Northern Territory Environment Protection Authority

ASSESSMENT REPORT 84

NOLANS PROJECT
ARAFURA RESOURCES LTD

December 2017

Environmental Impact Assessment Process Timelines

Date	Process
03/2008	Receipt of Notice of Intent – Nolans Rare Earth Project
25/05/2008	Minister for Natural Resources, Environment and Heritage decision – Environmental Impact Statement (EIS) required
10/12/2014	Receipt of clause 14A notification (amended NOI) – Nolans Project
23/12/2014	NT EPA decision on clause 14A notification – EIS required
29/05/2015	Terms of Reference issued to Proponent
27/05/2016	Draft EIS for the Project released for public comment
26/08/2016	NT EPA direction to prepare EIS Supplement issued
31/10/2017	EIS Supplement received
21/12/2017	Assessment Report issued

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Abbreviations and Glossary

Adaptive management	A learning-oriented approach to making decisions on the management of natural resources in the presence of uncertainty. It involves iterations of decision making, monitoring, and assessment of system responses, leading to adapted decision-making (Williams & Johnson, 2017).
Advisory bodies	Agencies having administrative responsibilities in respect of the proposed action
ADWG	Australian Drinking Water Guidelines
ALARA	As low as reasonably achievable
AMD	Acid and metalliferous drainage
ANCOLD	Australian National Committee on Large Dams
ARI	Average recurrence interval; a measure of the rarity of rainfall events
ASX	Australian Securities Exchange
BMP	Biodiversity Management Plan
Bq/g	Becquerels per gram, a measure of radioactivity; one Becquerel is one disintegration per second
Bowtie diagram	In relation to Process Safety; illustrates linkages between potential causes of an incident, or risk, and the preventative and mitigating controls that could be put in place
CLC	Central Land Council
Draft EIS	Draft Environmental Impact Statement
DENR	Department of Environment and Natural Resources
EA Act	*Environmental Assessment Act*
EAAP	Environmental Assessment Administrative Procedures
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
Environment	All aspects of the surroundings of man including the physical, biological, economic, cultural and social aspects (section 3 of the *Environmental Assessment Act*)
ESCP	Erosion and Sediment Control Plan
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
GDE	Groundwater dependent ecosystem
GL	Gigalitre (a billion litres)
ICE	Independent Certifying Engineer
MM Act	*Mining Management Act*

MNES	Matters of National Environmental Significance
mS/yr	Millisieverts per year, a measure of the dose equivalent (biological effect of ionising radiation)
Mt	Million tonnes
NMD	Neutral mine drainage
NOI	Notice of Intent
NORM	Naturally Occurring Radioactive Materials
NT EPA	Northern Territory Environment Protection Authority
NTG	Northern Territory Government
Operator	The operator for a mining site referred to in section 9(1) of the *Mining Management Act*
PAF	Potentially acid forming
PAPL	Phosphoric acid pre-leach (proposed method of processing to produce a rare-earth concentrate)
Process Safety	A blend of engineering and management skills (exceeding workplace safety skills) focused on preventing catastrophic incidents and near misses, particularly where there is a loss of control of material with potential for high consequences (explosions, spills of hazardous waste, hydrocarbons and fire)
Relevant regulator	Responsible Minister or delegate or agency responsible for administering the relevant legislation for that action
Responsible Minister	Northern Territory Minister for Primary Industry and Resources
RSF	Residue Storage Facility
The Minister	Northern Territory Minister for Environment and Natural Resources
The Australian Government Minister	Australian Government Minister for Environment and Energy
The Project	Nolans Project
The Proponent	Arafura Resources Ltd
SAPL	Sulfuric acid pre-leach (previously proposed method of processing to produce a rare-earth concentrate)
SIMP	Social Impact Management Plan
Supplement	The Supplement to the draft EIS
the/this Report	This Assessment Report 84, for the Nolans Project
TPWC Act	*Territory Parks and Wildlife Conservation Act*
TSF	Tailings Storage Facility
WRD	Waste Rock Dump

Summary and Recommendations

Environmental impact assessment (EIA) is a process for identifying the potential environmental impacts and risks of a proposed action, evaluating the significance of those impacts and risks and determining appropriate avoidance, minimisation/mitigation measures to reduce those impacts and risks to acceptable levels. This Assessment Report (the Report) examines the EIA of Nolans Project (the Project), proposed by Arafura Resources (the Proponent). This report marks the end of the assessment process by the Northern Territory Environment Protection Authority (NT EPA).

This report is provided to the Northern Territory Minister for Environment and Natural Resources (the Minister) and for the Minister for Primary Industry and Resources (the responsible Minister) for approvals that would be required for the Project. This Report is not intended to provide an environmental approval although it will guide the decision for a mining authorisation (by the responsible Minister) and the decision for an approval under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The Proponent is proposing to develop and operate Nolans Project (the Project), a rare earth mine, located approximately 135 km north-northwest of Alice Springs in the Northern Territory (NT). The Project includes an open-pit mine with associated waste rock dumps and tailings storage facility (TSF), diversion of an ephemeral creek, a processing site with a residue storage facility (RSF), an accommodation village, water abstraction from a new borefield in the Southern Basins, and linear infrastructure including roads, pipelines and power lines. The Project is anticipated to operate for 55 years. Expected production rates are 14 000 tonnes per annum of rare earth oxide and 110 000 tonnes per annum of phosphoric acid. The refining of the rare earth oxide would occur at another location and is not included in this assessment.

The NT EPA initially identified that potential environmental impacts and risks to the environment were: Contamination of groundwater from waste storage facilities and pits; alterations to recharge of the Ti Tree groundwater basin (volume and contamination); leakage of wastes from the waste storage facilities in the long term; hazards to public from transporting chemicals; radiation hazards for workers; the public and the environment; impacts on flora and fauna, uncertainties of closure and rehabilitation adequacy; and public concern over environmental, health and social impacts of the Project. These potential impacts and risks contributed to the decision to assess the Project at the level of an Environmental Impact Statement (EIS).

The Project was determined to be a controlled action under the EPBC Act for likely significant impacts on listed threatened species and communities and its potential to significantly impact on the whole environment as a result of nuclear actions. The NT EPA has assessed the Project on behalf of the Australian Government in accordance with the bilateral agreement between the Australian and Northern Territory governments.

In making this Report, the NT EPA had regard to the information provided by the Proponent, submissions on the draft EIS and Supplement, advice from specialists from the Northern Territory Government as well as relevant guidelines and standards. The NT EPA has assessed the Project against the NT EPA's objectives for the key environmental factors of: Hydrological processes; Inland water environmental quality; Terrestrial flora and fauna; Social, economic and cultural surroundings; and Human health. Other environmental factors are addressed in Appendix 1.

The NT EPA acknowledges rare earth elements are key components in many green and sustainable products such as wind turbines for the clean energy industry and hybrid vehicles. Developing and enhancing responsible mining practices of these rare earths is critical to ensure mining operations and the waste products that remain after mining do

not result in ongoing unacceptable environmental impacts or an environmental legacy for the Northern Territory Government (NTG).

The project is in an arid zone of Australia where groundwater is a scarce and valuable resource. The proposed borefield would abstract water from a groundwater resource that is poorly understood. There is uncertainty around the potential impacts of this abstraction to groundwater dependent vegetation and potential future users of the resource. The NT EPA recommends that the Proponent be required to implement practices for the sustainable use of groundwater for this Project. This includes minimising water consumption, applying corporate water governance and providing open and transparent reporting of the use of that groundwater resource. The NT EPA makes the recommendation for the development of a **Water Abstraction Management Plan** to ensure monitoring and updated groundwater models are used for adaptive management responses to achieve sustainable groundwater use. The NT EPA also recommends transparent reporting of water management in an annual Water Management Report.

A permanent diversion of Kerosene Camp Creek is proposed as part of the Project. The NT EPA makes the recommendation for an updated creek diversion design to demonstrate that the diversion and levee would effectively permanently deliver creek flows to the downstream tributary. This would include maintaining water quality regimes and sediment transport.

The NT EPA also notes that mine wastes would contain naturally occurring radioactive materials (NORM) that has the potential to impact on the environment if not effectively contained for the long term. Some uncertainty remains on the acid and metalliferous drainage (AMD) testing of waste rock and waste from the phosphoric acid pre-leach (PAPL) processing. The NT EPA considers the results of additional test work is required to inform detailed design of the waste rock dumps, tailings storage facility and residue storage facility to ensure appropriate management of wastes and minimise potential leachates. The NT EPA makes the recommendation for this further work to be conducted to inform detailed designs of the waste storage facilities.

The NT EPA notes the Proponent's commitment to design, construct, maintain, operate and decommission the TSF and RSF to the Australian National Committee on Large Dams (ANCOLD) guidelines. The NT EPA is of the opinion that waste storage facilities should be designed, constructed and operated in a manner that facilitates the meeting of the relevant closure objectives. To demonstrate this objective has been met, the NT EPA recommends periodic inspection, review and auditing of the waste facilities by independent technical experts, including an **independent certifying engineer.** This would include performance monitoring of these facilities and an assessment of the overall performance and long-term integrity, as part of a rigorous regulatory process.

The NT EPA considers that significant environmental impacts may occur as a result of the Project if a major incident were to occur at the Project. This could include, but is not limited to, TSF/RSF failures and overflows, generation of AMD and leachate, and uncontrolled releases of contaminated water or tailings/residue slurry that is likely to include radioactive elements in concentrations that may be higher than NORM associated with the deposit. To add certainty that these risks to the environment from the Project would be appropriately prevented and managed, the NT EPA recommends the development and implementation of a **process safety plan**. This would enable the regulator to ensure critical controls are implemented that would most likely prevent such an incident or mitigate consequences should it occur.

The NT EPA considers that effective long term containment of mining waste, post-closure or following unforeseen closure, is essential to ensure protection of the environment, including radiological protection. The NT EPA has recommended that mine closure planning be an integral part of mine planning and that **progressive rehabilitation** is undertaken according to an approved schedule during Project

operations. This would lower the risk of environmental harm during and after the life of the Project including any period of care and maintenance. The NT EPA recommends the Mine Closure Plan be updated prior to any approvals or decisions for the Project to inform the mining security bond required under the *Mining Management Act* (MM Act) and that it be regularly reviewed and updated throughout the life of the Project. The NT EPA recommends that security bond be revised based on the updated Mine Closure Plan to ensure the costs of rehabilitation and post-closure liabilities are not borne by the NTG and the community, in the event of the Operator abandoning the site or becoming insolvent.

The NT EPA makes 16 recommendations as an outcome of the EIA. These recommendations are for the Proponent and decision-makers to consider with respect to conditions of future approval processes and for the execution of the proposed action. The NT EPA emphasises that due to the lack of site-specific information (including baseline data), considerable uncertainty remains around the potential for significant environmental impacts over the life of the Project. The NT EPA emphasises that the environmental commitments, safeguards and recommendations outlined in the EIS, this Assessment Report and in the final management plans, must be implemented by the Proponent and oversighted and enforced by the relevant regulator throughout the life of the Project to deliver acceptable environmental outcomes.

The NT EPA considers that, subject to the implementation of the recommendations, the Project can be managed in a manner that is likely to meet the NT EPA's objectives and avoids significant or unacceptable environmental impacts and risks.

List of Recommendations

Recommendation 1

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

- **identified in the final Environmental Impact Statement for the Nolans Project (draft Environmental Impact Statement and Supplement)**
- **recommended in this Assessment Report 84.**

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

Recommendation 2

The Proponent or Operator shall provide written notice to the Northern Territory Environment Protection Authority and the responsible Minister if it alters the Nolans Project and/or commitments in such a manner that the environmental significance of the action may change, in accordance with clause 14A of the Environmental Assessment Administrative Procedures.

Recommendation 3

Before approvals or decisions are given or made for the Project, the Proponent or Operator shall provide to the relevant regulator a Water Abstraction Management Plan for the Nolans Project. The Water Abstraction Management Plan must, at a minimum provide:

a) **a full description of the groundwater model, assumptions and parameters**
b) **further information to validate the existing class 1 groundwater model, including a clarification of recharge of the borefield and cross sections of**

appropriate spatial and vertical resolution of the NE Southern Basins aquifers

c) **revised model outputs for estimated groundwater drawdown, and recovery of groundwater levels post-closure (including 50, 100 and 1000 years), at the borefield and mine site, for the projected life of the Project**

d) **a framework identifying timing, methods and parameters for the collection of further information on baseline groundwater levels, flow directions and flow rates to understand natural variance and hydrological conditions in the borefield and mine site**

e) **details of all monitoring bores, including the lithology and aquifers intersected and the purpose of monitoring at each bore**

f) **confirmation that all bores and bore meters would be constructed, operated and registered in accordance with the 'Minimum construction requirements for water bores in Australia' as published by the National Uniform Drillers Licensing Committee and the Department of Environment and Natural Resources 'Non-urban water metering code of practice for water extraction licences'**

g) **measures to quantify and record the volume of water abstracted from the borefield and mine site to support minimum monthly reporting of pumping records from individual bores**

h) **a framework, including timeframes, for progressing to a Class 2 numerical groundwater model consistent with the Australian Groundwater Modelling Guidelines**

i) **an independent peer review of the updated Water Abstraction Management Plan by a suitably qualified independent professional**

The Water Abstraction Management Plan should be developed and implemented to the satisfaction of the relevant regulator.

Recommendation 4

The Water Abstraction Management Plan established in Recommendation 3 must include assessment and management of any stock or drinking water bores that could be impacted by the Project, in agreement with the owners and/or operators of those bores. This is to include:

a) **conducting a hydro-census (condition) survey of local groundwater users prior to construction to establish baseline conditions**

b) **a program to monitor water levels at those bores to detect whether levels are within observed baseline conditions**

c) **measures to ensure identified groundwater user bores remain operational or provide an alternative water bore or supplies if required.**

Recommendation 5

The Water Abstraction Management Plan established in Recommendation 3 must incorporate an assessment of groundwater dependent ecosystems. This is to include:

a) **mapping of potentially groundwater dependent vegetation by intersection of the following areas:**

    - **where standing water level is less than 15 metres below ground level**

- **where vegetation contains potentially groundwater dependent species (this could be mapped using remote sensing and confirmed by field survey)**
- **where groundwater is predicted to have a significant drawdown, due to the Project, including after completion of the Project**

b) applying conservative preliminary trigger levels to areas where groundwater is less than 15 metres below ground level to avoid impacts on groundwater dependent vegetation

c) an assessment of stygofauna to determine the likelihood of presence of stygofauna and, if present, include appropriate mitigation measures

d) procedures for applying clear, quantitative and measureable trigger levels for groundwater drawdown and an outline of specific adaptive management responses that would be implemented if necessary

e) proposed mitigation and management responses in the event that trigger levels are exceeded

f) a plan to monitor groundwater levels (drawdown) and vegetation health, in areas where groundwater dependent vegetation occurs, and refine trigger levels for groundwater drawdown based on site-specific data

g) an independent peer review of the proposed initial and revised groundwater trigger levels and vegetation health monitoring assessment by a suitably qualified independent professional.

Recommendation 6

Mining approvals in relation to groundwater abstraction should include conditions that require the Proponent or Operator to:

a) allocate clear responsibilities and accountabilities for water use and management

b) provide, in the Water Management Plan, regular updates of the projected water balance for the Project, including detailed estimates for the various phases of the Project and specifying the source and quantity of the water to be used

c) demonstrate how water considerations are integrated in Project planning including final Project design and technologies

d) report on continual improvement initiatives in water use and efficiencies including the provision of relevant water use targets

e) provide details on how water would be effectively managed during Project operations, including minimising water consumption, maximising water reuse and preventing water waste including unnecessary or excessive flow or flood of water

f) abstract water from bores only when equipped with operating flow meters

g) record the volume of water abstracted from the borefield and the mine site as reported in the Water Abstraction Management Plan (Recommendation 3)

h) provide an annual Water Management Report to stakeholders. This is to include water use performance, performance in relation to triggers and any changes in triggers.

Public disclosure of the Water Management Plan and annual Water Management Report shall be provided on the websites of (as applicable), the Proponent or Operator and relevant regulatory authorities.

Recommendation 7

Before approvals or decisions are given or made for the Project, the Proponent or Operator shall provide to the relevant regulator an updated Kerosene Camp Creek diversion design and modelling that demonstrate how the diversion would:

a) **maintain the existing regional hydrologic regime by effectively delivering the natural flows of Kerosene Camp Creek to downstream reaches**

b) **avoid surface and sub-surface flows reporting to the pit, even in a 1000 year average recurrence interval flood event (1000 year ARI event)**

c) **maintain sediment transport and water quality regimes that allow the watercourse diversion to be self-sustaining**

d) **maintain surface water quality (as informed by acid and metalliferous drainage testing of basement rock)**

The detailed diversion design is to be peer reviewed by an appropriately qualified independent professional and implemented to the satisfaction of the relevant regulator.

Recommendation 8

Before approvals or decisions are given or made for the Project, the Proponent or Operator shall provide to the relevant regulator an updated Acid and Metalliferous Drainage (AMD) Management Plan for the Nolans Project. The AMD Management Plan must, at a minimum, provide:

a) **results of additional testing to demonstrate to a high level of confidence, that there is a low risk of AMD and NMD from all waste streams and stockpiled ore**

b) **details of the scope of the additional kinetic, column and barrel leach tests to provide results on the long-term leachate generation from wastes**

c) **a plan for the further testing required to design the waste rock dumps based on the results of AMD site-specific representative waste rock samples.**

Recommendation 9

Before approvals or decisions are given or made for the Project, the Proponent or Operator shall engage an appropriately qualified and experienced Independent Certifying Engineer (ICE) to oversee the design and any works undertaken at the waste storages (Tailings Storage Facility, Residue Storage Facility and Waste Rock Dumps). The ICE is to provide:

a) **objective and independent expert review to the relevant regulator on the suitability of the site selection for the waste rock dumps, tailings and residue storage facilities including review of alternative sites and assessment of comparative risks**

b) **objective and independent expert review to the relevant regulator on the adequacy of the tailings and residue storage facility design, including details of the sub-surface drainage and type of low-permeability liners to**

ensure long-term containment of tailings/residues or leachate from waste rock dumps

c) regular inspections, auditing and reporting to the relevant regulator during construction of the tailings and residue storage facilities and waste rock dumps to ensure construction and operation is in accordance with the endorsed design and design objectives

d) objective and independent expert review of the proposed performance monitoring program for the waste storages including potential seepage and leachates from the storage facilities

e) objective and independent expert review of the decommissioning and final rehabilitation to minimise long-term risks to the environment, community, future land use and visual amenity from the waste storages

f) an independent assessment of the Project's management of tailings and residues, including performance monitoring results in an annual report to the relevant regulator and the Proponent or Operator.

The annual report shall be provided on the websites of (as applicable), the Proponent and Operator and the relevant regulator.

Recommendation 10

Before approvals or decisions are given or made for the Project, the Proponent or Operator shall provide to the relevant regulator an updated erosion and sediment control plan for the Project. The plan should outline all permanent and temporary erosion and sediment control measures proposed to be installed for the Project. The updated plan should be prepared by a suitably qualified person and in accordance with the international standards for erosion and sediment control (as amended from time to time) or higher standard. An independent, suitably qualified and experienced auditor should be engaged to review and approve the plan, and to inspect and approve work is undertaken according to the plan.

