project should be scrapped.	ECNT Ian Hollingsworth NLC
Human health • Concerns about contamination of downstream users' riverine food supply. • If mine aspects are not properly managed, downstream Aboriginal land and communities are likely to experience major impact. • The Nauiyu Aboriginal community on the Daly River is at risk from any chronic or acute transport of high contaminant levels.	NLC
Economics • Lower production scenario would provide maximised returns and operating margins and approval should be for this capacity. • Financial failure possible.	ECNT AFANT
Stakeholder Impacts • Stakeholder expectations not met. • Impacts to downstream water users.	AFANT ECNT NLC
Amenity • WRD should not be retained as a feature in the landscape following closure. • Social expectations not met with final proposed WRD design. • It is unacceptable that the WRD will be retained after mine closure.	

Issue - Impacts	Raised By
Impacts on tourism and recreation • Spectacular recreational fishing experiences in the Daly River system should not be put at risk. • Visibility of site from tourist locations. • Impacts on recreational fishing value.	

Issues – Information presented in the draft EIS	Raised By
Generic • If the limestone quarry is still proposed, it would be inappropriate to assess under separate process. • Site referred to as brownfield but involves significant footprint increase to new areas. • No chapter specifically on offsets. • Some figures contain legends and values displayed as question marks. • Details of studies or their outcomes could not be found in some cases. • Assumptions and expectations have been made with little rationale in some cases (Appendix I). • Problems with how some information has been collated or summarised from technical reports into main EIS document.	AFANT ECNT NLC
Acid and metalliferous drainage • Details of waste rock handling to avoid AMD risk should be included in EIS. • Projected tailings characteristics, including AMD potential, should be compared to that of previous operations. • Absence of data makes it difficult to perceive the extent of impact that AMD from mine components would have. • Information on stability of NAF cover material not apparent in the draft EIS. • Contingency plans should be developed for dealing with long-term AMD issues and included in	ECNT NLC

Issues – Information presented in the draft EIS	Raised By
Supplement. • Existing seepage issues with TSF1 are not adequately addressed. • Potential for seepage via fracture zones at each TSF should be described. • Implications of sub-optimal WRD structure for engineering design and AMD generation have not been described.	
Surface water quality • No assessment of background water quality to inform reliable monitoring of perturbations. • Assessment based on preliminary and relatively unreliable ecotoxicity study results. • Assessment of surface water impact is inaccurate. • Impacts obscured in baseline condition assessment by focusing on metals and biology without interpretation of general water chemistry data. • Use of 80% species protection level is inappropriate; 95% is recommended. • Numerical values for release of waste water are not specified in the licence or in the draft EIS. • Assessment and management needs to be based on site specific trigger levels. • Draft EIS unclear on expected quality of accumulated pit water.	Ian Hollingsworth NLC AFANT
Groundwater • Inconsistent comments on potential for interaction between pit and shallow groundwater. • Inconsistencies about groundwater impacts post mine closure. • Consequences of eliminating natural groundwater recharge over 300ha area are not considered. • Rate of seepage and quality should be monitored to determine contaminant loads and source of AMD. • Appropriate modelling required on changes to groundwater flows under proposed WRD landform.	AFANT NLC
Water management • No mention of recent overflow events to the Edith River. • Draft EIS recognises need for additional engineering but is not clear on response. • Issues of controlled/uncontrolled discharge not addressed. • Contradictions in information regarding post-closure mine pit equilibrium/overflows. • Proponent's management ability has not been demonstrated. • Surface water management should provide maps of changed surface water flows under the new topography at different stages.	AFANT Ian Hollingsworth ECNT NLC