Recommendation 11

Before approvals or decisions are given or made for the Project, the Proponent or operator shall provide to the relevant regulator a Biodiversity Management Plan for the Project. The Biodiversity Management Plan must, at a minimum, contain:

a) an identification of potential project impacts and risks, mitigation measures and preventative actions for the protection of biodiversity values and habitat for threatened species

b) a procedure for pre-clearance surveys for threatened species, including the great desert skink

c) the final alignment of the borefield access track, incorporating a buffer of at least 200 m around the known warren of the great desert skink

d) the scope, standards and timeframes for a flora and fauna monitoring program

e) procedures for managing fire risk from the Project on habitat for threatened species

f) weed hygiene and control procedures for avoiding the introduction and/or spread of weeds into habitat for threatened species

g) **procedures for avoiding and/or managing the risk of introduced fauna on threatened species**

h) **goals, measures and criteria for the rehabilitation of habitat for threatened species following the closure and decommissioning of the Project.**

Recommendation 12

The Proponent shall establish the Community Reference Group as a forum to consult with stakeholders on agreed post mining land uses and engage on the broader environmental management and performance of the Project's operations including water use, monitoring results, and mine closure and rehabilitation.

Recommendation 13

Prior to the commencement of any construction, the Proponent or Operator must obtain relevant authorities and consents to disturb any/all sites of historical and cultural significance that may be disturbed by the Project.

Recommendation 14

The Proponent or Operator shall engage an independent process safety expert, endorsed by the relevant regulator to:

a) **develop a process safety plan that details how process safety systems would be implemented to prevent the occurrence of a major process safety incident**

b) **provide oversight of the implementation of process safety via regular inspections**

c) **provide reporting of process safety oversight to the relevant regulator.**

The process safety plan must:

a) **identify major process safety hazards at the Project**

b) **document the risks and controls and identify critical controls**

c) **provide bowtie diagrams to present risks and controls for the Project's identified process safety hazards in a graphical form**

d) **document the controls and associated accountabilities and active monitoring responsibilities**

e) **monitor and report on the effectiveness of the controls, identifying areas for improvement and actioning**

f) **document the independent process safety expert's oversight inspection schedule that would report on whether process safety systems are embedded into the culture of the organisation**

g) **provide provisions for publicly reporting the independent process safety oversight reports.**

Recommendation 15

Approvals and decisions for the Project shall have conditions that require the Mine Closure Plan to progressively include:

a) **alternative risk based rehabilitation options that identify a range of closure scenarios and strategies for the Waste Rock Dumps, Tailings Storage Facility, Residue Storage Facility and the pit and provide justification that the preferred closure option minimises environmental risks**

b) **identification and management of knowledge gaps relating to closure-specific technical information; including environmental baseline data, waste characterisation, pit lake characterisation, and review of monitoring data; to inform sustainable mine closure**

c) **details of pre-closure research trials, investigations and modelling aimed at closing knowledge gaps to inform detailed rehabilitation design. These are to include, but not be limited to, revegetation trials, final cover materials, capping design and groundwater studies particularly in respect of drawdown in the vicinity of the mine pit.**

The Mine Closure Plan is to be peer reviewed by an appropriately qualified independent professional prior to submission to the relevant regulator.

Recommendation 16

Before approvals or decisions are given or made for the Project, the Proponent or Operator shall provide to the relevant regulator a conceptual Mine Closure Plan that must be reviewed and updated every three to five years. The Mine Closure Plan must:

a) **provide details on progressive rehabilitation works and incorporation of progressive rehabilitation in mine planning activities**

b) **address all aspects of rehabilitation and mine closure, including stakeholder agreed post mining land use, rehabilitation objectives, completion criteria and rehabilitation monitoring**

c) **include details of the pre-closure research trials and investigations that would inform, guide and support appropriate cover systems and rehabilitation of ecosystems for closure**

d) **include final landform designs that are consistent with surrounding topography of the area and consistent with current standards and best practice**

e) **include a commitment to ensure all landforms, including the pit lake, are safe and stable**

f) **include an adaptive management approach in response to progressive rehabilitation performance monitoring results to ensure rehabilitation is successful**

g) **establish ongoing monitoring and maintenance of the site post mining in accordance with an approved monitoring and maintenance program until such time as the relevant regulator directs.**

Approvals and decisions in relation to the Project shall include conditions that require reporting to the relevant regulator on progressive rehabilitation works and performance.

1 Introduction

1.1 Purpose of this report

Arafura Resources Ltd (the Proponent), proposes to develop and operate the Nolans Project (the Project), a rare earth mine, located approximately 135 km north-northwest of Alice Springs in the Northern Territory (NT).

The Project has been assessed by the Northern Territory Environment Protection Authority (NT EPA) at the level of Environmental Impact Statement (EIS) under the *Environmental Assessment Act* (EA Act) and the *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) in accordance with the bilateral agreement between the Australian and Northern Territory Governments.

The NT EPA has prepared this Assessment Report (this Report) in accordance with section 7(2)(g) of the EA Act and clause 14(3) of the Environmental Assessment Administrative Procedures (EAAP). The purpose of this Report is to ensure that matters affecting the environment to a significant extent are fully examined and reported. This Report is provided to the Northern Territory Minister for Environment and Natural Resources (the Minister), and the Minister for Primary Industry and Resources (the responsible Minister) to be considered in decisions made by the Territory Government. This Report it is not intended to provide an environmental approval although it will guide the decision for a mining authorisation (by the responsible Minister) and guide the Proponent in the execution of the Project. This report should inform regulatory decisions regarding conditions for construction, operation and closure; during the approval and ongoing authorisation decisions for the life of the Project.

This report is also provided to the Australian Government Minister to assist with the making of a decision for an approval under the EPBC Act (by the relevant delegate).

1.2 Scope of the assessment

The NT EPA assessed the potential environmental impacts and risks associated with the Project in accordance with the requirements under the EA Act, the EPBC Act and the bilateral agreement between the Australian and Northern Territory Governments.

The matters relating to the environment the NT EPA considered necessary to be dealt with in the EIS for the Project were identified in the Terms of Reference (NT EPA, 2015) in accordance with clause 8(3) to (6) of the Environmental Assessment Administrative Procedures. As the Project was determined to be a controlled action under the EPBC Act, the potential impacts and risks to matters of national environmental significance (NES) have been included in the scope of this assessment as outlined in section 6 of this Report.

The draft EIS for the Project underwent an eight-week public exhibition period between 27 May and 22 July 2016. Sixteen submissions on the draft EIS were received from Government agencies and four from non-government organisations. All submissions were forwarded to the Proponent and were responded to individually in the Supplement to the draft EIS.

In preparing this Report, the NT EPA has considered each of the submissions.

1.3 Approval and regulatory framework

The Project will require approval and regulation by the Northern Territory and Australian Governments. The framework for approval and regulation of the Project is provided in chapter 2 of the draft EIS and is summarised below, with an emphasis on the obligations and requirements of the Northern Territory Government.

The key legislative instruments for the Project are:

- an authorisation under the *Mining Management Act* (MM Act)
- an approval under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The NT EPA provides this Report to the Minister. The Minister is required to provide a copy of the Report to the responsible Minister (the Minister for Primary Industry and Resources). The responsible Minister, taking into consideration this Report, will then make a decision as to whether or not the Project should be authorised under the MM Act and if so, the conditions that may be applied.

Section 8A(2) of the EA Act requires the responsible Minister to give the NT EPA notice of the decision as soon as practicable, but within seven days, after making the decision. Alternatively, if the decision by the responsible Minister is contrary to this Report, the responsible Minister must comply with reporting obligations to the NT EPA and the Legislative Assembly in accordance with section 8A(3) of the EA Act.

The making of this Report and providing it to the Minister and to the Australian Government Minister marks the completion of the examination of the EIS by the NT EPA. The EIS and supporting documents can be viewed on the Project page on the NT EPA website at: https://ntepa.nt.gov.au/environmental-assessments/register/nolans-rare-earth

2 The project

2.1 Proponent

The Proponent is Arafura Resources Ltd, listed with the Australian Securities Exchange since 2003 (ASX code: ARU). It has interests in a number of mineral exploration and mining projects. The Nolans Project is the company's flagship project.

The Proponent intends to transition its business from exploration to mine development and ore processing. The Nolans Project would be the Proponent's first development project. It would be Australia's third rare earth mine, strengthening Australia's position as the second largest miner of rare earths in the world, after China.

The Proponent states that it has not been subject to any proceedings under Australian Government, State or Territory law with respect to the protection of the environment or the conservation and sustainable use of natural resources.

2.2 Project description

The Project is located 135km north north-west of Alice Springs, situated approximately 10 km west of Aileron Roadhouse (figure 1). Access to the Project site would be from the Stuart Highway, south of Alyuen community.

The predominant land use at the Project location and surrounding areas is pastoral; the area has been used for grazing cattle since the early 1880s. The majority of the Project footprint is situated on the Aileron Perpetual Pastoral Lease (PPL 1097), with the exception of the western part of the borefield area, which is situated on the Napperby Perpetual Pastoral Lease (PPL 1178).

The Project footprint covers four areas linked by access roads and pipelines: the mine site (including a creek diversion); processing site; accommodation village; and borefield (figure 2). These are further described below. The potential maximum area of disturbance associated with the Project is approximately 4161 ha (draft EIS, chapter 9). The actual area of disturbance will be a proportion of this full area assessed.

In the draft EIS, the Proponent stated it would continue to investigate the recovery of all potential products from the Project, including phosphate, uranium and thorium (if a commercial market for thorium emerged). The NT EPA notes the potential future recovery of materials from tailings or residues from the Project is not included in the scope of this assessment and the Proponent would be required to submit a notification under clause 6 of the EAAP for such an action. This Project assessment does not include an assessment of the plant where the mixed rare earth product from Nolans would be separated into individual rare earth products. The location of this plant is yet to be determined and would be assessed separately by the relevant government jurisdiction/s.

A detailed description of the Project is presented in chapter 2 of the Supplement to the draft EIS and is summarised in table 1.

Table 1: Project components

	Component	Size/capacity
Whole of Project	Total potential maximum disturbance; 55 year mine life	4161 ha[1]
Mine site	Size of total proposed mineral lease[2]	~ 1700 ha
	Open pit	135 ha, 285 m deep
	Topsoil storage stockpile	114 ha, 3 m high
	Waste rock dumps – maximum 5 (WRDs)	~ 460 ha 50 m high
	Tailings storage facility (TSF)	195 – 245 ha 22 - 25 m high
	Kerosene Camp Creek diversion	~ 4 km maximum depth 22 m
	Associated infrastructure: beneficiation plant, water holding infrastructure, ROM pad, etc.	80 ha
Processing site	Total size of mineral leases	1591 ha
	Processing plant: Phosphoric acid plant, sulfuric acid plant, sulfation kilns, recovery and purification units, storage tanks, etc.	60 ha
	Offices, workshop, warehouses, laboratory, emergency services facility, vehicle wash down areas and other minor buildings/facilities	40 ha
	Evaporation ponds (six cells; 10 ha each)	60 ha, 2.5 m high
	Residue storage facilities (RSFs). Individual residues would be stored in separate cells	~ 345 ha, 14 m high
	Gas fired power station	2 ha, 12 500 kW
	Fuel storage facility	1 ha
	Water treatment plant	1 ha
	Sewage treatment plant	1 ha
Borefield	Total abstraction	2.7 GL per annum
Worker accommodation village	Operational workforce 300 workers, construction workforce 500 workers	32 ha
	Sewage treatment facility	1 ha
Connecting and supporting infrastructure	Total area of disturbance	~ 270 ha
	Main access road (sealed) from Stuart Hwy to processing site	~ 16 km
	Internal road connecting mine site to processing site (unsealed)	8 km total length (5 km outside mineral leases)
	HDPE slurry pipeline to convey the mineral concentrate from the mine site to the processing site (above ground and bunded).	8 km total length (5 km outside mineral leases)
	Service infrastructure corridor connecting the borefield to the processing site; including above-ground water transfer pipelines, overhead powerlines and unsealed road	23 km, 60 ha
	Power distribution via high voltage overhead power lines located alongside pipelines and roads	30 km, 90 ha
	High pressure gas pipeline between the existing Amadeus gas pipeline and the processing plant	~ 300 m

[1] Derived from draft EIS and matches total clearing areas described in section 4.3.2. This is now an overestimate as the proposed mine site area was updated, and is smaller, in the Supplement (see note 2 below). The actual area of disturbance would be a proportion of this area assessed.
[2] Refer to Appendix 2 for Mineral Lease numbers and geographic coordinates. The proposed mine site area in the Supplement, and shown in figure 3, is smaller than indicated in the draft EIS

2.2.1 Construction and operation

The Project would be constructed at three locations (mine site; processing site; and borefield) with internal roads and service corridors connecting these.

The processing site would be located approximately five kilometres south of the mine site (figure 2). This location was chosen for having near-surface basement rock, thereby limiting the potential for soil and/or groundwater contamination.

The Proponent proposes to mine and process rare earths over a period of 55 years including a construction period of two years. Expected production rates are 29 700 tonnes per annum of intermediate rare earth products and 110 000 tonnes per annum of Phosphoric Acid. The intermediate rare earth products would be transported elsewhere for further separation, to produce 14 000 tonnes per annum of rare earth oxide. The most valuable components of the Nolans rare earth oxide, Neodymium (Nd) and Praseodymium (Pr), are used to make permanent high-powered magnets for technological applications including in the clean energy industry. The Phosphoric Acid would be sold to the chemical industry for use in fertilizers or other products. Of note, the ore body contains elevated levels of naturally occurring radioactive materials (uranium and thorium) that would largely remain on site in the waste storage facilities.

2.2.1.1 Water supply

The main source of water for the Project is the proposed borefield, approximately 20 km south-west of the mine site (figure 2). It is proposed that 2.7 GL/yr would be extracted from several production bores. Each bore would have a well head and pumping station. Potable water would be extracted from separate bores in borefield aquifers of higher water quality. Additional monitoring bores would also be present. There would be a centralised distribution pumping station. A service infrastructure corridor would connect the bores to the processing site; including above-ground water transfer pipelines, overhead powerlines and minor roads.

Water supply pipelines would be above ground and located alongside access roads (figure 2). A process water pipeline would connect the borefield to the processing site and mine site; and a potable water pipeline would connect the water treatment plant (within the processing site) to the accommodation village.

2.2.1.2 Power supply

Power demand for the Project, estimated at a total of 12 500 kW, would be met by a gas fired turbine facility located at the processing site. The gas supply would be obtained from the existing Amadeus Basin to Darwin gas pipeline via a new high pressure pipeline to the power station.

Additional emergency diesel generators would be located at the mine site, processing plant and the accommodation village. Power would be distributed to all components of the Project using high voltage overhead power lines totalling approximately 30 km. These power lines would be located alongside pipelines and roads.

2.2.1.3 Transport requirements

Materials, reagents and product to be used and produced at the Project would be transported to/from Alice Springs via the Darwin – Adelaide railway, and to/from the Project site by road from Alice Springs. This would amount to approximately 12 road train trips per 24-hour period (draft EIS, chapter 17). The transport of workers and contractors would amount to approximately 14 trips per day (draft EIS, chapter 17).

2.2.1.4 Workforce

It is estimated the Project would employ 375 full time equivalent staff during construction, reducing to approximately 250 workers during steady-state operations (draft EIS, chapter 15). It is expected that about 70% of the workforce would be fly-in fly-

out (FIFO) to Alice Springs, with the remainder being from Central Australia. All workers would be transported to and from the site by bus from Alice Springs or other local communities for their rostered work periods. The workforce would be housed in a purpose built accommodation village at a site approximately five kilometres east of the processing site, occupying 32 ha (figure 2). An additional temporary accommodation camp of 200 rooms would be in place for the construction period. Overflow accommodation needs are likely to be met by Aileron Roadhouse. A small sewage treatment plant unit would also be installed at the accommodation village.

2.2.1.5 Mine site diversion of Kerosene Camp Creek

Construction of the open pit located at the mine site would require diversion of the ephemeral Kerosene Camp Creek. The Proponent proposes to divert surface and subsurface flows of this creek to prevent inflow to the pit and minimise the risk of contamination of clean surface water from mining activities. The proposed diversion would start above the pit location to a nearby downstream tributary of the same creek (figure 3).

This diversion would be approximately four kilometres in length and would require significant excavation through a saddle, exceeding depths of six metres for over two kilometres (draft EIS, appendix A of appendix I) and reaching a maximum depth of 22 metres (Supplement, appendix 14). It would be around eight metres wide in the shallower sections and up to 27 m wide in the deepest sections (Supplement, appendix 13). The resulting diversion would have an average gradient of 0.1%, significantly lower than the 0.25% gradient of the existing creek (draft EIS, appendix A of appendix I).

2.2.1.6 Processing of rare earth product

A notable change between the publication of the draft EIS and the submission of the Supplement was a change in method of processing to be conducted as part of the Project. This reduces the estimated volume of tailings and residue waste but also has implications for potential environmental impacts due to potential leachate from waste streams and ore. The draft EIS included a Sulfuric Acid Pre-Leach (SAPL) which has now been changed to Phosphoric Acid Pre-Leach (PAPL). This assessment is based on testing completed for the draft EIS (SAPL process), as results from further testing from the PAPL process were not available to be included in the Supplement.

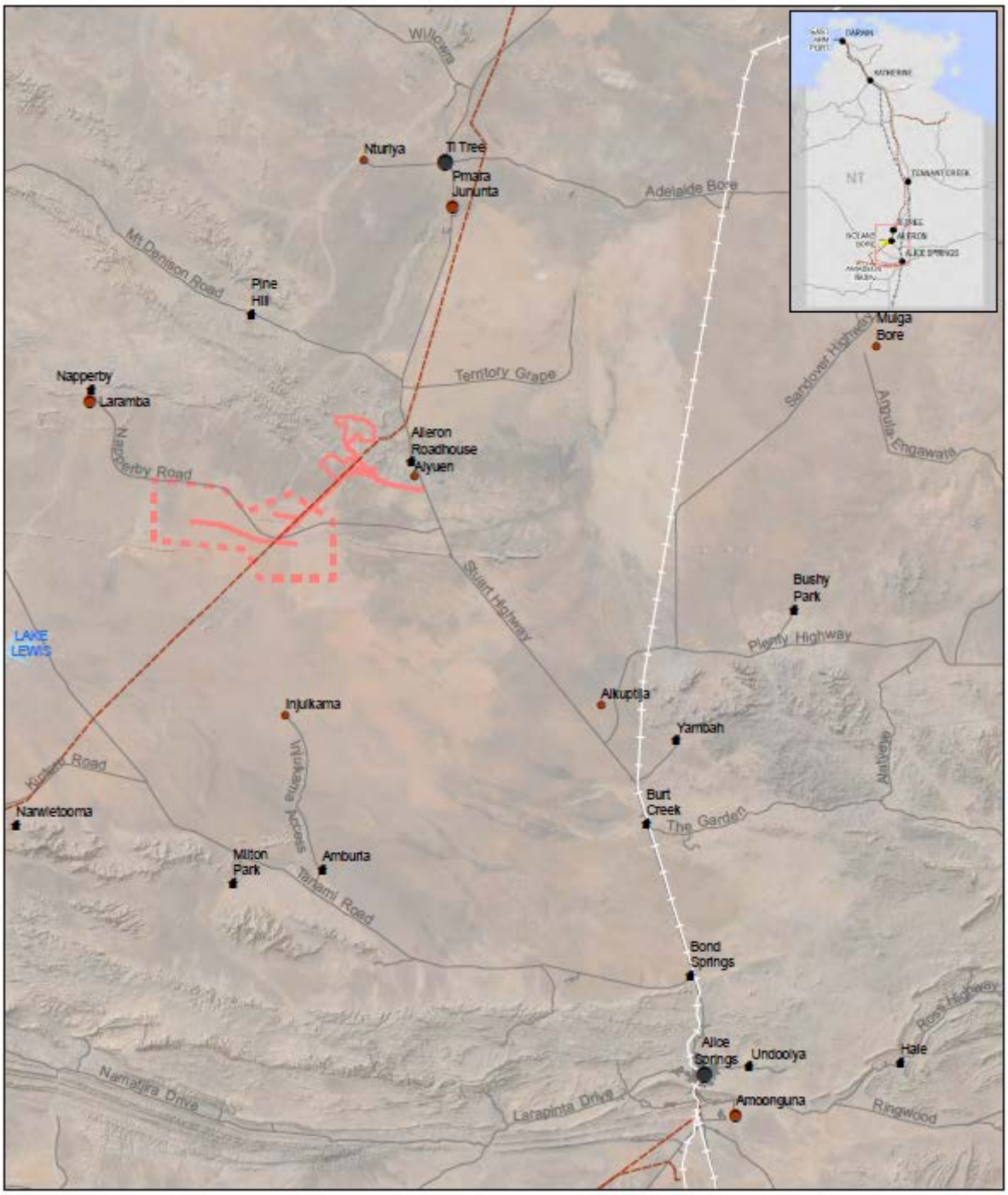

Figure 1: Project location map.
The Project area is outlined in pink. The red line is a Gas Pipeline. Grey lines are roads. The white line is the railway. Black dots are towns and brown dots are Aboriginal communities (larger dots) or outstations (smaller dots). Black houses are pastoral stations. Source: draft EIS, figure 1-1.

Figure 2: Project footprint map.
The map includes the mine site, processing site and accommodation village (all outlined in pink); borefield (dotted pink outline); access and haul roads (black lines); and pipelines (turquoise). The existing gas pipeline (yellow line) and roads (grey lines) are also shown. Source: draft EIS, figure 1-2.

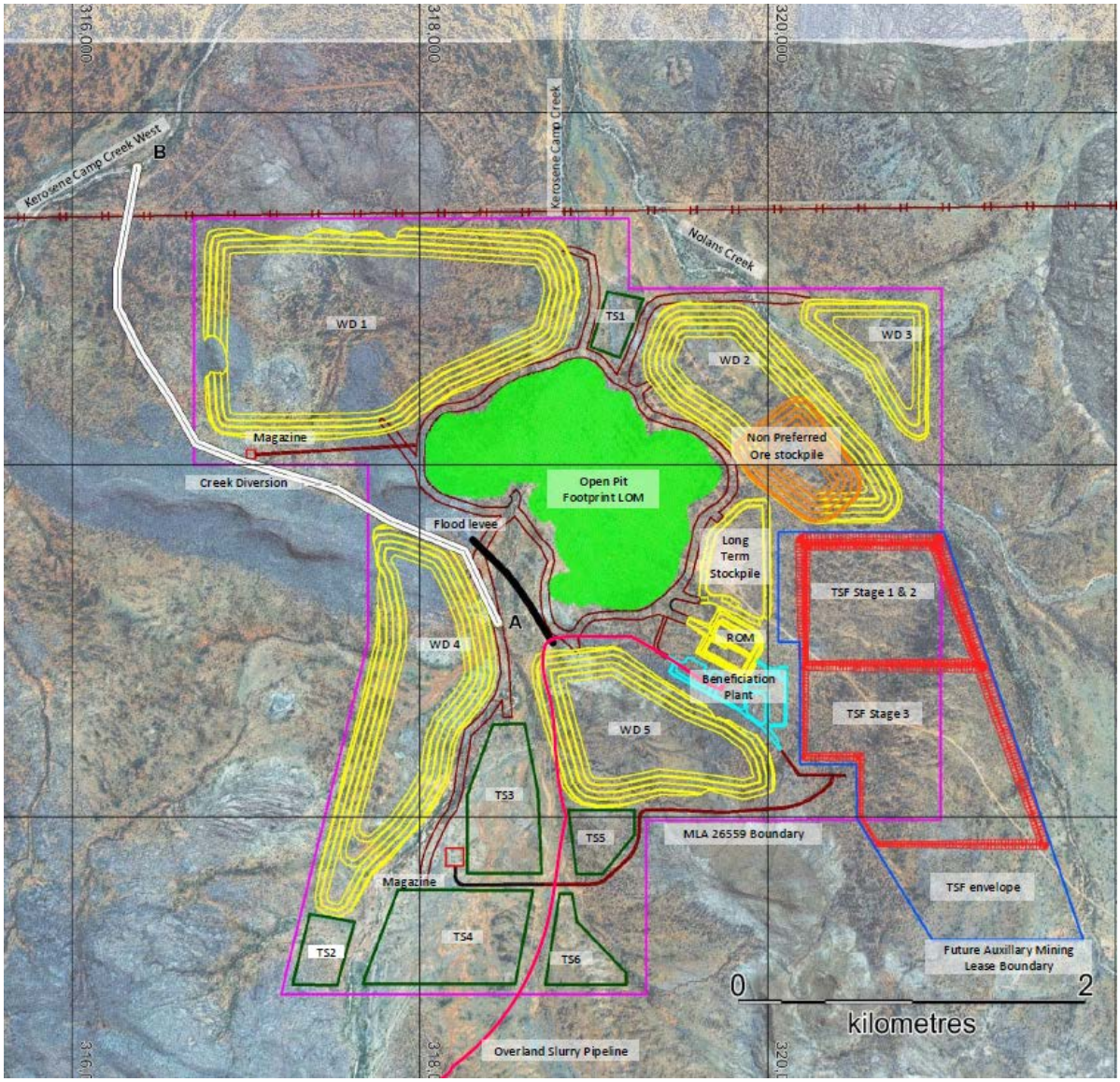

Figure 3: Proposed diversion of Kerosene Camp Creek and mine site layout. Diversion is shown in white. A levee (black) would prevent water ingress to the pit (green). The location of all other infrastructure is indicative only (WD = waste rock dump, ROM = run of mine, TS = topsoil storage). Source: supplied by Proponent.

2.2.2 Decommissioning and Closure

Several mine landforms would remain in the landscape following closure; including the open pit (containing a pit lake), creek diversion, waste rock dumps (WRDs), tailings storage facility (TSF) and residue storage facility (RSF). The intent of mine closure is to return the land, as close as is reasonably practical, to its pre-disturbance condition; with safe and stable landforms that support vegetation growth and enable potential future uses of the site. The proposed final land use is cattle grazing. All plant equipment, buildings, pipelines, power station, and unused materials would be removed from the site.

The current Project description (Supplement, section 2) indicates the TSF would have a disturbance footprint of 195 ha, height of 22 to 25 m and total storage of ~27 Mt of dry tailings. The RSF would encompass several cells over 356 ha, with embankment heights up to 14 m and total storage of ~17 Mt of dry residues (Supplement, section 2.9.1). Both of these facilities could contain radionuclides in concentrations higher than NORM associated with the deposit. The Proponent has committed to covering both with a minimum of two metres of benign waste rock, with the cover system to be based on outcomes of pre-closure trials (Supplement, section 2.9.3).

Waste Rock Dumps would have a total footprint of 460 ha and store 133 million loose cubic metres of waste rock. Approximately half of this waste rock would have radioactivity exceeding 1 Bq/g; this would be encapsulated with at least two metres of benign waste rock, placed progressively during operations. The small amount of potentially acid forming waste rock would be encapsulated in a WRD with a low permeability cover. The final landform design would be determined when representative waste rock is available, after mining commences (Supplement, section 2.10.1). The WRDs, TSF and RSF would have topsoil applied and be revegetated as appropriate to achieve closure objectives on stabilisation and post-closure land use (draft EIS, appendix W).

The pit would remain an open void and contain a pit lake that would become hypersaline and require restricted access by people and fauna post closure. It is the Proponent's view that it would also be a permanent groundwater sink with an increasing radius of groundwater drawdown.

The diversion of Kerosene Camp Creek would remain in place. The levee preventing the ingress of water into the pit would be upgraded to convey a 1000 year ARI (average recurrence interval) rainfall event. A flood-protection levee would be constructed around the perimeter of pit to prevent floodwaters entering the pit. This is currently proposed to be sufficient height to prevent a 1000 year ARI event, plus a 0.5 m freeboard (Supplement, section 14.4.1).

A draft Mine Closure Plan was included in the draft EIS (appendix W), and would continually evolve during the planning, construction and operation of the Project. This is discussed further in section 5.3 of this Report.

3 Key environmental factors

Having regard to the Notice of Intent, the draft EIS and Supplement, and comments from the public and advisory bodies during the EIS review, the NT EPA identified the following key environmental factors that may be impacted by the Project:

- Hydrological process
- Inland water environmental quality
- Terrestrial flora and fauna
- Social, economic and cultural surroundings
- Human health

The NT EPA has considered the importance of other environmental factors during the course of its assessment. Those factors that were not identified as key environmental factors are summarised at Appendix 1 of this Report.

The key environmental factors are discussed in sections 4.1 to 4.6 of this Report. The description of each factor shows why it is relevant and how it would be affected by the Project. The assessment of the factors is where the NT EPA decides whether or not the Project has met the NT EPA's environmental objective for each factor. The NT EPA considers that several aspects of the Project could lead to environmental impacts and risks across a number of the key environmental factors. These have been addressed as whole of project considerations in section 5 of this Report.

The NT EPA identified the following potential environmental impacts and risks that contributed to the decision to assess the Project at the level of an EIS:

- contamination (by seepage) of groundwater resources underlying the wastewater and waste rock storage facilities, and the pits
- impacts on recharge to the Ti Tree groundwater basin, including potential impacts due to contamination of surface water
- long term capacity of waste storage facilities to prevent leakage of wastes
- risks associated with increased traffic and the transportation of chemicals on public roads
- radiation hazards for workers, the public and the environment
- impacts of the increased mine footprint on local flora and fauna
- uncertainties regarding the treatment, storage and eventual disposal of waste material
- risks associated with the increased footprint with respect to the adequacy of closure and rehabilitation of the site
- public concern over environmental, health and social impacts of the Project.

Information requirements based upon identified potential impacts and risks were described in the Terms of Reference for the Project (NT EPA, 2015). The Proponent submitted the EIS to address the NT EPA's requirements.

4 Environmental Impact Assessment

The purpose of this section is to evaluate the Project and to present the view of the NT EPA on the environmental acceptability of the Project. The environmental acceptability of this Project is based on an analysis of:

- the proposed action (particularly which components or activities are likely to significantly impact the environment)
- the existing environment (particularly environmental values and sensitivities)
- the potential environmental impacts and risks and their significance and the evaluation of the significance of those impacts and risks
- proposed avoidance or minimisation / mitigation measures to reduce potential impacts and risks to acceptable levels and to meet NT EPA objectives.

Conclusions drawn and recommendations made in this Report are derived from consultation on the final EIS with advisory bodies, the NT EPA's examination of the EIS and responses from the Proponent to comments/consultation. Recommendations are made in this Report to add, emphasise or clarify any commitments made by the Proponent, where the proposed avoidance or minimisation/mitigation measures are considered insufficient or where a safeguard is deemed particularly important.

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

The NT EPA acknowledges that detailed design and operational plans for the Project have not been finalised. This Report will inform the granting and the decision of conditions for the mining authorisation under the MM Act.

It is likely that there will be minor and insubstantial changes in the Project following the conclusion of the EIA process. It will be necessary for approval mechanisms to accommodate subsequent changes to the environmental safeguards described in the final EIS and recommendations in this Report. The NT EPA considers that this assessment is valid for five years from the date of this Report. If the proposed action has not substantially commenced in this period, the NT EPA requests to be notified in writing by the Proponent or Operator.

Provided the Proponent is able to demonstrate that changes are unlikely to significantly increase potential impacts on the environment, an adequate level of environmental protection could be achieved by modifying the conditions attached to relevant statutory approvals governing the Project. These could include application of an agreed adaptive management framework. Otherwise, further environmental assessment may be required.

Recommendation 1

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

- **identified in the final Environmental Impact Statement for the Nolans Project (draft Environmental Impact Statement and Supplement)**
- **recommended in this Assessment Report 84.**

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

Recommendation 2

The Proponent or Operator shall provide written notice to the Northern Territory Environment Protection Authority and the responsible Minister if it alters the Nolans Project and/or commitments in such a manner that the environmental significance of the action may change, in accordance with clause 14A of the Environmental Assessment Administrative Procedures.

The remainder of this section of this Report discusses the key environmental factors and potential impacts and risks to those factors based on likely significance, and the Proponent's investigations and studies and/or commitments to identify, avoid, mitigate, monitor and manage the potentially significant environmental impacts and risks. For each key environmental factor, the NT EPA assesses whether or not the proposal meets its environmental objective for that factor.

4.1 Hydrological processes

4.1.1 Environmental objective

Maintain the hydrological regimes of groundwater and surface water so that environmental values are protected.

4.1.2 Groundwater hydrology

4.1.2.1 Environmental values

The Project is located in a hot, arid climate characterised by low rainfall and high evaporation. In an environment with scarce water resources, the conservation of groundwater resources is of high importance. There are significant regional groundwater aquifers in the vicinity of the Project (figure 4) with environmental values of water dependent ecosystems, drinking water supplies and agricultural water use.

The Ti Tree Basin, a regional scale aquifer of high quality water, is located north-east of the Project (figure 4). It has significant extractive values, and is currently used for irrigation of horticultural crops, town and community water supplies, and for stock use (draft EIS, chapter 8). The hydrology of this aquifer is relatively well understood due to its extensive monitoring and is managed under a gazetted water management plan. The Ti Tree Basin is a Water Control District administered by the Department of Environment and Natural Resources (DENR); meaning that specified quantities of water are allocated to users to ensure the sustainable use of groundwater resources.

South and south-west of the Project location are a series of groundwater basins including the Reaphook Paleochannel (and feeder aquifers), the Witcherry Basin and the Lake Lewis Basin (figure 4). This regional scale aquifer system, referred to as the Southern Basins, contains variable quality water and has potentially significant extractive values. It is currently used for small scale groundwater abstraction for stock and domestic purposes. This includes providing drinking water for Alyuen community (and Aileron Homestead) and Laramba community (and Napperby Homestead), and some stock water for Pine Hill, Aileron and Napperby Stations. In comparison with the Ti Tree Basin, the hydrology of the Southern Basins is not well understood, and its use is not regulated as it is not in a Water Control District. The most up-to-date knowledge of this system has been developed by the Proponent through investigations for this Project.

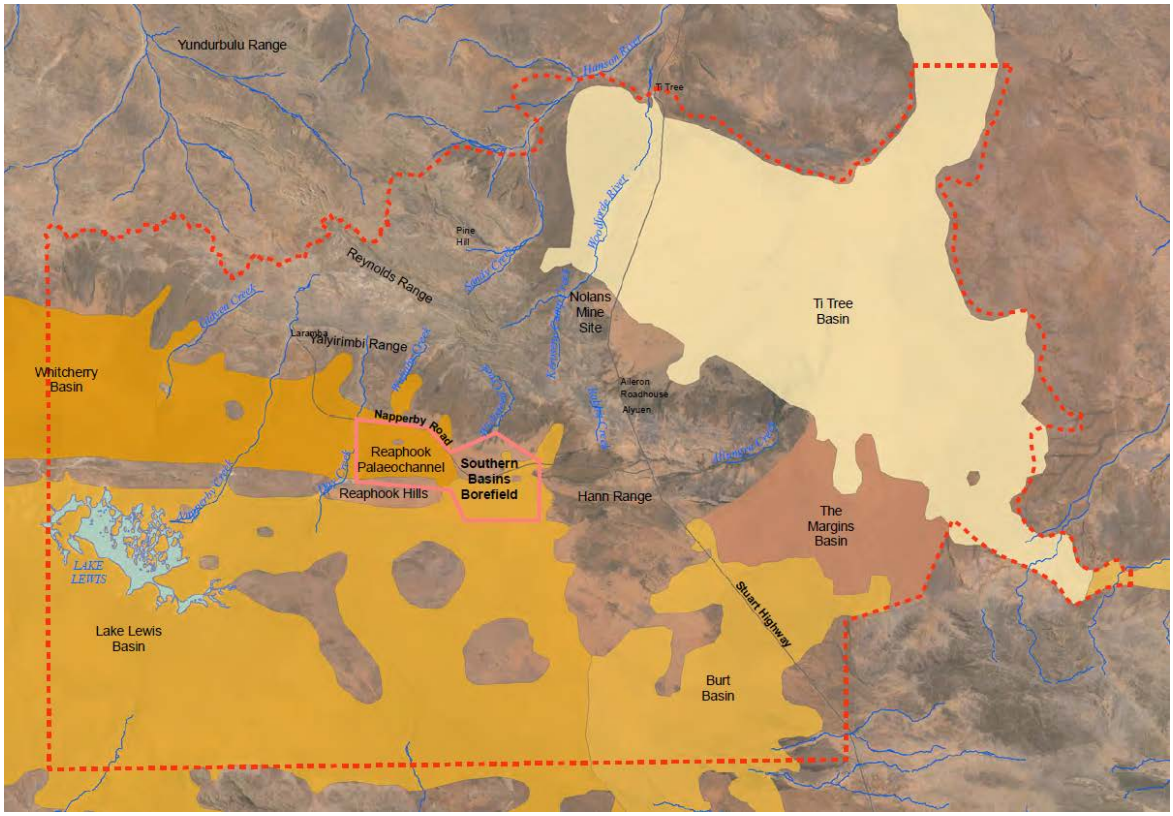

Figure 4: Regional groundwater basins in the vicinity of the Project. The groundwater study area for the EIS is outlined in red. The proposed borefield for the Project is outlined in pink. Source: Fig 8-1, draft EIS

The ore body within the mine site is located in a local aquifer that provides water for stock use (Supplement, appendix 3). It is surrounded by basement rocks with low permeability that is generally restricted to rock fractures (Supplement, appendix 3). The conceptual model for the mine site shows that the local aquifer is separated from the Ti Tree and Southern Basins by rocks of very low transmissivity. The Ti Tree Basin and Southern Basins are connected by an aquifer region referred to as the Margins (figure 4).

Groundwater in the region supports groundwater dependent ecosystems, including stygofauna and some tree species. These tree species are phreatophytes or facultative phreatophytes, meaning that they may fully or partially rely on subsurface groundwater (Supplement, appendix 11). The DENR has advised that these trees may access groundwater down to a level of about 15 metres below surface. These species are discussed further in section 4.3.

Ecosystems at Lake Lewis, a site of conservation significance, may also be partially or fully dependent on groundwater. Lake Lewis is a transitory salt lake system and Site of Conservation Significance about 70 km west-south-west of the Project area that supports a number of vulnerable species (Supplement, section 4.3). While the lake is largely fed by surface water, it also has a component of recharge from groundwater from the Southern Basins (Supplement, section 4.3).