Issues – Information presented in the draft EIS	Raised By
• WDL was not provided with the draft EIS. • No indication in draft EIS if TSF1 is adequately lined so potential for seepage unknown. • Many unknowns regarding seepage to Horseshoe Creek. • Mine water balance calculations exclude groundwater seepage to mine pit. • Assessment of water-related impacts difficult due to numerous problems with documents attached to draft EIS that describe surface water management. • Goldsim model referred to in documents not provided as part of draft EIS. • Some key scenarios have not been included in the model. • Management plan for Batman pit and WRD should be developed for the Supplement. • Risk of some retention ponds continuing to release AMD is not addressed or acknowledged. • Location of equalisation pond unclear. • Appropriate modelling required on changes to surface water flows under proposed WRD landform.	
Biodiversity • Too much focus on dust, which is an unknown; not enough given to other, more-direct impacts on Gouldian Finch habitat. • Difficult to determine from information whether or not concentrations of water-borne chemical species represent a threat to aquatic fauna. • No attempt to predict impacts on aquatic fauna diversity and abundance with chronic AMD. • The Proponent has not adequately addressed risks to Gouldian Finches. • The draft EIS seems to accept that impacts to finch habitat are inevitable. • Water quality data does not appear to discuss lethal doses and bioaccumulation.	ECNT NLC
Greenhouse and climate change • Assessment of climate risks in risk management chapter is not adequate. • Management measures are vague and should specify how risks are accounted for through design. • Climate change risks of flash flooding should be better integrated into risk models.	ECNT

Issues – Information presented in the draft EIS	Raised By
Mine closure • Adequacy of the closure strategy. • Concern with assumption that there will be no AMD from WRD after mine closure. • Not enough information on passive treatment/wetland system to determine if it will work. • Proponent should include stronger commitments to final site rehabilitation and closure, and risk minimisation strategies. • Rehabilitation and closure criteria should be developed and agreed upon in early stages in case of unexpected closure. • Closure plan does not indicate that landform will be stable and self-sustaining or that water and solute balance will be controlled. • Engineering specifications in closure plan do not support rehabilitation objectives. • Information needed to support a reasonable landscape rehab plan has not been collected.	AFANT Ian Hollingsworth NLC
Social • No attempt to predict impacts on human health if chronic AMD occurs. • Chemistry of seepage needs to be estimated in terms of dilution and risk to the environment and people using the Edith and Fergusson Rivers. • Consumption rates of riverine food species should be determined to interpret human health impacts. • Information on risk of chemical species of special interest to the public is absent. • Water quality data does not appear to discuss potential human health risks.	NLC

Issue - Proposal	Raised By
Benefits derived from the project • If conducted effectively, project could lead to improvements in legacy issues.	NLC
Alternatives	AFANT

Issue - Proposal	Raised By
• Alternatives to untreated water discharge have not been fully investigated. • Alternatives should address immediate rehabilitation with comparison of costs with rehabilitation after mining. • Backfilling of pit with waste rock. • Backfilling with PAF material from WRD and TSF if AMD issues cannot be addressed satisfactorily. • Locations for TSF2 to avoid increasing risks of overflow, loss of structural integrity and seepage from flooding events. • No alternatives suggested by proponent for energy supply. • Solar power system to supplement gas should be considered. • Water treatment plant capable of processing greater volumes is required. • Underground mining. • TSF1 should be removed and the area rehabilitated.	ECNT Ian Hollingsworth NLC
Expansion of legacy mine • The proposed expansion will dwarf the current site infrastructure and increase issues proportionately.	AFANT ECNT
Water management • No plans to prevent discharge of untreated water from some retention ponds. • Question whether deepening of RP1 will reduce discharge impacts. • RP1 wall should be raised and bigger pumps installed. • Contaminated water retention facilities are not being scaled up in proportion to sources of contamination. • Runoff from LGO stockpile and plant area should not drain untreated to Batman Creek after closure. • Concerns with locating TSF2 in a water course. • Unacceptable for any untreated water to be released into the Edith River. • Proponent should commit to treating all water prior to discharge. • Project should be designed for 500 year ARI to account for climate change risks. • Greater commitment to use impermeable layers and seepage recovery systems in TSF1 to ensure appropriate containment. • Projected seepage rates from TSF1 are not acceptable for a mine seeking best practice.	AFANT ECNT Ian Hollingsworth NLC