4.1.2.2 Potential impacts

The Project may impact significantly on environmental values that depend on the existing hydrological groundwater regime. Specifically, groundwater drawdown may contribute to a reduction in the volume of groundwater available to current and future users of regional aquifers, and may impact significant ecosystems. This could be due to:

- abstraction of groundwater and subsequent long-term drawdown at the borefield

- removal of the ore body aquifer and subsequent permanent drawdown of groundwater at the mine site.

4.1.2.3 NT EPA assessment

Borefield groundwater abstraction

The proposed borefield for the Project would extract 2.7 GL/yr of groundwater from five bores in the Reaphook Paleochannel (NE Southern Basins; figure 4). This rate of water abstraction would cause a localised drawdown of groundwater, with the potential to permanently alter hydrological processes in the Southern Basins system. Potential impacts include a restriction of future use of this water resource or reduced water supply to groundwater dependent ecosystems including those at Lake Lewis. These impacts are difficult to predict without a good understanding of the groundwater system and how groundwater abstraction would affect groundwater drawdown and flows.

The Proponent has conducted hydrogeological investigations since 2012 using bore data in conjunction with airborne electromagnetic geophysical datasets. In total, the Proponent has drilled 78 investigation bores (figure 5) and obtained data from additional existing bores across the groundwater study area. Of the investigation bores, 28 were in the NE Southern Basins; in which water levels were monitored between 2014 and 2017 (Supplement, appendix 3).

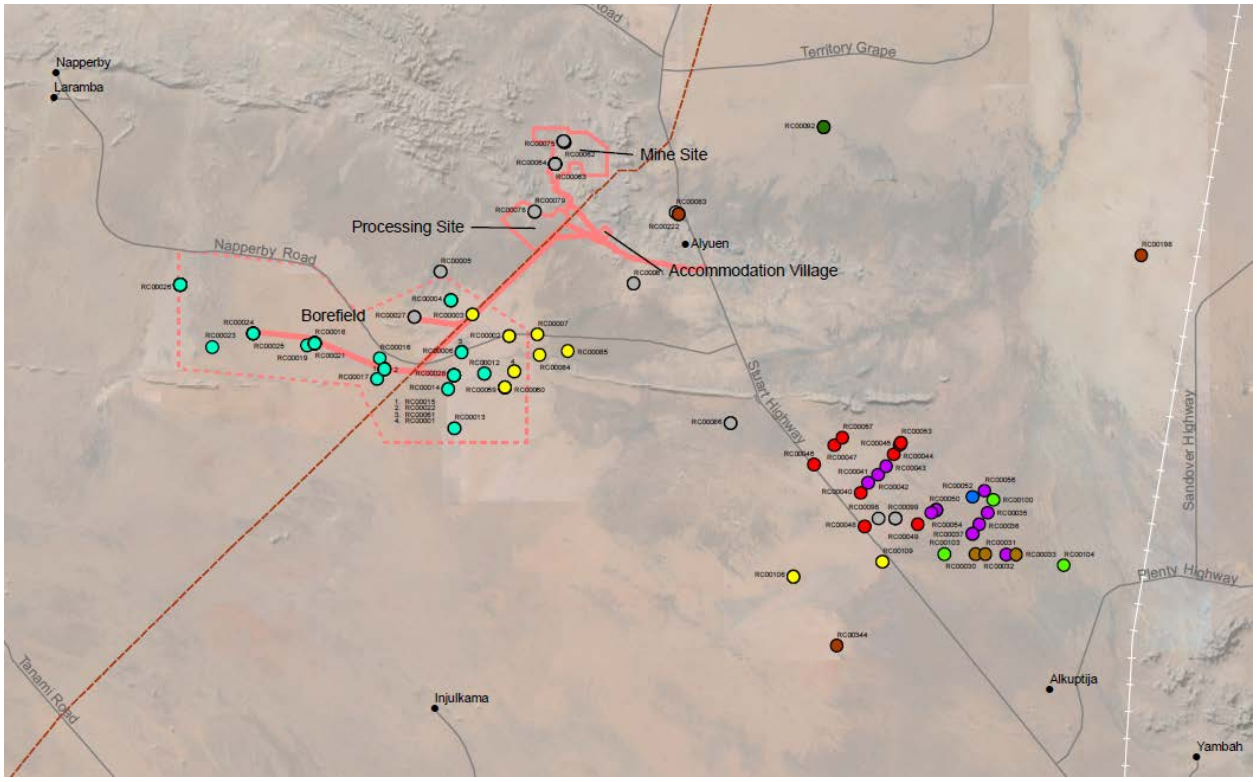

Figure 5: Groundwater investigation bores for the Project. The outline of the proposed borefield for the Project is dotted pink. Source: Supplement, appendix K of appendix 3, figure 3.

The Proponent has assessed the potential impacts to groundwater hydrology from groundwater abstraction and developed a conceptual groundwater model. The conceptual groundwater model indicates the Reaphook Paleochannel contains a multi-layered aquifer system that largely consists of sand and gravel with minor clay. Across the proposed borefield, the standing water level (below ground level) varies from less than ten metres to about 30 metres (Supplement, appendix K of appendix 3, figure 12). The system is recharged from overlying and adjacent alluvial aquifers and throughflow from the east (Supplement, appendix 3). Uncertainties remain on this recharge; water

levels were observed to be stable despite significant rainfall events in early 2017 indicating that recharge does not appear to be strongly driven by local infiltration.

Based on the information provided in the EIS, it is uncertain whether the acquired data has been adequately interpreted to provide a valid assessment of the groundwater resource.

The Proponent has constructed a Class 1 numerical groundwater model according to the Australian Groundwater Modelling Guidelines (NHMRC, NRMMC , 2011). The model outputs were based on a mining period of 40 years, less than the current proposal of 55 years. The model predicted that there would be a drawdown of at least one metre over an area of 380 to 810 km^2 (Supplement, section 4.4). The majority of that area may have a drawdown of between one and five metres, with a maximum drawdown of about six metres[1] (draft EIS, chapter 8). All model scenarios predict that by 1000 years after mine closure, significant recovery would occur such that no areas of the borefield would have a drawdown of over one metre. The NT EPA is of the opinion, there is limited accuracy in the quantitative predictions from a preliminary class 1 model for a 1000 year period and notes continual model review based on real monitoring data is the preferred option to assess potential impacts.

The Proponent acknowledges this is preliminary modelling with a high degree of uncertainty and limited capability for predicting environmental impacts. The Proponent has committed to further validating the Class 1 groundwater model with the provision of additional baseline information prior to construction of the Project and by using data collected in the first five years of water abstraction. The Proponent has provided mitigation measures for sustainable use of groundwater, including conducting a review of the groundwater model annually in an updated Water Management Plan as part of mining approvals.

The Proponent has committed to continue hydrogeological investigations and within 10 years of operation would update and recalibrate the groundwater model, using monitoring data, to a Class 2 groundwater model. This would require temporal monitoring flow gauges to be installed on abstraction bores and data obtained over an extended period (~ 10 years) of substantial water abstraction (Supplement, section 4.22). The Proponent has committed to installing additional monitoring bores to inform the groundwater model. The Water Management Plan includes collecting operational monitoring at 17 bores across the borefield and five production bores (Supplement, appendix 4).

The NT EPA considers that further information is necessary to validate and upgrade the existing Class 1 groundwater model and progress to a Class 2 groundwater model. This would improve its predictive capacity and enable a better assessment of potential environmental impacts of water abstraction and subsequent drawdown. It would require updating the groundwater monitoring program to inform the model, updating the groundwater model for the revised mining period (currently 55 years) and improving the estimation of recharge rates. The NT EPA recommends modelling updates are incorporated into a **Water Abstraction Management Plan,** separate from the Water

[1] This is based on model 139; the only model for which drawdown contours over one metre have been presented. This model is not current as it used an abstraction rate of 4.7 GL/yr rather than the currently proposed 2.7 GL/yr. However, the NT EPA considers that its predictions are likely to be broadly applicable because it has a similar contour for the one-metre drawdown as the most conservative of the current models (# 400).

Management Plan, to ensure monitoring results and model outputs inform adaptive management responses.

Adaptive management is an approach suitable for managing potential unknown impacts to groundwater drawdown from mining projects in Australia. It includes developing management objectives, targets/triggers, actions to mitigate the risk, monitoring programs, evaluating monitoring data and changing the management regime when triggers are reached (Lee, 2014). Where performance outcomes or limits are set as any condition of an approval, then adaptive management triggers and action need to be taken in advance to ensure those outcomes or limits are not breached. The NT EPA recommends mining authorisations clearly define specific adaptive management responses for groundwater management for the Project.

Recommendation 3

Before approvals or decisions are given or made for the Project, the Proponent or Operator shall provide to the relevant regulator a Water Abstraction Management Plan for the Nolans Project. The Water Abstraction Management Plan must, at a minimum provide:

- **a) a full description of the groundwater model, assumptions and parameters**
- **b) further information to validate the existing class 1 groundwater model, including a clarification of recharge of the borefield and cross sections of appropriate spatial and vertical resolution of the NE Southern Basins aquifers**
- **c) revised model outputs for estimated groundwater drawdown, and recovery of groundwater levels post-closure (including 50, 100 and 1000 years), at the borefield and mine site, for the projected life of the Project**
- **d) a framework identifying timing, methods and parameters for the collection of further information on baseline groundwater levels, flow directions and flow rates to understand natural variance and hydrological conditions in the borefield and mine site**
- **e) details of all monitoring bores, including the lithology and aquifers intersected and the purpose of monitoring at each bore**
- **f) confirmation that all bores and bore meters would be constructed, operated and registered in accordance with the 'Minimum construction requirements for water bores in Australia' as published by the National Uniform Drillers Licensing Committee and the Department of Environment and Natural Resources 'Non-urban water metering code of practice for water extraction licences'**
- **g) measures to quantify and record the volume of water abstracted from the borefield and mine site to support minimum monthly reporting of pumping records from individual bores**
- **h) a framework, including timeframes, for progressing to a Class 2 numerical groundwater model consistent with the Australian Groundwater Modelling Guidelines**
- **i) an independent peer review of the updated Water Abstraction Management Plan by a suitably qualified independent professional**

The Water Abstraction Management Plan should be developed and implemented to the satisfaction of the relevant regulator.

Mine site groundwater drawdown

Groundwater hydrological processes would be permanently altered at the mine site. This includes the removal of the localised aquifer that coincides with the ore-body and is confined by surrounding low-permeability rocks. The groundwater model presented in the draft EIS indicates that the open pit would become a permanent groundwater sink with estimated inflows of eight litres a second (draft EIS, chapter 8). This would result in a continuous drawdown of groundwater surrounding the pit. At the end of mine life the open pit would contain a pit lake that would reach equilibrium where evaporation matches inflows, at a level 80 m below the original aquifer depth (draft EIS, appendix K).

The groundwater sink from the pit is not predicted to have any significant impact on the high quality aquifers of the Ti Tree Basin and Southern Basins after closure of the Project because the rock basement connecting these aquifers has very low transmissivity. Uncertainty remains on the predictions of the drawdown modelling and the NT EPA makes recommendation 3 to ensure the model is refined and updated.

The NT EPA notes that there are uncertainties surrounding the behaviour of mine pit lake post-closure. It is recognised that a pit lake functioning as a terminal sink largely protects the greater undisturbed regional environment from potentially contaminated seepage. However, the long term behaviour of mine pit groundwater sinks is uncertain; the sink may transform into a source in future due to increasing water density or climate change (McCullough, et al., 2013). The NT EPA considers further studies are required on the final void water quality including the surrounding groundwater level and expected quality of water held in the void prior to final acceptance of the Mine Closure Plan. The NT EPA makes recommendations 15 and16 in section 5.3, to ensure the proposed final landforms support sustainable mine closure.

While groundwater drawdown at the mine site presents a relatively small and discrete area of permanent impact in the region, current modelling indicates an increasing area of impact. The NT EPA considers it is not an acceptable closure objective to allow continuing groundwater drawdown impacts and this is discussed further in section 5.3. Additional groundwater investigations, further modelling and definition of the confined nature of the localised pit aquifer should be provided as part of the **Water Abstraction Management Plan** outlined in recommendation 3 of this Report.

Groundwater drawdown – impacts to users

The modelled maximum drawdown at the Aileron/Alyuen and Laramba/Napperby supply locations near the proposed borefield are 0.6 and 1.3 m respectively (Supplement, UID 80). This is unlikely to impact on water supplies, as the existing supply bores are likely to have contingency to allow for localised drawdown while operating the bores (draft EIS, chapter 8). The NT EPA considers it would be important to carefully understand and monitor any impact and implement effective mitigation measures if needed.

Recommendation 4

The Water Abstraction Management Plan established in recommendation 3 must include assessment and management of any stock or drinking water bores that could be impacted by the Project, in agreement with the owners and/or operators of those bores. This is to include:

a) conducting a hydro-census (condition) survey of local groundwater users prior to construction to establish baseline conditions

b) a program to monitor water levels at those bores to detect whether levels are within observed baseline conditions

c) measures to ensure identified groundwater user bores remain operational or provide an alternative water bore or supplies if required.

The NT EPA notes that the Southern Basins aquifers currently support only small scale abstraction for stock and domestic purposes. However, the system does contain some high quality water and has potentially significant extractive values for possible future uses. The abstraction of water for this Project may limit the availability of water for possible alternative future uses.

Groundwater drawdown in the mine site area would be likely to impact on some of the current use of stock water in the area. Due to the permanent groundwater sink of the final pit, Aileron Station stock water bores would be irreversibly impacted, with this source of water no longer available. Current modelling indicates that Pine Hill Station stock water bores in the vicinity of Kerosene Well, eight kilometres downstream of the proposed mine pit, would not be impacted (draft EIS, appendix K). As a mitigation measure the Proponent has committed to provide substitute water from elsewhere for existing stock bores, if required (Supplement, section 5). The uncertainty of this impact would be addressed by the application of recommendation 4.

Groundwater drawdown – impacts to groundwater dependent ecosystems

Tree species that are partially dependent on groundwater (described in section 4.3.2.1) could be impacted by groundwater drawdown. These are known to occur in the vicinity of Day Creek at the western end of the borefield – both along the channel and near the Reaphook Hills (in riparian vegetation, Corymbia alluvial open woodland and Bloodwood sandplain; Supplement, appendix 9). They are unlikely to occur in significant densities over the remainder of the borefield which is spinifex-dominated sand plain (DENR, 2000), but this has not been confirmed by mapping at an appropriate scale. They are also known to occur in Riparian vegetation in the vicinity of the mine site.

The DENR has advised that vegetation is only likely to be groundwater dependent where groundwater depth is less than 15 metres below ground level. Impacts to this vegetation would be highly likely if groundwater is drawn down beyond 15 metres below ground level, but could also occur if shallower groundwater is drawn down significantly. In some parts of the Day Creek area near the borefield, groundwater depth is less than ten metres (Supplement, figure 12, appendix K of appendix 3, figure 12), and is predicted to have a drawdown of between one and five metres due to the Project (draft EIS, figure 8-8). This could be a significant drawdown.

The groundwater sink from the pit may impact groundwater dependent, and sensitive, riparian vegetation in the vicinity of the proposed mine site. While the geographic extent of this drawdown is uncertain, it is likely to be a deep drawdown close to the pit, which would be likely to impact on any vegetation that was groundwater dependent. The NT EPA considers that groundwater dependent vegetation may be potentially impacted by groundwater drawdown associated with the Project. The NT EPA makes recommendation 5 for further understanding any groundwater dependence of vegetation and for developing mitigating measures for any potential impacts.

Groundwater drawdown at the mine site has the potential to impact on stygofauna, should it be present in calcrete aquifers. A study conducted in 2010 for the Proponent (Supplement, appendix 15) was not able to effectively survey the calcrete aquifers within the mine site because one bore in the calcrete was believed to contain rainwater and other bores did not contain water. The report noted that this calcrete is likely to contain superficial aquifers with a high likelihood of containing stygofauna. If these aquifers are hydraulically linked to the deeper fractured rock aquifer in the ore body, they would be impacted by dewatering of the ore-body aquifer. The NT EPA makes recommendation 5 for the Proponent to conduct a risk-based stygofauna habitat impact assessment, during the mining authorisation stage, to determine the likelihood of presence of stygofauna

and, if present, inform appropriate mitigation measures in the Water Abstraction Management Plan.

The borefield abstraction would not take water from any calcrete aquifers that are known to provide habitat for stygofauna. The NT EPA considers it is unlikely that stygofauna would be impacted by borefield water abstraction.

The NT EPA acknowledges the uncertainty around the modelled drawdown and the groundwater dependence of vegetation. Drawdown uncertainties would be addressed by further refinement and update of the groundwater model as outlined in recommendation 3.

The NT EPA considers that it is important to further understand groundwater dependent ecosystems and potential impacts of drawdown. In the absence of baseline data and given the uncertainty in the model drawdown predictions, the NT EPA recommends setting conservative groundwater level triggers and management responses in the **Water Abstraction Management Plan** until that knowledge gap is filled. Further studies and groundwater and vegetation monitoring programs are required to fill that gap. Resulting site-specific triggers could possibly be less conservative, meaning that the requirement for an adaptive management response, such as reducing or ceasing pumping and/or sourcing alternative water supplies, would be less likely over time. This would provide more certainty to the Proponent or Operator that they can continue to abstract water from the borefield, allowing the continuation of mining activities and ensuring the groundwater dependent vegetation is not impacted.

Recommendation 5

The Water Abstraction Management Plan established in recommendation 3 must incorporate an assessment of groundwater dependent ecosystems. This is to include:

- **a) mapping of potentially groundwater dependent vegetation by intersection of the following areas:**
  - **where standing water level is less than 15 metres below ground level**
  - **where vegetation contains potentially groundwater dependent species (this could be mapped using remote sensing and confirmed by field survey)**
  - **where groundwater is predicted to have a significant drawdown, due to the Project, including after completion of the Project**
- **b) applying conservative preliminary trigger levels to areas where groundwater is less than 15 metres below ground level to avoid impacts on groundwater dependent vegetation**
- **c) an assessment of stygofauna to determine the likelihood of presence of stygofauna and, if present, include appropriate mitigation measures**
- **d) procedures for applying clear, quantitative and measureable trigger levels for groundwater drawdown and an outline of specific adaptive management responses that would be implemented if necessary**
- **e) proposed mitigation and management responses in the event that trigger levels are exceeded**
- **f) a plan to monitor groundwater levels (drawdown) and vegetation health, in areas where groundwater dependent vegetation occurs, and refine trigger levels for groundwater drawdown based on site-specific data**

g) **an independent peer review of the proposed initial and revised groundwater trigger levels and vegetation health monitoring assessment by a suitably qualified independent professional.**

Based on the current modelling outputs and distance of the borefield to Lake Lewis (70km), it is unlikely that groundwater drawdown associated with the Project would have any impact on groundwater contributions to Lake Lewis. Preliminary modelling predicts no groundwater drawdown at the lake, and the peak loss in the total water balance of the lake is estimated at 0.01% (Supplement, section 4.3). The NT EPA considers groundwater drawdown is highly unlikely to impact on the Lake Lewis Site of Conservation Significance and values associated with this site. Updated modelling should provide additional certainty on this prediction.

Sustainable water use

The Project is located in an arid region where groundwater resources are a shared resource and have high value. The NT EPA considers the Proponent is obligated to minimise groundwater abstraction to demonstrate best practice in water stewardship and responsible and sustainable water management. The International Council on Mining and Metals (ICMM) provides water stewardship guidance with the aim to achieve a safe, fair and sustainable mining industry (ICMM, 2017). Water stewardship is one of the principles underpinning a best practice framework for sustainable development in the mining industry. The commitments under the ICMM water stewardship framework include:

- apply strong and transparent corporate water governance
- manage water at operations effectively
- collaborate to achieve responsible and sustainable water use.

The Proponent has committed to maximising water efficiencies through recycling tailings supernatant water, recovering water from the processing plant and further reductions to be incorporated during the detailed design phase (Supplement, section 2.11). The current water balance is generalised for the whole life of the mine and it would be updated following additional test work and evaluations. The NT EPA recommends sustainable use of groundwater by the Proponent which includes minimising water consumption, applying corporate water governance and providing an open and transparent reporting of the use of that groundwater resource. These should be outlined in the Water Management Plan, separate to the Water Abstraction Management Plan discussed above.

Recommendation 6

Mining approvals in relation to groundwater abstraction should include conditions that require the Proponent or Operator to:

a) **allocate clear responsibilities and accountabilities for water use and management**

b) **provide, in the Water Management Plan, regular updates of the projected water balance for the Project, including detailed estimates for the various phases of the Project and specifying the source and quantity of the water to be used**

c) **demonstrate how water considerations are integrated in Project planning including final Project design and technologies**

d) **report on continual improvement initiatives in water use and efficiencies including the provision of relevant water use targets**

e) **provide details on how water would be effectively managed during Project operations, including minimising water consumption, maximising water reuse and preventing water waste including unnecessary or excessive flow or flood of water**

f) **abstract water from bores only when equipped with operating flow meters**

g) **record the volume of water abstracted from the borefield and the mine site as reported in the Water Abstraction Management Plan (recommendation 3)**

h) **provide an annual Water Management Report to stakeholders. This is to include water use performance, performance in relation to triggers and any changes in triggers.**

Public disclosure of the Water Management Plan and annual Water Management Report shall be provided on the websites of (as applicable), the Proponent or Operator and relevant regulatory authorities.

Summary

The NT EPA considers that there is potential for impacts on groundwater hydrological processes and associated environmental values. The significance of impacts is difficult to predict until groundwater numerical modelling is updated based on five to ten years of operational pumping data from the Project. Additional uncertainty remains on the potential impacts to riparian and other groundwater dependent vegetation. Although the potential impacts to stygofauna have not been fully assessed, the NT EPA is of the opinion that potential impacts to stygofauna are likely to be highly localised.

The NT EPA has made recommendation 3 for a **Water Abstraction Management Plan** to refine the groundwater model and improve its predictive capacity to enable appropriate management responses. Recommendation 4 would provide mitigation to potential impacts of groundwater users and the NT EPA makes recommendation 5 to inform groundwater trigger values in relation to potential impacts to groundwater dependent vegetation at the borefield. Recommendation 6 reinforces good water stewardship in recognition that in an arid zone where groundwater is a precious resource it is important for the Project to use water conservatively to reduce potential impacts from groundwater drawdown.

The mining of the ore body would permanently alter local groundwater hydrological processes, resulting in a localised groundwater sink. The NT EPA considers it an unacceptable closure objective for ongoing drawdown impacts from this sink and this is to be addressed in the Proponent's Mine Closure Plan. The NT EPA makes recommendation 3 for further investigations to more accurately define the localised pit aquifer and extent of impacts to be implemented in the **Water Abstraction Management Plan.**

4.1.3 Surface water hydrology

4.1.3.1 Environmental values

The Project is located in a hot, arid climate characterised by low rainfall and high evaporation. Surface water features are all ephemeral; they support flora and fauna and recharge groundwater resources across the region. Flow records from the Woodforde River (Arden Soak Bore, 26 km downstream of the proposed mine site) show that flow events occur only once or twice in most years and are most likely in the summer months (December to March). The Proponent has not yet provided baseline surface flow data from the Project area.

The Project spans a surface water divide at the eastern extension of the Reynolds Range (figure 2). The proposed mine site is located to the north of this divide (figure 3), where surface runoff drains generally northwards to the Woodforde River. The

processing site, accommodation village and borefield are located to the south of the divide where surface runoff drains generally south or south-west to flood-out on the plains in the broader Lake Lewis catchment.

In the region, semi-permanent water holes exist in places where water pools in basement rock. These provide a source of water for environmental use (e.g. native fauna) until evaporation depletes the water (draft EIS, chapter 8). These features are present in the hills and ranges near the Project area, but are all upstream or in separate catchments from the Project (Supplement, section 4.16).

Riparian woodland is a significant vegetation community that is sustained by surface water flows, particularly along waterways to the north (downstream) of the mine site. Another important function of regional surface water processes is in the recharge of groundwater aquifers by seepage along waterways and near the base of ranges (draft EIS, chapter 8).

4.1.3.2 Potential Impacts

The Project may impact on environmental values that depend on the existing hydrological surface water regime. Construction and operation of the Project would have the potential to result in the following direct impacts on surface hydrology:

- change in the flow pathway and amount of water in Kerosene Camp Creek and potentially downstream including Woodforde River
- change in localised runoff pathways associated with roads and other Project infrastructure, altering flood regimes and potentially increasing erosion
- impacts to depth and velocities of flooding at the town of Ti Tree from a potential dam break at the TSF.

4.1.3.3 NT EPA assessment

Kerosene Camp Creek diversion

The permanent diversion of Kerosene Camp Creek would divert surface water from an upstream catchment of approximately 20 km^2 (draft EIS, figure 7-9). It would be directed through an engineered steep-sided channel excavated into in the bedrock (Supplement, appendix 13). This would impact on localised hydrological processes and significant riparian vegetation, mainly outside of the proposed mineral lease, by altering flows as follows:

- cessation of flows in a ~3 km length of the creek, ~2 km of which is inside the proposed mineral lease. The area of riparian vegetation impacted would be 11 ha (Supplement, UID 235).
- reduce flows along a further ~3 km of the creek's length, downstream of the confluence with Nolans Creek.
- increase flows along ~ 4km of the tributary of Kerosene Camp Creek as the result of the diversion. Riparian vegetation may be impacted by the movement of excess water and possible deposition of sediment.

The NT EPA considers that the permanent loss of 11 ha of riparian vegetation due to the Kerosene Camp Creek diversion is not significant on a regional scale and cannot be avoided should the Project be approved for implementation.

It would be important that the diversion channel is designed to effectively deliver the surface water flows from the catchment above the mine pit to the Woodforde River and thus maintain its environmental values. It is unclear if the current creek diversion designs

(Supplement, section 4.15 and Appendices 13 & 14) would achieve this, because an earlier assessment suggested that sedimentation near the diversion entrance may cause flood waters to enter the pit instead of the diversion (draft EIS, appendix A of appendix I). The NT EPA considers that the Proponent must demonstrate that the diversion would be fit for purpose, and maintain river environmental values to the maximum extent practicable, prior to any approvals.

An important feature of the diversion is a levee bank that would prevent the ingress of water into the pit for all flows up to a 100 year ARI, during operation. Post-closure this would be upgraded to ensure diversion of a 1000 year ARI flood event. This would be complemented by a flood protection levee around the pit, designed for a 1000 year ARI event plus a 0.5 metre freeboard, to be designed during the detailed design phase of the Project (Supplement, section 4.14.1). If either levee bank were to fail post closure, the water from the upstream catchment may not be delivered to the Woodforde River. The NT EPA considers it is important to ensure the diversion and levee banks are designed such that they would permanently deliver water to the downstream tributary via the diversion channel and provide a high level of confidence that environmental values would be maintained in the Woodforde River.

Recommendation 7

Before approvals or decisions are given or made for the Project, the Proponent or Operator shall provide to the relevant regulator an updated Kerosene Camp Creek diversion design and modelling that demonstrate how the diversion would:

a) maintain the existing regional hydrologic regime by effectively delivering the natural flows of Kerosene Camp Creek to downstream reaches

b) avoid surface and sub-surface flows reporting to the pit, even in a 1000 year average recurrence interval flood event (1000 year ARI event)

c) maintain sediment transport and water quality regimes that allow the watercourse diversion to be self-sustaining

d) maintain surface water quality (as informed by acid and metalliferous drainage testing of basement rock)

The detailed diversion design is to be peer reviewed by an appropriately qualified independent professional and implemented to the satisfaction of the relevant regulator.

A catastrophic failure of the TSF/RSF

Changes to flooding scenarios could be caused by a dam break at the TSF prior to it being covered for closure. The Proponent modelled downstream flooding in the case of a dam failure at the TSF during a 100 year ARI rainfall event. This indicated that released water would contribute to significant downstream flooding at least 50 km to the north. At the town of Ti Tree, it would add about 10% to the natural flood depth and slightly increase velocities (draft EIS, appendix J). The NT EPA considers it is critical to prevent a dam break at the TSF. This is addressed in section 4.2.3 (Inland water environmental quality – surface water).

Changes to localised runoff pathways

Construction of the mine including the pit, waste rock dumps, tailings storage facilities, roads and processing plant would require the installation of new hardstand areas and the redirection of surface water flows, resulting in a potential increase of surface water runoff. These could potentially lead to localised erosion or deposition in creek beds.

The Proponent proposes to use engineering controls that assist in maintaining surface water flows, including culvert designs, longitudinal drainage and floodway crossings. In addition, the Proponent has committed to diverting all runoff from disturbed areas into sediment ponds. The Proponent presented flood modelling for the pre-disturbance mine site. This would need to be updated following detailed design of the proposed mine site and provided as part of the application for mining authorisation.

Summary

The NT EPA considers that impacts on surface water flows are unlikely to be significant as they can be managed and mitigated through site layout and engineering design informed by further flood modelling scenarios. Well informed engineered design and construction of stormwater and waste storage infrastructure should attenuate surface flows, manage flow velocities and contain surface water during peak rainfall events. The NT EPA has made recommendation 7 for updating the creek diversion design to demonstrate that surface water flows would be maintained and self-sustained post closure.

4.1.4 Conclusion against NT EPA objective

With the implementation of relevant management plans and recommendations identified above, the NT EPA considers that the Project could be conducted in such a manner that its objective for hydrological processes is likely to be met.

4.2 Inland water environmental quality

4.2.1 Environmental objective

Maintain the quality of groundwater and surface water so that environmental values including ecological health, land uses, and the welfare and amenity of people are protected.

4.2.2 Groundwater quality

4.2.2.1 Environmental values

Groundwater quality was determined from 158 samples taken from 71 bores across the study area between 2012 and 2016 (draft EIS, appendix K). These included samples from four bores at the mine site area (Supplement, appendix B of appendix 3) and others across the study area including the processing site and proposed borefield (figure 4). Test results were compared with Australian Drinking Water Guidelines (ADWG) and ANZECC guidelines for protection of freshwater aquatic ecosystems.

Groundwater quality varied across the study area. Samples were generally alkaline (pH ~8) and fresh to brackish (electrical conductivity average ~2500 micro Siemens per centimetre) but saline in some areas. A substantial proportion of samples had elevated metals, including uranium (draft EIS, appendix B of appendix K) that exceed environmental, stock and drinking water guidelines (draft EIS, appendix L). The general pattern of groundwater quality is as follows:

- the highest quality groundwater (“freshest”) is in the alluvial, shallow fluvial and calcrete aquifers. This includes the eastern part of the proposed borefield.
- the Reaphook Paleochannel aquifer, coincident with the majority of the proposed borefield, contains groundwater of moderate quality.
- the groundwater quality is lowest in the basement rocks, including at the mine site and processing plant.

Existing groundwater quality maintains environmental values that include the maintenance of potentially groundwater dependent ecosystems along Kerosene Creek, Woodforde River, Day Creek and other locations, and also potentially for stygofauna. Ultimately groundwater from the Reaphook Paleochannel / Southern Basins discharges at Lake Lewis and other areas further west, where ecosystems are dependent on the existing water quality. Landholders and local communities access groundwater for stock and drinking water supplies (refer to section 4.1.2.1).

4.2.2.2 Potential impacts

Contaminants in waste storage facilities have the potential to impact on groundwater quality via infiltration or leaching. Specifically, the following Project processes could potentially release such contaminants:

- potential acid and metalliferous drainage from mined materials
- infiltration or leachate from TSF and RSF
- infiltration or leachate from waste rock dumps
- leachate from Kerosene Camp Creek diversion.

Additional contaminants may be added to groundwater via the infiltration of contaminated surface water. This is discussed in section 4.2.3.

Notably, mine pit material contains naturally occurring radioactive materials (NORM) including uranium and thorium, which are primarily present in the ore with only small quantities in the waste rock. The NT EPA notes radioactive materials are found in association with rare earth deposits and processing these ores can subsequently increase the concentration of NORM in wastes (US EPA, 2012). Tailings and residues that would ultimately be stored onsite in the waste storage facilities may be in concentrations higher than NORM in the deposit. It is predicted that 25% of radionuclides from the ore would report to tailings (as solids), and 75% to the processing circuit, ending up in the residues. There is potential for these elements and their decay products to contaminate groundwater in the vicinity of the Project via seepage, and for radionuclide concentrations to be above groundwater background levels.

4.2.2.3 NT EPA assessment

Potential AMD from mined and waste materials

The potential for contaminants leaching from waste rock, ore, tailings and residue were tested using chemical analyses and presented in the Acid and Metalliferous Drainage (AMD) Assessment Report (draft EIS, appendix L) and in the Supplementary Tailings and Residue Report.

For waste rock and ore, 122 samples, representative of material throughout the proposed mine pit, were subject to stage 1 static AMD testing (Supplement, table 4-34). Results indicated that approximately 95% of the material is non-reactive and non-acid-forming (Supplement, table 4-34). Of these samples, 24 samples showing the highest risk of AMD across the material types were subject to stage 2 AMD and leachate testing. Those results showed there was a very low risk of acid generation from ore and waste-rock, and that most of the waste rock was non-sulfidic (draft EIS, appendix L). Nominally 1% of the material is potentially acid-forming (PAF), and this material is confined to a few defined areas within the pit (Supplement, appendix 16, figure 35).

In addition, assays used for resource classification informed the assessment of potential AMD material. Out of 3 473 assays, 194 exceeded 2000 ppm sulfur. This was used as a conservative cut-off, based on advice from the Proponent's consultant that rocks exceeding 3000 ppm sulfur could be PAF. However 177 of these samples were apatite-

rich mineralisation which is unlikely to be acid-generating (Supplement, appendix 16). The NT EPA notes that while sulfur cut-off indicates low likelihood of the waste rock generating acid, it does not indicate the potential for neutral mine drainage or saline leachate. The potential for rare earth deposits to generate AMD is generally low however, elements such as uranium and vanadium could be mobile under neutral mine drainage conditions, and these elements are constituents of some rare earth ores (US EPA, 2012). The Proponent has committed to undertake additional testing and characterisation of waste rock when representative waste rocks become available.

For tailings and residues, four samples were subject to AMD testing. Two samples represented tailings and two samples represented residues. All were large composite samples of several tonnes considered to be representative of the first seven to ten years of mining (Supplement, section 4.27). Results indicated that samples did not present a significant risk of acid generation and leachate from tailings is consistent with that from waste rock in terms of environmental and human health risk. Leachate from residues is relatively saline and alkaline. However, the NT EPA notes that the samples representing residues were generated from an alternative method of processing (SAPL – see section 2.2.1.6) rather than the proposed PAPL process. The NT EPA considers that additional AMD testing of waste from the PAPL process is required prior to mining approvals.

The preliminary AMD tests indicated that the majority of waste rock, ore, tailings and residues are unlikely to generate AMD. The small proportion (nominally 1%) of PAF waste material would be stored separately or blended with NAF or acid-consuming material in accordance with the AMD Management Plan (draft EIS, appendix L, section 6). The Proponent has indicated that there is sufficient carbonate in the vicinity of the Project that would be suitable as neutralising material (Supplement, appendix 16). It is intended that the PAF waste rock would be isolated and encapsulated into the WRDs under a low-permeability cover to prevent infiltration of water and the entry of oxygen (Supplement, section 2.10.1).

The Proponent has acknowledged that further testing of waste rock, tailings and residues is necessary to more confidently support the assertion that there is a very low risk of AMD, prior to mine development. It has committed to completing sequential, column and barrel leach tests to confirm the results of earlier leach testing, and to conducting AMD testing on wastes from the updated PAPL process, during the planning phase of the Project. These tests should also provide more certainty on the potential for neutral mine drainage and release of potential metals in leachates.

The NT EPA considers the results of additional test work is required to inform detailed design of the waste rock dumps, TSF and RSF to ensure management of leachates. The NT EPA recommends this further work and makes recommendation 8 to confirm waste characteristics. The NT EPA expects the AMD Management Plan would be revised continually throughout the life of the Project to ensure appropriate AMD management strategies are modified, if required, and implemented.

If the additional test work identifies variations of PAF material significantly different from those described in the EIS, the Proponent would be required to submit a clause 14 (a) notice of alteration to the NT EPA and the responsible Minister for consideration under the Environmental Assessment Administrative Procedures (EAAP).

Recommendation 8

Before approvals or decisions are given or made for the Project, the Proponent or Operator shall provide to the relevant regulator an updated Acid and Metalliferous Drainage (AMD) Management Plan for the Nolans Project. The AMD Management Plan must, at a minimum, provide:

a) **results of additional testing to demonstrate to a high level of confidence, that there is a low risk of AMD and NMD from all waste streams and stockpiled ore**

b) **details of the scope of the additional kinetic, column and barrel leach tests to provide results on the long-term leachate generation from wastes**

c) **a plan for the further testing required to design the waste rock dumps based on the results of AMD site-specific representative waste rock samples.**

Infiltration or leachate from TSF and RSF

As discussed above, there is potential for neutral metalliferous or saline leachate from the TSF and RSF. Additionally, imperfect neutralisation of acidic residues may lead to acidic leachate from the RSF. Radioactive materials including uranium and thorium could be a component of contaminants mobilised into groundwater from tailings and residues. Leachate testing indicates that any leaching or infiltration from the TSF or RSF is likely to contain radionuclides (Supplementary Tailings & Residue Report).

To minimise seepage to groundwater, the Proponent has committed to the use of low-permeability liners (minimum 1 x 10^{-8} m/s) in the TSF and RSF. The type of liners to be used would be decided after further testing of waste materials, and would include compacted clay liners and/or high-density poly-ethylene (HDPE). The local source of clay materials would be determined during the planning phase of the Project. The Proponent intends to neutralise all residues that would report to the RSF, however the facility would be designed for imperfect neutralisation including elevated metal solubility (Supplement, section 4.28). Additionally, in the long term, any leachate from the TSF would be directed to drain towards the pit lake and thereby not impact on the surrounding environment.

The Proponent has committed to monitor performance of the TSF/RSFs with seepage detection and interception systems, supplemented with down-gradient bores to monitor for any changes to groundwater chemistry and trigger a management response if necessary (Supplement, appendix 2). The risk of contaminants leaching from the TSF and RSF into groundwater or surface water would be mitigated by the design of the facilities and management of seepage in accordance with Australian National Committee on Large Dams (ANCOLD) guidelines. The ANCOLD guidelines design objectives are:

- safe and stable containment of tailings
- management of decant and rainfall runoff
- minimisation and control of seepage
- a cost effective storage system
- a planned system for effective closure.