Issue - Proposal	Raised By
• Concerns with design of diversions around TSF2. • Addressing the risk of TSF2 placed within an ARI 100 year flood area by diverting a creek is not adequate. • Concern about the accumulation of large amounts of potentially acid water in the pit. • Concern that groundwater contamination will be ongoing and will increase if management is insufficient. • Waste discharge is the 'easy' solution adopted by the Proponent.	
Biodiversity • River health monitoring program should be developed.	NLC
Site rehabilitation and mine closure • Budget for rehab and closure should not be compromised by cost cutting measures due to gold price fluctuations. • There are likely to be unforeseen legacy issues that will add to closure costs. • Rates of erosion of NAF should be calculated and plans developed for long-term management of cover stability. • Modelling employed to demonstrate cover stability over at least 1000 years. • Active dewatering and pit water treatment required at closure if pit is backfilled. • Long-term integrity of the pit as a storage facility questioned. • Concern that passive treatment will not have adequate capacity. • WRD structure proposed may not be optimal. • WRDs generally unstable under tropical conditions and require significant ongoing maintenance. • Plant growth medium and NAF depth on WRD may not be sufficient. • Concern about scouring and degradation of NAF cover materials from WRD with extreme weather events.	ECNT NLC AFANT
Infrastructure • Standard weather station installed to enable systematic monitoring of conditions and baseline data for current and future development.	ECNT

Issue – Regulation of the Proposal	Raised By
Offsets	
Greenhouse • Proponent should commit to purchasing NT-based carbon offsets.	ECNT
Biodiversity • Specific offsets discussion and commitments required in EIS. • Measures to compensate for the unavoidable impacts on Gouldian Finch habitat. • Specific land clearing offset ratios recommended.	
Regulation	
Regulatory responsibility and management • Current site highlights what can go wrong when poorly designed mines are allowed to proceed by government. • Site should be maintained in better condition than when purchased rather than 'equal or better'. • Ongoing liability for rehabilitation should be more clearly defined. • Closure criteria should be clear on expectations of proponent and government. • Lack of reasonable intervention in WDL reduces confidence in discharge management. • Regulator needs to clearly specify what constitutes an acceptable mine plan. • In-perpetuity trust should be developed to fund on-going maintenance of key mine components.	AFANT ECNT Ian Hollingsworth NLC

NT Government Submissions

Issue	Raised By
Options/ alternatives • Alternative power for the site should be considered.	PWCNT

Issue	Raised By
Monitoring • Integrated monitoring program recommended. • Reactive dust monitoring required. • Monitoring should be rigorous and independent. • Groundwater monitoring program required. • Monitoring of any dry season flow events with protocol to address any fish kills.	DPI DLRM PWCNT DME
Mine closure • Questions how the Proponent will minimise long-term impacts following closure.	PWCNT
Issue – Information presented in draft EIS	**Raised By**
General • Corrections required in legislation referenced and some additional legislation. • Some units used are incorrect or not consistent in the documents. • Request additional monitoring parameters. • Apparent contradictions in some information.	DME DoH
Biodiversity • Gouldian finch breeding sites in Yinberrie Hills are nominated for listing on NT Heritage Register and should be included in heritage section and the draft Cultural Heritage Management Plan. • More comprehensive review of existing data for Yinberrie Hills required. • EIS underestimates the potential risk to Gouldian finch population due to importance of habitat near the mine site. • Significant underestimate of finch habitat to be cleared. • Clearing of habitat needs to be limited below current proposal. • Areas of concern for dust impacts on finch population are likely to be much larger due to probable lower dust threshold. • Greater mitigation warranted for dust impacts on finches. • Contingency measures required if monitoring indicates a significant adverse impact on finches.	DLPE DLRM PWCNT

Issue	Raised By
• Offsets to improve habitat quality for Gouldian finch.	
Socio-economic • Potential impacts from increased demand for housing in Katherine. • Figures for workforce requiring Katherine accommodation don't agree with previous advice to Planning. • Potential social impacts would be better informed by clarification of projected housing demand. • Specific mitigation required to address exacerbation of existing labour and skills shortfalls	DLPE DoB
Health • Monitoring program for detection of contamination of food chain, particularly edible fish, should be included. • Potable water treatment issues.	DoH
Water management • Passive treatment for TSF2 seepage will be difficult to construct without disturbing local creeks. • Wetland treatment won't have capacity. • Capacity of TSF1 to accept excess water until TSF2 is constructed is questioned. • Clarification required on whether TSF2 will be a zero discharge facility or not. • Question TSF2 seepage water meeting 95% protection levels for water quality. • Methods to achieve timely response to non-compliance in monitoring of discharge. • Management of water during extreme weather into the future. • Does not appear to be design for construction of TSF2. • No detailed information on passive wetland systems. • No detailed information on water treatment plant.	DME PWCNT
Erosion • Erosion and sediment control plan required as part of the MMP.	DLRM
AMD / Contamination • Closure objectives for pit not congruent with increasingly acidic pit water. • Proponent needs to understand current volumes of seepage to assist with modelling. • Questions whether recommendations from previous seepage investigations were implemented.	DME PWCNT