The NT EPA notes the Proponent's commitment to design, construct, maintain, operate and decommission the TSF/RSF to ANCOLD guidelines and considers the mitigation measures proposed by the Proponent would minimise seepage impacts from the TSF/RSF. The NT EPA is of the opinion that the management of tailings and residues should be objective-based to confirm the facilities are safe, stable, and compliant with design and environmental parameters (European Commission, 2012). To demonstrate this objective has been met, the NT EPA recommends periodic review and auditing of the TSF/RSFs by independent technical experts, including an **independent certifying engineer.** In addition, performance monitoring of the facilities is important to indicate changes and provide early warnings which could indicate potential operating or

environmental issues as well as providing an assessment of the overall performance and long-term integrity (European Commission, 2012).

The NT EPA considers best practice industry standards in tailings and residue management should be applied to minimise potential environmental impacts and risks and costs to current and future generations if tailings are not contained in the long-term. With the presence of NORM in the wastes, the design, construction, operation and decommissioning of the tailings and residue storage facilities warrants independent technical review and operational oversight to ensure risks are minimised. The use of independent monitoring and review further promotes a transparent and effective regulatory process.

Infiltration or leachate from Waste Rock Dumps

The Proponent has stated that there is a very low risk of acidic (or alkaline) or neutral metalliferous leachate, or saline leachate, from waste rock at concentrations that would impact on groundwater. Seepage impacts from AMD are considered low based on very low sulfur content of the waste rock and low contained trace metals. Additionally, the Proponent expects any leachate or infiltration would drain towards the pit lake in the long term, thereby reducing the risk of impact on the surrounding environment. Accordingly, the Proponent has proposed that the waste rock dumps would not contain a low-permeability liner.

The Proponent has committed to managing the small quantity of PAF waste rock in accordance with the AMD Management Plan. The Proponent has also committed to completing the final design for waste rock dumps once 'representative' waste rock is available from the mining process. This means waste rocks dump design would not be finalised until after the mining authorisation process is completed. Until waste rock design is finalised and it is confirmed that leachate and infiltration from waste rock is benign, the NT EPA considers there is a risk of potential impact to the surrounding environment. To account for this, the NT EPA recommends the review of waste rock management by independent technical experts (competent persons), including an **independent certifying engineer.**

Recommendation 9

Before approvals or decisions are given or made for the Project, the Proponent or Operator shall engage an appropriately qualified and experienced Independent Certifying Engineer (ICE) to oversee the design and any works undertaken at the waste storages (Tailings Storage Facility, Residue Storage Facility and Waste Rock Dumps). The ICE is to provide:

a) **objective and independent expert review to the relevant regulator on the suitability of the site selection for the waste rock dumps, tailings and residue storage facilities including review of alternative sites and assessment of comparative risks**

b) **objective and independent expert review to the relevant regulator on the adequacy of the tailings and residue storage facility design, including details of the sub-surface drainage and type of low-permeability liners to ensure long-term containment of tailings/residues or leachate from waste rock dumps**

c) **regular inspections, auditing and reporting to the relevant regulator during construction of the tailings and residue storage facilities and waste rock dumps to ensure construction and operation is in accordance with the endorsed design and design objectives**

d) objective and independent expert review of the proposed performance monitoring program for the waste storages including potential seepage and leachates from the storage facilities

e) objective and independent expert review of the decommissioning and final rehabilitation to minimise long-term risks to the environment, community, future land use and visual amenity from the waste storages

f) an independent assessment of the Project's management of tailings and residues, including performance monitoring results in an annual report to the relevant regulator and the Proponent or Operator.

The annual report shall be provided on the websites of (as applicable), the Proponent and Operator and the relevant regulator.

Groundwater contamination

If contamination of groundwater were to occur as a result of the Project, it could impact on other users of the resource, including the environment. Riparian and other groundwater dependent vegetation could be adversely affected by contaminants, which may compound any impacts from groundwater drawdown (discussed in section 4.1.2). Contamination could also limit the use of the groundwater for extractive purposes.

The Proponent assessed the potential impact on people of radiological materials leaching from the RSF (draft EIS, section 12.4.4). This indicated that the radiological impact of RSF liner failure and subsequent leaching to groundwater would be negligible – ingestion of 1000 L /yr at Aileron would give an incremental annual dose of ~0.016 mSv/y, well below the public dose limit of 1.0 mSv/y above background levels (ARPANSA, 2005). There was no assessment of radiological impacts from liner failure at the TSF. However, as the TSF would receive about one third of the radioactive material of the RSF, resulting doses to groundwater users in the Ti Tree Basin are likely to be lower than those predicted for the RSF. The NT EPA considers that there is potential for small amounts of radionuclides to leach into groundwater, but that this is unlikely to present a significant health risk to other current users of the NE Southern Basins and Ti Tree groundwater resources.

Any contaminants that seep into groundwater at the processing site, accommodation site, borefield or roads/tracks would enter the catchment for the NE Southern Basins. Contaminants would need to travel considerable distances (likely over 35 km) to affect riparian and other groundwater dependent vegetation in the vicinity of Day Creek. The closest stock and drinking water extraction bores are located eight to ten kilometres from the proposed processing site. Providing the Proponent implements best practice water management on site which includes minimising seepage of contaminants to groundwater as outlined in recommendation 9, the NT EPA considers that there is a low likelihood that groundwater contamination would impact current and potential future users.

The Proponent has committed to developing and implementing a groundwater monitoring program as part of the Water Management Plan. This would include establishing baseline water quality and developing specific trigger values (Supplement, appendix 4). This would enable the detection of any contamination from the sources discussed above, and the implementation of mitigation measures. The NT EPA notes that there are currently inadequate baseline datasets for water quality. The Proponent has committed to collecting 24 months of baseline data prior to Project operation.

The Proponent has committed to monitoring groundwater for only a short term (two years) following active mining. The NT EPA considers that this monitoring period is likely to be insufficient and the post closure monitoring period should be agreed to by the regulator at a later date prior to acceptance of the final mine rehabilitation and closure plan as referred to in recommendations 15 and 16 in section 5.3.

Summary

The NT EPA considers that there is potential for impacts on groundwater environmental quality and associated environmental values. Uncertainty remains on the likelihood of some of these potential impacts because further AMD testing is required on waste materials to better understand potential contamination risks and to design waste storage infrastructure accordingly. The NT EPA has made recommendation 8 for this further testing to inform detailed design and allow for updated AMD Management Plans to be implemented.

The NT notes the Proponent's commitment to design, construct, maintain, operate and decommission the TSF/RSF to ANCOLD guidelines to minimise seepage impacts from the TSF/RSF. The NT EPA makes recommendation 9 to ensure regular technical review and oversight of waste storages occurs by independent experts, including an **independent certifying engineer.** The NT EPA is of the opinion the use of independent monitoring and review further promotes a transparent and effective regulatory system.

4.2.3 Surface water environmental quality

4.2.3.1 Environmental values

Little information is available on surface water quality due to the lack of permanent surface water in the area and the infrequency of flows in local watercourses.

Relevant data available on the NTG water portal were recorded in February and March 2011 at a site in the Woodforde River, 26 km downstream from the mine site (21 km north). These data show the water was fresh, very turbid, neutral in pH and with sufficient dissolved oxygen to support aquatic life.

The values of this natural surface water include maintaining healthy riparian ecosystems and providing drinking water for fauna. Another important value is the recharge of groundwater aquifers – the Ti Tree Basin aquifer (from the mine site) and the Southern Basins aquifers (from all other Project components).

4.2.3.2 Potential impacts

The construction and operation of the Project may have the following potential impacts and risks to surface water quality:

- overflow from TSF or RSF or catastrophic failure of TSF or RSF
- spills of any reagents or fuels (etc.) used in the Project
- project activities that disturb soils/substrate such that sediments are mobilised in water
- potential leachate from basement rocks exposed for the creek diversion.

Contamination of surface water could also affect groundwater indirectly via infiltration to groundwater aquifers.

4.2.3.3 NT EPA assessment

Overflow or catastrophic failure at TSF or RSF

Contaminants (including radionuclides) could enter surface waters from an overflow or dam-break of the TSF or RSF during the operational life and prior to final closure. The physical failure of the TSF/RSF and resultant spread of contaminants has potential to impact the environment. The Proponent modelled dam-break scenarios that included both a sunny-day event (absence of rainfall or other natural runoff) and flood-failure event (during a 100 year ARI event) (draft EIS, appendix J; Supplement, appendix 2).

For the TSF sunny-day dam-break scenario, released water would flow 27 km to the north. In this case, contaminants in the water may result in impacts to the health of riparian vegetation along Kerosene Camp Creek and the Woodforde River. For the TSF flood-failure scenario, released water would contribute to significant downstream flooding for at least 50 km to the north. In either scenario, sediments would be mostly deposited within Kerosene Camp Creek and not reach Woodforde River (Supplement, section 4.12).

For the RSF a dam failure was modelled based on a single cell failure after 10 years of operation (Supplement, appendix 2). This provides only a rough indication of possible consequences, given that Project operation is proposed for 55 years and the RSF would comprise multiple cells. The predicted runout distance was 21 km for a depth of 200 mm, and 49 km for a depth of 100 mm.

The Proponent has committed to implement measures to lower the risk of dam failures (Supplement, section 5). These include designing the facilities to accommodate a 100 year ARI event and constructing the dams according to ANCOLD guidelines. The NT EPA recommends inspection of the dams by an **independent certifying engineer,** as outlined in recommendation 9. The TSF would be designed so that any overflow due to a high-rainfall event would report to the mine pit. Overflow from the RSF during a high-rainfall event would travel in drainage channels towards the south, but due to the physical distance, it is unlikely to reach Lake Lewis. The NT EPA makes recommendation 9 to ensure TSF/RSFs are safe, stable, erosion-resistant and non-polluting and the siting, design, operation, monitoring and decommissioning is overseen by independent experts.

Potential impacts can be avoided by preventing a dam-break at the TSF and RSF. The NT EPA refers to the ICMM position statement[2] on preventing catastrophic failure of tailings storage facilities. This requires Operators to apply a strong management and governance framework to maintain the integrity of TSFs and minimise the risk of catastrophic failures. The NT EPA is of the opinion that a catastrophic collapse of the TSF/RSF would be a major process safety incident that has potential to impact human health, the community, environmental values, company reputation and financial losses that could result in premature closure of the mine.

Process safety and critical control management have been identified as essential to managing low probability, serious consequence events such as catastrophic failure of TSF/RSFs. With effective implementation of the principles of process safety, the Proponent or Operator is better positioned to prevent this major incident from occurring. The NT EPA recommends the Proponent provide a **process safety plan** that provides additional detailed information on the preventative and mitigating controls in the event of a TSF/RSF overflow or collapse. This implementation of process safety systems for whole-of-project risks is discussed further in section 5.2.

Spills of reagents or fuels

The release, discharge or spill of any hazardous substance (including reagents or fuels) that could contaminate surface water would be prevented and mitigated in accordance with the Hazardous Substances Management Plan (draft EIS, appendix H of appendix X) that would be reviewed during the mining authorisation process. The plan specifies that storage of hazardous substances would be in accordance with Australian standards,

[2] https://www.icmm.com/website/publications/pdfs/position-statements/2016_icmm-ps_tailings-governance.pdf

codes and regulations, including bunding, and appropriate clean-up procedures to reduce the potential for surface water contamination.

The NT EPA considers that impacts on environmental values from spills of hazardous substances are unlikely to be significant and can be management in accordance with the relevant plan.

Erosion and Sedimentation

Erosion and sediment movement would be prevented by the development and implementation of an Erosion and Sediment Control Plan (ESCP). A preliminary ESCP was provided at appendix D of the Water Management Plan (draft EIS, appendix L of appendix X). The ESCP has been developed in accordance with the relevant guidelines. This would be updated for review during the mining authorisation process.

Recommendation 10

Before approvals or decisions are given or made for the Project, the Proponent or Operator shall provide to the relevant regulator an updated erosion and sediment control plan for the Project. The plan should outline all permanent and temporary erosion and sediment control measures proposed to be installed for the Project. The updated plan should be prepared by a suitably qualified person and in accordance with the international standards for erosion and sediment control (as amended from time to time) or higher standard. An independent, suitably qualified and experienced auditor should be engaged to review and approve the plan, and to inspect and approve work is undertaken according to the plan.

Surface water quality from Kerosene Camp Creek diversion

The geochemistry of the rock walls in the diversion of Kerosene Camp Creek could be a source of contaminants that may impact the quality of surface water and potentially groundwater if water infiltrates into the Ti Tree Basin. The NT EPA considers core drilling results of the basement rock for the diversion should undergo AMD testing during the planning phase of the project. The updated detailed diversion design established in recommendation 7 must be informed by the results of AMD testing of the basement rocks at the diversion.

The risks relating to the release of contamination to surface waters would be mitigated by the design of infrastructure, including stormwater sediment retention ponds, to contain surface waters from across the Project site (Supplement, appendix 4). The Proponent has committed to developing and implementing a Surface Water Monitoring Plan. This would include establishing baseline water quality and developing specific trigger values (Supplement, appendix 4). This would enable the detection of any contamination from the sources discussed above, and the implementation of mitigation measures.

Summary

The NT EPA is satisfied that the potential impacts and risks to inland water environmental quality (surface water quality) can be avoided or managed appropriately.

The NT EPA considers the additional AMD test work is required to inform detailed design of the waste rock dumps, TSF and RSF to ensure management of leachates and makes recommendation 8. The NT EPA is of the opinion that the construction and selective placement of waste rock in accordance with the Acid and Metalliferous Management Plan requires oversight by qualified technical experts and makes recommendation 9.

The impacts of overflow or collapse of the TSF/RSF are likely to be mitigated by designing and operating the facilities to ANCOLD guidelines overseen by an **independent certifying engineer,** as outlined in recommendation 9. The implementation of process safety systems, outlined further in section 5.2, would provide greater certainty that the Proponent is implementing preventative and mitigating controls to prevent TSF/RSF overflow or collapse.

The NT EPA makes recommendation 10 to minimise potential impacts and risks associated with surface contaminants, erosion and sedimentation. Uncertainty remains on the AMD potential for basement rock in the Kerosene Camp Creek diversion and the NT EPA makes recommendation 7 to ensure appropriate design of the diversion is implemented to minimise surface water impacts.

4.2.4 Conclusion against NT EPA objective

With the implementation of relevant management plans recommendations identified above, the NT EPA considers that the Project could be conducted in such a manner that its objective for inland water quality is likely to be met.

4.3 Terrestrial flora and fauna

4.3.1 Environmental objective

Protect the Northern Territory's flora and fauna so that biological diversity and ecological integrity are maintained.

4.3.2 Terrestrial flora and vegetation

4.3.2.1 Environmental values

Vegetation was classified into 14 communities across the main study area[3] (draft EIS, appendix M). An additional seven vegetation types were described and mapped over the Day Creek area, at the western end of the borefield (Supplement, appendix 15). This information was obtained by field survey using standard methods (Brocklehurst, et al., 2007). All vegetation communities are well represented in the Burt Plain bioregion and none are considered rare or threatened at a regional scale. Less than 1% of the bioregion is conserved within reserves.

Three vegetation communities are considered as significant in this assessment. Riparian woodland is considered a sensitive vegetation type in the NT (NRETAS, 2010). It plays a critical role in providing ecosystem services to maintain landform and water quality, as well as providing habitat and microclimate for other species (DLRM, 2017). It occurs along water courses and drainage channels, occupying 4.6% of the main study area. The Coolabah swamp vegetation community, occurring in the main study area, is considered an important vegetation type of the Burt Plain bioregion (draft EIS, appendix M).

Potentially groundwater dependent ecosystems (GDEs) are also considered important for containing certain tree or shrub species that may fully or partially rely on groundwater. These include River Red Gum (*Eucalyptus camaldulensis* subsp. *arida*),

[3] Main vegetation study area: total 5692 ha: mine site, processing site, accommodation village, a 200 m corridor along all proposed access roads, a 100m corridor along the water pipelines, plus a small swamp near the accommodation village.

Bean Tree (*Erythrina vespertilio*), Ghost Gum Coolabah (*Eucalyptus victrix*), Desert Bloodwood (*Corymbia opaca*) and Coolabah (*Eucalyptus coolabah* subsp. *arida*). These species were not individually addressed in the assessment, except in terms of their vegetation communities.

A total of 326 flora species were recorded within the study area, representing 28% of all flora species known to occur in the Burt Plain bioregion. Of these, 15 species are introduced. Three species are listed as near threatened under the *Territory Parks and Wildlife Conservation Act* (TPWC Act).

4.3.2.2 Potential impacts

Construction and operation of the Project would require the clearing of native vegetation for the Project and changes to the surface and groundwater hydrology.

Potential indirect impacts to vegetation include changes to vegetation composition as a result of weeds, changes to the fire regime and dust from mining activities and transportation.

4.3.2.3 NT EPA assessment

Direct impacts – clearing of native vegetation

Mining activities associated with the Project would result in the direct removal of approximately 4161 ha of vegetation. The vegetation types to be cleared are:

- Mulga shrubland on sand red earths over tussock grasses or spinifex (2524 ha)
- mixed woodland over tussock grasses (657 ha)
- **riparian woodland** along water courses and drainage channels (240 ha)
- Hakea/Senna shrubland on calcareous alluvial plains and low rises (232 ha)
- Acacia/Triodia shrubland on rocky outcrops (206 ha)
- *Triodia basedowii* hummock grassland on sandplains (105 ha)
- Thirteen other vegetation types (total 197 ha).

Clearing would not occur in the coolabah swamp vegetation that is considered regionally important, or in the groundwater dependent vegetation in the Day Creek area.

The vegetation communities that would be cleared for the Project are relatively common throughout the region and most are not considered to be significant vegetation types. The NT EPA considers that the clearing of the above vegetation types is unlikely to have a significant residual impact on vegetation in the region.

The three species listed under the TPWC Act are all widespread in the region or beyond (Northern Territory Herbarium, 2015) so were not considered further in the assessment. No flora species listed under the EPBC Act have been recorded or are predicted to occur within 20 km of the study area due to the lack of suitable habitat (draft EIS, appendix M).

Indirect impacts

Changes to hydrological processes due to the Project are likely to impact on riparian woodland and other groundwater dependent vegetation. This has been discussed in section 4.1. Irreversible losses of riparian vegetation in the vicinity of the mine pit are not considered significant on a regional scale. There are uncertainties regarding impacts to

groundwater dependent vegetation in the borefield, which are addressed by recommendation 5 in section 4.1.2.

Soil disturbance and mining activities have the potential to transport and establish weeds within the Project area. Project activities would increase the potential for weed invasion in the mine area and along access roads. Buffel grass (*Cenchrus ciliaris*) and couch grass (*Cynodon dactylon*) are two species already present at the mine site that are known threats to biodiversity in the bioregion (Neave, et al., 2006), especially along drainage lines.

Further weed invasion could impact on significant Riparian woodland by competing directly for resources. In addition, weeds can impact significant fauna by altering fire regimes, altering habitat structure/composition, or attracting exotic fauna. To manage the risk the Proponent has committed to developing and implementing a Weed Management Plan which includes hygiene measures and protocols for identifying and managing any incursions.

Changes to the fire regime (frequency and/or intensity) can result in changes to vegetation composition and floristic diversity. The establishment of the Project is expected to result in increased fire control in the area, and the Proponent has committed to preparing a Fire Management Plan for the Project to avoid/manage the risks from fire.

While potential impacts to vegetation as a result of smothering by dust and sediment from mining related activities are not expected to be significant, these would be managed through a dust management plan which would be prepared as part of the Environmental Management Plan for the Project.

Summary

The NT EPA considers that the direct impacts from vegetation clearing would be unlikely to be significant as all of the vegetation types to be cleared are well represented in the region. The NT EPA also considers that potential indirect impacts to vegetation from weeds, fire and dust are unlikely to be significant, and can be appropriately managed in accordance with standard management plans. NT EPA makes recommendation 5 to address potential impacts to riparian vegetation and other groundwater dependent vegetation from groundwater drawdown (section 4.1.2).

4.3.3 Terrestrial fauna

4.3.3.1 Environmental values

Information on the fauna around the Project was obtained from field surveys in 2010, 2011 and 2015, including targeted surveys for threatened species. These were informed by desktop studies to determine fauna species that have been or could be present in and around the mine area. Fauna surveys were generally consistent with the Australian Government and NT EPA's biodiversity guidelines (DSEWPaC, 2011a; DSEWPaC, 2011b; DEWHA, 2010; NT EPA, 2013).

Surveys recorded a total of 174 native terrestrial fauna species. This included 25 native mammals, 103 birds, 41 reptiles, three frogs and two invertebrates. Five species of non-native mammals were recorded within the Project area (draft EIS, appendix N): the camel (*Camelus dromedarius*), cat (*Felis catus*), European rabbit (*Oryctolagus cuniculus*), house mouse (*Mus musculus*) and red fox (*Vulpes vulpes*). Cattle (*Bos taurus* and *B. indicus*) were also seen but not recorded.

The following threatened species were either confirmed as occupying the Project area or have suitable habitat that may be impacted by the Project:

- **Black-footed rock wallaby** (MacDonnell Ranges race) *Petrogale lateralis* (Vulnerable – EPBC Act). Populations occur in suitable habitat within two

kilometres of the mine site, with individuals occasionally moving through the Project footprint. Separate suitable habitat for this species occurs to the south and east of the borefield area in the Reaphook hills and Hann Range.

- **Great desert skink** *Liopholis kintorei* (Vulnerable – EPBC Act/TPWC Act), a medium-large fossorial skink occurring in scattered locations in sandy and gravelly habitats in the western deserts region of Central Australia. Suitable habitat for *L. kintorei* occurs in the borefield area, and one active communal burrow and latrine site has been located. The burrow was confirmed as active using camera traps.

- **Greater bilby** *Macrotis lagotis* (Vulnerable – EPBC Act/TPWC Act), a medium sized fossorial marsupial which occurs in arid and semi-arid habitats. Suitable habitat occurs in the borefield area but aerial surveys did not locate any burrows. *M. lagotis* would have previously occurred throughout the region, as indicated by historic records within 60 km of the Project.

- **Princess parrot** *Polytelis alexandrae* (Vulnerable – EPBC Act/TPWC Act). Suitable sandplain foraging habitat for the species occurs in the borefield. *P. alexandrae* has not been recorded during any recent or previous studies in the Project area.

- **Night parrot** *Pezoporus occidentalis* (Endangered – EPBC Act/Critically Endangered – TPWC Act). Preferred foraging plants for this species (*Triodia basedowii* and *chenopod* shrubland) occur in the Project area. Targeted surveys of the site did not identify any individual birds. Survey methods for the species are still being established and there is limited information about the habitat requirements of the species.

- **Brush-tailed mulgara** *Dasycercus blythi* (Vulnerable – TPWC Act). Suitable sandplain habitat for *D. blythi* occurs in the borefield. Targeted surveys recorded 36 individuals and 45 active burrows.

- **Southern marsupial mole** *Notoryctes typhlops* (delisted – EPBC Act/Vulnerable – TPWC Act), a fossorial marsupial. Suitable sandplain habitat for this species is likely to occur in the borefield area. Targeted surveys for the species were not undertaken for the purposes of this assessment. *N. typhlops* was delisted under the EPBC Act while this Project was being assessed (3 December 2015).

4.3.3.2 Potential impacts

Construction and operation of the Project would result in the following processes that may impact on threatened species:

- clearing of vegetation that is considered suitable habitat
- fragmentation of habitat due to clearing
- vehicle movements increasing the potential for mortality due to road-strike
- disturbance associated with dust, noise and artificial lighting
- changes to the fire regime
- habitat change due to the introduction and spread of weeds
- competition and predation by introduced fauna.

4.3.3.3 NT EPA assessment

The NT EPA has assessed this factor to address the requirements of the EA Act and the EPBC Act in accordance with the Bilateral Agreement. The information used in this assessment was provided by the Proponent in the EIS (the draft EIS and Supplement) and included consideration of the following plans, conservation advice and policies:

- EPBC Act Environmental Offsets Policy (DSEWPaC, 2012)
- A recovery plan for the Great Desert Skink (*Liopholis kintorei*) (McAlpin, 2011)
- National Recovery Plan for the Greater bilby (*Macrotis lagotis*) (Pavey, 2006)
- Recovery plan for five species of rock wallabies: Black-footed rock wallaby (*Petrogale lateralis*), Rothschild rock wallaby (*P. rothschildi*), Short eared rock wallaby (*P. brachyotis*), Monjon (*P. burbidgei*) and Nabarlek (*P. concinna*) 2012-2022 (Pearson, 2013)
- Threat abatement plan for predation by feral cats (DoE, 2015)
- Threat abatement plan for predation by the European red fox (DSEWPaC, 2011d)
- Threat abatement plan for competition and land degradation by rabbits (DSEWPaC, 2011c)
- Threat abatement plan to reduce the impacts on northern Australia's biodiversity by the five listed grasses (DSEWPaC, 2012)
- Threat abatement advice for ecosystem degradation, habitat loss and species decline in arid and semi-arid Australia due to the invasion of buffel grass (*Cenchrus ciliaris* and *C. pennisetiformis*) (DoE, 2015)
- Conservation advice for the great desert skink (Threatened Species Scientific Committee, 2016), greater bilby (Threatened Species Scientific Committee, 2016), princess parrot (Threatened Species Scientific Committee, 2008) and night parrot (Threatened Species Scientific Committee, 2016).

Black-footed rock wallaby (Petrogale lateralis)

The Project would require the clearing of 266 ha of habitat for *P. lateralis*. Much of this area is considered to be dispersal and foraging habitat, and would no longer be available for dispersal. Critical habitat for *P. lateralis* occurs in the rocky outcrops of the Yundurbungu Hills, within and adjacent to the mine site. These would provide shelter from extremes of temperature and predators. Three outcrops would be at least partly covered by waste rock dumps for the Project. While these habitats are considered critical for refuge for the species, the removal of these areas would not be considered to have a significant impact on the available habitat for the population within the region.

Mining activities would increase vehicle movements along the haul and access roads which would increase the risk of road-strike which could kill or injure individual *P. lateralis*. The areas at highest risk are roads located near rocky outcrops and breakaways. To reduce the risk of road traffic on threatened species, the Proponent has committed to preparing and implementing a Traffic Management Plan which includes measures for reducing the risk of road-strike. The Plan would include restrictions on driving at night when the highest risk to the species would occur as individuals leave the outcrops and forage/disperse. The NT EPA is satisfied that the preparation and implementation of measures in an approved Transport Management Plan would be adequate to reduce the level of risk from road-strike to an acceptable level.

In addition to the 266 ha of habitat to be cleared, about 150 ha of suitable habitat for *P. lateralis* occurring in the vicinity of the proposed mine is predicted to have increased dust levels (exceeding 50 µg/m^3) which may impact on the species. The NT EPA considers that potential impacts from dust are unlikely to have a significant impact on the species in the context of available habitat for the population within the region.

There is also potential for *P. lateralis* to be impacted by noise, vibration or light from the Project. This is likely to result in individual animals avoiding dispersal through the mine site, however this is considered unlikely to have a significant impact on the local population.

Foraging habitat for *P. lateralis* is vulnerable to altered fire regimes with large-scale wildfires rendering habitat largely unsuitable for the species. This is due to the removal of vegetative cover and food resources for the species, which may reduce ground-layer vegetation cover and increase the chance of predation by cats or foxes. The appropriate burning regime for the species is considered to be cool burns in a patch-burning regime (Pearson, 2013). The Proponent proposes to manage fire risk from the Project through the development and implementation of a Fire Management Plan. To reduce the risk of large-scale fires, the NT EPA recommends that the Biodiversity Management Plan and Fire Management Plan include specific requirements for protecting *P. lateralis*, including identifying the required vegetation structure for the species and the necessary fire regimes for ensuring the habitat requirements of the species are met.

A key risk to *P. lateralis* is the loss of individuals from predation by introduced and native predators (DoE, 2015; DSEWPaC, 2011d)). These predators may be attracted to the Project area as a result of the increased availability of water and the presence of domestic waste, which could be used as food resource by feral predators (e.g. fox, cat) and native predators (dingo). The increase in predator abundance could impact *P. lateralis*. The Proponent has identified this as a potential risk of the Project and is proposing to fence open water sources and waste disposal areas. Monitoring would be undertaken to assess the abundance of introduced/native predators.

The adequacy of the measures outlined in the Biodiversity Management Plan would be determined through annual monitoring of *P. lateralis* in rocky habitat around the mine. The Proponent proposes to monitor the species using aerial surveys and motion cameras. Given there is a risk of disturbing *P. lateralis* during aerial surveys, monitoring activities should be limited to camera trapping and undertaken in accordance with the standards for camera trapping surveys in the Northern Territory (Gillespie, et al., 2015). The surveys should be designed in consultation with the DENR and the DoEE and described in the Biodiversity Management Plan at recommendation 11.

Overall, the NT EPA concludes that the likely reduction in habitat for this species from the Project would be unlikely to have a significant impact on the regional population of *P. lateralis* occupying the Reynolds Range. Other potential indirect impacts on this species are likely to be effectively avoided or mitigated by the implementation of the Biodiversity Management Plan as outlined in recommendation 11. Additionally, the proposed actions outlined in this report are consistent with the black-foot rock wallaby recovery plan (Pearson, 2013) and with the fox, cat and European rabbit threat abatement plans (DoE, 2015; DSEWPaC, 2011d).

Great desert skink (Liopholis kintorei)

The presence of an active communal warren in the Project area is considered to be significant given the small number of sites that are known to be occupied by *L. kintorei*. The National Recovery Plan estimates that the remaining populations occur at seven isolated sites (McAlpin, 2011). The presence of *L. kintorei* in the Project area would be outside the mapped distribution for the species and would likely be the most easterly recent record of the species.

The Proponent proposes to clear 122 ha of suitable habitat for *L. kintorei* in the proposed borefield but this would not directly affect the known warren. The warren is located approximately 65 m south of the current borefield access track and 1721 m from the closest proposed bore. The warren would be protected from clearing and construction activities through the establishment of a 200 m buffer. This would require the realignment of the borefield access road, to be addressed during the detailed design phase of the Project. The guide for decision makers in the recovery plan (McAlpin, 2011) suggests that new infrastructure within two kilometres of known populations may impact on this species. As the borefield access track would not be a new road, and it would be used only infrequently for maintenance purposes, the NT EPA considers that the proposed 200 m buffer is not inconsistent with the recovery plan.

The key threat to habitat for *L. kintorei* is fire. Large and regular fires alter vegetation structure. *L. kintorei* prefers habitats which have a low fire frequency and are characterised by large hummocks with *Eremophila leucophylla* (Pearson, et al., 2001). The NT EPA acknowledges the Proponent's commitment to prepare a Fire Management Plan which would reduce the likelihood of fires and the risks for fauna.

Given the sensitivity of *L. kintorei* to fire regime changes, the NT EPA considers that it would be appropriate for the Biodiversity Management Plan to identify the specific habitat requirements of *L. kintorei* and outline how the proposed fire management measures would ensure that *L. kintorei* habitat is not degraded or adversely impacted by fuel reduction burns and other fire management activities required for the Project.

Project activities would increase the potential for weed invasion along access roads in suitable habitat for *L. kintore*i. Buffel Grass (*Cenchrus ciliaris*) and Couch Grass (*Cynodon dactylon*) are known threats to biodiversity in the bioregion (Neave, et al., 2006). These risks would be addressed through the development and implementation of a Weed Management Plan which includes weed hygiene procedures, monitoring and control measures.

Another key threat to *L. kintorei* is predation by invasive and native predators (McAlpin, 2011). The Proponent has committed to undertaking measures to avoid making the Project area favourable to invasive and natural predators. In particular, areas that provide new resources (food and water) would be adequately fenced to avoid predators accessing and becoming established. Annual monitoring is proposed to be undertaken as part of the Biodiversity Management Plan.

The NT EPA recommends that further targeted surveys for *L. kintorei* be undertaken within suitable habitat during pre-clearance surveys. If additional warrens are identified during pre-clearance surveys, the Proponent should contact the DENR to seek advice on how best to avoid and manage the impacts of these warrens.

It is acknowledged that the Proponent has committed to monitoring the *L. kintorei* warren to determine if there is a change in numbers. Given the low detectability of the species during surveys, the NT EPA considers that it would also be appropriate for the Proponent to intensively survey for additional burrows using diurnal transects in summer. The monitoring measures should be outlined in the Biodiversity Management Plan for the Project.

The NT EPA acknowledges the significance of this species in the Project area. The Proponent has proposed measures to avoid impacts on this species. The NT EPA recommends further surveys to locate any additional *L. kintorei* warrens that could be present in or around the Project area (as part of recommendation 11). The implementation of the management plans to address key threats to the species would ensure that the Project does not result in the loss of any key sites for the species. Additionally, the proposed actions outlined in this report are not inconsistent with the giant desert skink recovery plan (McAlpin, 2011) and are consistent with the fox, cat and

European rabbit threat abatement plans (DoE, 2015; DSEWPaC, 2011d).The NT EPA considers that the potential impacts to this species are unlikely to be significant.

Greater bilby (Macrotis lagotis)

M. lagotis has declined significantly across its historical distribution with remnant populations in the Pilbara, south-western Queensland, Central Australia and the Kimberley region. In the Northern Territory, *M. lagotis* appears to be restricted to the Tanami bioregion, Sturt Plateau bioregion and the northern Great Sandy Desert bioregion.

The absence of recent *M. lagotis* records from the site and the bioregion suggests that the species is not present and direct impacts to it would be highly unlikely as a result of the Project. The potential impact of clearing 122 ha of suitable habitat, noting the large distance from the nearest known occurrence of the species, would be relatively insignificant.

Princess parrot (Polytelis alexandrae)

P. alexandrae is a highly mobile and nomadic species which appears to be sparsely distributed across its range. The main population occurs in the Great Sandy Desert with movements outside of this area attributed to seasonal availability of food and ephemeral water.

The NT EPA notes that the proposed clearing of 362 ha of suitable *P. alexandrae* habitat is unlikely to have a significant impact on the available habitat relative to the extent of occurrence (2 million km^2) and the area of occupancy (10 000 km^2). This habitat is likely to be used only occasionally by the species for foraging purposes.

The proposed area to be cleared is unlikely to affect the availability or access to remaining habitat in the Burt Plain Bioregion.

The main threat to *P. alexandrae* is thought to be habitat degradation due to herbivores (sheep, rabbits and camels). The Aileron and Napperby pastoral stations have been used for livestock and feral animal grazing since the early 1880s. The Project is unlikely to increase the grazing pressure on adjacent areas of habitat either through domestic livestock or increased densities from feral herbivores (rabbits and camels).

Night parrot (Pezoporus occidentalis)

Vegetation surveys for the Project identified vegetation types that may provide suitable foraging habitat for the species. Correspondence with the National Recovery Team for *P. occidentalis* concluded that the Project area would be unlikely to support the species as the vegetation is not old growth and would be unsuitable for roosting and nesting. Furthermore, the presence of continuous sandplain habitat with no natural firebreaks would mean that the vegetation would be unlikely to form suitable old growth vegetation. Given the lack of suitable habitat, *P. occidentalis* is unlikely to occur in the area and there is little potential for impacts on this species.

Brush-tailed mulgara (Dasycercus blythi)

D. blythi occurs across large areas of Central Australia occupying sandplain habitat particularly with a cover of sandhill canegrass (*Zycochloa paradoxa*). The species has been subject to historic declines with the cause largely unknown. Pavey et al (2006) proposed that environmental degradation and the homogenisation of habitat throughout arid Australia may have negatively affected the species. Furthermore, changes in fire regimes, grazing and predation by introduced predators are likely to be a threat.

The Project would require the clearing of 125 ha of occupied habitat for *D. blythi*. This is unlikely to be significant relative to the extent of occurrence and the species' area of

occupancy. The Proponent is proposing to avoid impacts to the species during vegetation clearing in the borefield by capturing and translocating any *D. blythi* away from the site. The NT EPA acknowledges the Proponent's commitment and recommends that any captured *D. blythi* are released outside of cleared areas but within 500 m in suitable habitat[4].

Other possible threats to *D. blythi* in the bore field area may include changes to the fire regime, changes to the density of introduced predators and grazing activities. The development and implementation of a Biodiversity Management Plan and Fire Management Plan would need to suitably address these threats. Furthermore, the Fire Management Plan should identify the preferred habitat requirements for the species and appropriate burning regime to maintain those habitat areas.

Measures proposed in recommendation 11 are likely to ensure that *D. blythi* can persist in suitable habitat in the borefield.

Southern marsupial mole (Notoryctes typhlops)

Given that suitable habitat for the species occurs on the site, there is potential for the species to be present. The species does occur over a significant area across Central Australia outside of the Project area. The clearing of sandplain habitat for the Project would be unlikely to result in a significant loss of habitat for this species.

To ensure threatened species and biodiversity are protected during the construction and operation of the Project, the NT EPA considers that it would be appropriate for the Minister for the Environment and Energy to require that the Biodiversity Management Plan is submitted for approval under the EPBC Act. In preparing this advice, the NT EPA has given consideration to the recovery actions and objectives identified in the National Recovery Plans that are relevant to this Project. The NT EPA considers that should the Project proceed, it would be consistent with those actions and objectives.

Recommendation 11

Before approvals or decisions are given or made for the Project, the Proponent or operator shall provide to the relevant regulator a Biodiversity Management Plan for the Project. The Biodiversity Management Plan must, at a minimum, contain:

a) an identification of potential project impacts and risks, mitigation measures and preventative actions for the protection of biodiversity values and habitat for threatened species

b) a procedure for pre-clearance surveys for threatened species, including the great desert skink

c) the final alignment of the borefield access track, incorporating a buffer of at least 200 m around the known warren of the great desert skink

d) the scope, standards and timeframes for a flora and fauna monitoring program

e) procedures for managing fire risk from the Project on habitat for threatened species

[4] The capture and movement of *D. blythi* into habitat beyond 500 m of cleared areas would require a permit under the TPWC Act.

f) weed hygiene and control procedures for avoiding the introduction and/or spread of weeds into habitat for threatened species

g) procedures for avoiding and/or managing the risk of introduced fauna on threatened species

h) goals, measures and criteria for the rehabilitation of habitat for threatened species following the closure and decommissioning of the Project.