Issue	Raised By
• Potential to generate AMD from PAF and uncertain waste rock and tailings, and elevated metal levels from NAF. • Concerns about leaching and discharge of contaminated water. • Not possible to ascertain representative sampling for AMD but dataset appears limited. • Further assessment of NAF required.	

NT Environment Protection Authority submission

Issue – Impacts
Biodiversity • Impacts on fish passage from creek diversion design. • Hot plume from power station on Gouldian finch habitat.
Dust • Contamination of vegetation from dust. • Peak dust deposition rates in Gouldian finch habitat.
Groundwater • Effects on Yinberrie Hills vegetation of long-term drawdown to the pit.
Risk • Some risk ratings not justified. • Reassessment of some residual risks required due to perceived issues with risk ratings. • Only dust risk considered with respect to fauna.
Issue – Information presented in the Draft EIS
General • Some terminology is inconsistent and needs definition.
Surface water management

• Unclear or inconsistent information on water management. • Changes to proposal since modelling need to be considered. • Additional modelling still to be undertaken. • More information on monitoring, settlement and equalisation ponds. • More information on lined sludge disposal cell. • More information on clean and dirty water partitioning. • More information on specific retention ponds, including measures to further minimise overflows. • Expectations of water quality from the water treatment plant. • Catastrophic failure of TSFs and contingencies needs discussion. • Increased seepage from TSF1.
Waste rock / tailings / AMD • Fate of low grade ore and scats if not economic to process. • More detail required on fate of lead in tailings. • Expansion and capping of WRD and associated changes in drainage catchments. • Explanation required regarding zero discharge claims for TSF1.
Biodiversity • No commitment to expand Gouldian finch monitoring. • Not all significance criteria under EPBC Act have been considered for Gouldian finch. • Suitable finch habitat within the project area needs to be illustrated and different areas delineated according to habitat type.
Dust • Likely composition of dust. • Assumptions for dust emissions estimate optimistic. • No sensitivity analysis evident for dust. • Management measures for dust discussed only generically. • No monitoring or performance indicators for dust in Yinberrie Hills.
Hazardous materials • No measures for spills or accidents involving hazardous materials on roads. • Storage area for hydrocarbons not specified.
Issue - Proposal

Water management • Mitigation for contaminated water before discharge. • Expectation of improved water quality criteria with future WDL. • Effects of year-round discharge from water treatment plant to creeks.
Land management • Questions regarding the handling and storage of topsoil.
Biodiversity • Avoidance, mitigation and management measures proposed to reduce risks to Gouldian finch, not just monitoring. • Specific trigger values for dust impacts and other potential impacts to Gouldian finches are/may be required. • Further research on other stressors to Gouldian finches.
Waste rock / tailings / AMD • Describe cyanide management proposed to comply with ICMC.
Dust • Dust mitigation contingencies if water supply restricted. • Dust Management Plan to include measures for minimising impacts to Gouldian finch.
Monitoring • Discharge water monitoring • Monitoring downstream to account for fine particle and TOC deposition zones for metal retention. • Monitoring recommendations picked up as commitments. • Monitoring of dust impacts on vegetation. • Comparative sites for monitoring of creek impacts. • Revegetation monitoring for creek diversions.
Creek diversion • Simplistic design proposed with consequent increased flow velocities and effects on TSF.
Alternatives • Water containment strategies during intense rainfall events to minimise untreated discharges. • Backfilling the Batman pit with PAF waste rock. • Water treatment and disposal options if planned reduction of current water inventory prior to mining is not successful.

Offsets • Proponent should consider, develop and propose appropriate offsets for Gouldian finch.
Mine closure • Passive treatment method needs more discussion. • Duration of control measures for seepage from tailings until manageable by passive treatment.

Appendix B – Dr David Jones review

Appendix C –Gouldian finch review – Professor John Woinarski