Summary

The NT EPA has considered the potential impacts of the Project on seven threatened species and considers that significant impacts to those species are unlikely. This is due to the regionally small area of habitat being impacted and/or the proposed avoidance and management measures proposed to be implemented by the Proponent. The implementation of the Biodiversity Management Plan at recommendation 11 with relevant management sub-plans (Fire Management Plan, Weed Management Plan, Invasive Species Monitoring and Management Plan and Fauna Monitoring Plan) would contribute to avoiding or reducing the potential impacts and risks of the Project on the above species.

4.3.4 Conclusion against NT EPA objective

With the implementation of relevant management plans and recommendations identified above, the NT EPA considers that the Project could be conducted in such a manner that its objective for terrestrial flora and fauna is likely to be met.

4.4 Social, economic and cultural surroundings

4.4.1 Environmental objective

Protect the rich social, economic, cultural and heritage values of the Northern Territory

4.4.2 Socio-economic considerations

4.4.2.1 Environmental values

The Project is located ten kilometres west of Aileron Roadhouse, a stopover on the Stuart Highway. The roadhouse provides employment to several people and services to local communities and people travelling on the Stuart Highway. The majority of the Project footprint is located on Aileron pastoral Station, except for the western half of the borefield area on Napperby pastoral Station.

The Alyuen community, near the Roadhouse, is an Aboriginal family outstation that is home to about 20 people. Several other Aboriginal communities are in the vicinity of the Project (figure 1); Laramba is the largest, with a population of approximately 300 people, located 50 km west of the Project. The region has a largely Aboriginal population (80%) characterised by a high level of disadvantage across all socioeconomic indicators. There are limited opportunities for employment in the region (draft EIS, chapter 15).

The nearest service town is Ti Tree, approximately 53 km north of the mine site with a population of about 280. The major service and supply base for the region is Alice Springs, 135 km south-southeast of the Project. It has a population of approximately 28 000 people with a wide demographic mix.

Traffic in the region is generally light and well below capacity for the Stuart Highway.

4.4.2.2 Potential impacts

The following potential socio-economic impacts may occur as a result of the Project:

- potential positive and negative social and economic impacts to the region
- increase in traffic on local and Alice Springs roads, and on the railway.

4.4.2.3 NT EPA assessment

The construction and operation of the Project would bring business, employment and training opportunities to the region, and potentially also improved services and infrastructure. These could potentially improve the socio-economic status of residents – locally and in Alice Springs. There is also potential for negative impacts on community resilience and cohesion due to altered distribution of financial benefits or services.

The construction and operation of the Project would provide local economic benefits to businesses as well as employment opportunities through the provision of resources, staff and services. The Proponent indicates a capital expenditure of $1.19 billion over a three-year construction period of which $866 million would be spent in Australia and $145 million in the Northern Territory ($71 million in Alice Springs). In steady state operations, expenditure is estimated at $90.6 million per year, including $38 million in the NT and $18 million in the Alice Springs region (draft EIS, chapter 15).

It is estimated the Project would employ 375 full time equivalent staff during construction, reducing to approximately 250 workers during steady-state operations (draft EIS, chapter 15). The Proponent has indicated most of the workforce would be fly-in fly-out or bus-in bus-out from Alice Springs.

There is potential for Project-related traffic to impact on other users of the road and rail transport networks and other people affected by those networks. A traffic assessment for operations was conducted by the Proponent and would require updating to incorporate construction and any changes to the Project. The traffic assessment in the draft EIS forecast a 4% increase in daily traffic on the Stuart Highway at the proposed intersection with the Project access road. The Proponent suggested the impact on road users is unlikely to be significant due to the small number of vehicle movements per day (predicted total 26; draft EIS, chapter 17) and the road capacity. The NT EPA advises the use of road and rail, including the updated traffic impact assessment and management plan would require endorsement by the Transport and Civil Services Division, Department of Infrastructure, Planning and Logistics.

The Proponent would implement a Social Impact Management Plan (SIMP – draft EIS, appendix K of appendix X) to boost positive impacts and minimise negative socio-economic impacts of the Project. The SIMP requires the development of a workforce plan to ensure equitable opportunities and outline a program for work-readiness and training. It also includes a community engagement plan and a Community Relations Officer would work with communities to address concerns relating to distribution and management of economic benefits. Relevant management plans would be made available on the Proponent's website.

The NT EPA considers it is important local stakeholders and the community have a clear understanding of the potential risks and benefits of the Project and how they would be managed by the Proponent over the life of the Project. The communication of risk involves stakeholder engagement and should occur early, often and with a genuine intent to listen, participate and seek acceptable compromises where possible (Wilkinson & King, 2016). The NT EPA considers it important that the Proponent communicate to stakeholders about the Project and the real and perceived levels of risk associated with it, including consultation with stakeholders about agreed post mining land uses and closure and rehabilitation options. This includes communicating the results of environmental performance such as water use outlined in the annual **Water Management Report** (suggested in recommendation 6, section 4.1.2) and reaching stakeholder acceptance of an agreed post mining land use as part of the **Mine Closure Plan** (section 5.3). The NT EPA makes recommendation 12 for the establishment of the

Community Reference Group to ensure effective communication with stakeholders and the management of social and economic impacts.

Recommendation 12

The Proponent shall establish the Community Reference Group as a forum to consult with stakeholders on agreed post mining land uses and engage on the broader environmental management and performance of the Project's operations including water use, monitoring results, and mine closure and rehabilitation.

The Proponent has adequately identified and assessed the potential social and economic impacts and risks associated with the Project. The Project would provide economic and social benefits to the region, and implementation of the SIMP and the Community Reference Group would provide for the mitigation and management of potential impacts.

4.4.3 Social amenity

4.4.3.1 Environmental values

Local residents and visitors to the area experience a quiet, remote locality with relatively low levels of noise, odour, dust and visual alteration of the landscape from its natural state. Traffic on the Stuart Highway, 10 km east of the proposed mine site, generates some noise and dust. Cattle grazing activities have altered the visual amenity of the landscape through the construction of infrastructure including access roads, tracks, fences, water bores and holding yards (draft EIS, chapter 16).

4.4.3.2 Potential impacts

The following potential impacts to amenity may occur as a result of the Project:

- changes to the visual amenity of the landscape
- the generation of noise, odour and dust impacting sensitive receptors.

4.4.3.3 NT EPA assessment

The visual amenity of the landscape in the vicinity of the Project would be permanently impacted by the Project due to the construction of waste landforms and the open pit. However, landforms at the mine site would be lower than surrounding hills and not visible from the Stuart Highway, 10 km to the east. The RSF at the processing site may be visible from Napperby Road, nine kilometres to the south. The NT EPA considers that these impacts to visual amenity would not be significant on a regional scale.

The Proponent assessed the potential impacts of noise on the nearest sensitive receptors of Aileron Roadhouse and Anna's Reservoir, where amenity may be impacted by noise. The predicted noise levels at these sensitive receptors due to Project operational activities were well below the relevant noise criteria and baseline ambient noise levels at Aileron Roadhouse (draft EIS, chapter 14). The draft EIS predicted that airblast overpressure from blasting activities would be below the relevant construction criteria of 115 dB(L) within two kilometres of the construction zones and no sensitive receptors were identified in this area, The Proponent has committed to implementing noise controls in a Noise Management Plan to mitigate impacts to fauna as discussed in section 4.3.3.

The emissions from the Project include the odorous gases of sulfur dioxide and nitrogen dioxide. The modelled predicted distribution of these gases indicates that concentrations of both would be below the relevant criteria at the sensitive receptors and within the proposed mineral lease (draft EIS, appendix Q). Dust generated from the Project is not predicted to reach sensitive receptors. The modelled distribution of all dust pollutants was below the relevant criteria within three kilometres of the proposed mine site. The NT

EPA considers it is unlikely that dust or odours from the Project would impact on the amenity of the surrounding environment.

The Air Quality and Dust Management Plan and the Noise Management Plan would be provided as part of the mining authorisation under the MM Act. Air quality, dust and noise monitoring results would be provided to the Community Reference Group outlined in recommendation 12. The NT EPA considers this would provide sufficient monitoring and management provisions to ensure sensitive receptors are not impacted by the generation of dust.

4.4.4 Aboriginal heritage and culture

4.4.4.1 Environmental values

The Project area is home to the local Anmatyerr people (living in local communities) who have retained strong ties to their land, water and culture. Nearby, Anna's Reservoir (*Angkwerl*) has strong cultural significance for its dreaming, rock art and semi-permanent waterhole.

Several sacred sites exist in the vicinity of the proposed mine footprint. In addition, the field archaeological investigation for the EIS identified 32 archaeological sites, most with moderate to high archaeological significance. Three of these were located within RWA8. Many of the sites have been significantly eroded or disturbed from pastoral and other land uses. As only 12% of the study area was covered by the survey, it is likely that additional archaeological material is present in areas that would be impacted by the Project.

4.4.4.2 Potential impacts

The following potential impacts may occur as a result of the Project:

- a reduction in the access to land for cultural reasons
- a change in the cultural values of land and water due to potential impacts on hydrological processes, inland water quality, flora and fauna, landform and visual amenity
- damage to sacred sites, archaeological sites, and archaeological items.

4.4.4.3 NT EPA assessment

Access to the Project site would be restricted to the public, limiting the ability of local Anmatyerr people to access land. The SIMP includes provisions for Anmatyerr access to land at the Project site for cultural activities (if practical), and annual visits to the site by traditional owner groups (if requested). The NT EPA notes the Proponent's commitment to provide continued access to land. The Community Reference Group outline in recommendation 12 may be an appropriate avenue to negotiate this continued access to land.

There is also potential for the Anmatyerr cultural values of land and water to be impacted if the environmental objectives of other factors are not met. The NT EPA considers that this can be avoided or minimised by addressing the other environmental factors as discussed in this Report.

Archaeological resources in the vicinity of the Project would be subject to direct or indirect impact from the Project. Impacts would be mitigated by the implementation of the Cultural Heritage Management Plan (CHMP – Supplement, appendix 7), which has been revised in consultation with the Heritage Branch, Department of Tourism and Culture. The Proponent has also committed to seek approval of the CHMP from the CLC and traditional owners. The plan includes procedures to avoid significant sites and

areas, to protect cultural and heritage values of significant places or items, and to deal with any new archaeological items discovered during the course of the Project.

The most significant area of potential heritage impact is RWA8 (Aboriginal Areas Protection Authority Certificate Restricted Works Area) which contains objects of high archaeological and cultural significance. To avoid impacts to RWA8, the Proponent has committed to investigate options to locate the access road elsewhere, and to liaise with traditional owners regarding management of RWA8 (Supplement).

Recommendation 13

Prior to the commencement of any construction, the Proponent or Operator must obtain relevant authorities and consents to disturb any/all sites of historical and cultural significance that may be disturbed by the Project.

The NT EPA considers the Proponent has adequately identified the cultural heritage items. These items are protected under the *Heritage Act* and the Proponent would require approvals prior to any disturbance.

4.4.5 Conclusion against NT EPA objective

With the implementation of relevant management plans and recommendations identified above, the NT EPA considers that the Project could be conducted in such a manner that its objective for social, economic and cultural surroundings is highly likely to be met.

4.5 Human health

4.5.1 Environmental objective

Ensure that the risks to human health are identified, understood and adequately avoided and/or mitigated.

4.5.1.1 Environmental values

The location of the Project, and particularly the rare earth ore body, has elevated levels of naturally occurring radioactive material (NORM). Background radiation levels (gamma radiation) and concentrations of radionuclides (in soil and air) in the region are elevated compared with the Australian average. At the surface of the ore body, these are even higher. This is consistent with other near-surface undeveloped uranium and rare earth bodies. Currently these elevated levels of radiation pose little risk to people because of the low visitation rate and because NORM is undisturbed and mostly below the surface.

The nearest sensitive receptors are Aileron Roadhouse/Homestead and Alyuen community, both 12 – 15 km from the proposed processing and mine sites. The proposed accommodation village for the Project is five kilometres from the processing site and nine kilometres from the mine site.

4.5.1.2 Potential impacts

During and after Project operations, human health may be impacted by radiation emitted by NORM that has been disturbed and brought to the earth's surface as a result of the Project.

4.5.1.3 NT EPA assessment

During operation of the Project, the Proponent predicted that mine and processing plant workers would be exposed to radiation doses of 1.5 mSv/y and 2.8 mSv/y respectively (draft EIS, chapter 12). This is well below the 20 mS/y recognised limit for workers arising from work or industrial activities. The predicted public radiation dose was 0.032 mSv/y for people living full time at the accommodation village, and 0.011 mSv/y for

residents of Aileron and Alyuen community. An additional assessment estimated that a conservative potential dose of 0.108 mSv/y or 0.329 mSv/y may be received from consuming bush tucker at Aileron community and the Accommodation village respectively, due to the Project. These are all well below the public dose limit of 1.0 mSv/y above background levels (ARPANSA, 2005).

Following closure (or during care & maintenance), there is a risk that people could be exposed to radiation resulting from the Project due to the presence of radionuclides in the TSF and RSFs. The Proponent used a standard method to assess the long term safety of radioactive waste disposal facilities. It was predicted that the public dose rate for humans living on the rehabilitated TSF or RSFs would be comparable with existing natural background levels (draft EIS, chapter 12). If the waste facility structures were eroded due to excessive rainfall, public doses could be up to 2.7 mSv/y for full time residents at the site, and future drilling into the structures could result in occupational doses up to 4.1 mSv/y.

It is estimated the WRDs would contain up to 145 Mt of low-level radio-active waste material (>1 Bq/g; Supplement, section 2.10.2) to be stored on the surface for the long term. The Proponent has committed to covering this material with a minimum of 2 m of benign rock and topsoil so as to isolate the radioactivity for long term containment and minimise erosion and instability of the WRDs. As part of the Mine Closure Plan discussed in section 5.3, the Proponent would be required to demonstrate this proposed cover would be adequate to isolate radioactivity for long term containment.

The Proponent has committed to implementing a Radiation Management Plan and Radiation Waste Management Plan in accordance with ARPANSA requirements. These plans would be required to be submitted as part of the mining approval process and would detail risk reduction controls that are As Low As Reasonably Achievable (ALARA) to reduce radiation exposure to employees, the community and the receiving environment.

With the implementation of the Radiation Management Plan and Radioactive Waste Management Plan, the NT EPA considers that the Project could be conducted in such a manner that would not result in increased risks to human health from radiation emitted by NORM. In addition, the NT EPA has considered the potential impacts and risks of the Project on all the environmental factors discussed in this Report.

4.5.2 Conclusion against NT EPA objective

With the implementation of relevant management plans and recommendations identified above, the NT EPA is satisfied the Project could be conducted in such a manner that its objective for human health is highly likely to be met.

5 Whole of Project considerations

5.1 Radiation protection

The Guide for Radiation Protection of the Environment (ARPANSA, 2015) deals specifically with radiation protection of wildlife, and recommends this be assessed in conjunction with radiation protection of people.

The NT EPA has assessed the potential impacts of the Project on radiation protection of people and wildlife in section 4 of this Report. In particular, the EPA has assessed the potential impacts of radiation on people in section 4.5 of this report (Human health), and on flora and fauna in section 4.3 (Terrestrial flora and fauna). Additional potential impacts on people and wildlife that could occur through contamination of water with radionuclides have been discussed in section 4.2 (Inland water environmental quality). The NT EPA notes that the proponent has considered the relevant Australian Government policy, guidelines and plans on this matter.

Operation of this Project would involve dealing with naturally occurring radioactive materials (NORM) that occur within the ore-body to be mined. Uranium and thorium would be removed from the open pit and ultimately could be concentrated and stored onsite in the waste storage facilities. There is potential for ionising radiation from these elements and their decay products to be above background levels into the future, well beyond the life of the Project. This could impact on people and/or wildlife. If radionuclides are not effectively contained on site, the area of potential impact could extend beyond the proposed mine site and processing site.

The NT EPA considers the implementation of best-practice management of waste materials would increase certainty of containment of radionuclides and radiation protection of wildlife and people into the future. To ensure best-practice management is implemented, the NT EPA has recommended an **independent certifying engineer** to oversee the design and operation of Project waste storage facilities (section 4.2.2, recommendation 9).

The NT EPA also recommends a process safety plan be developed for the Project (section 5.2, recommendation 14). This would enable the Proponent or Operator to demonstrate the risks of failure of waste storage facilities (or other high consequence events) have been reduced to a level that is as low as reasonably achievable (ALARA).

To ensure the containment of radionuclides in waste storage facilities for the long term, the NT EPA has made recommendations 15 and 16 to establish best practice mine closure, including progressive rehabilitation, in the Mine Closure Plan (section 5.3).

If the relevant recommendations in this Report are taken into account by the relevant regulator/s and reflected in management of the Project, the NT EPA considers that potential impacts on people and wildlife from ionising radiation arising from the Project can be avoided or mitigated. In that case, the NT EPA considers that it is likely that the potential impacts and risks from ionising radiation on the environment as a result of the Project would be acceptable.

5.2 Process safety

The NT EPA considers that greenfield resource development in the Territory must be constructed and operated to leading industry standards including operating environmental management systems that minimise environmental risks both during operation and post closure. For this Project, the NT EPA considers the oversight of process safety systems for the Project's mining operations and storage of waste rock, tailings and residues would strengthen regulation to prevent the occurrence of catastrophic major incidents (process safety incidents) that may impact the environment (Wilkinson & Murphy, 2017).

A process safety incident is a loss of control of material with the *potential* for high consequences. Examples include spills of hazardous substances, chemicals and hydrocarbons, release of contaminated water, fires or explosions which have the potential to impact human health and safety, the community, environmental values, company reputation and financial losses. Process safety incidents also include exposures to the environment that may impact over an extended period of time, such as long-term seepage from the TSF or RSF contaminating groundwater supplies.

Process safety is a blend of engineering and management skills focused on preventing process safety incidents (Energy Institute, 2017). Process safety skills exceed those required for managing workplace safety as it considers how major hazards (rather than human safety hazards) are assessed and controlled. With effective implementation of the principles of process safety, the Proponent or Operator is better positioned to prevent major incidents occurring.

The regulation of process safety provides additional certainty that the Proponent or Operator is managing its significant risks by preventing catastrophic incidents. The NT EPA recommends a **process safety plan** that provides additional detailed information on both the preventative and mitigating controls in the event of a serious incident. This **process safety plan** would identify all process safety hazards on site and document the risks and implementation of preventative and mitigating controls.

The NT EPA considers regulatory oversight of process safety at the Project is an additional layer of oversight that enables the Proponent or Operator to demonstrate risks at the site have been reduced to a level that is as low as reasonably achievable (ALARA). With a clearly documented **process safety plan** that includes identified hazards, threats and controls to prevent major incidents from occurring, the regulatory agency can focus on ensuring the operator implements those critical controls (ICMM, 2017). Critical controls are those controls that would have the greatest impact on preventing the risks relating to a major process safety incident from occurring or would provide the greatest mitigation of the potential consequences. The NT EPA considers applying the principles of process safety, including focusing on how the operator implements critical controls, can also be applied to major environmental risks. This includes but is not limited to preventing TSF/RSF failures and overflows, management of AMD and leachate and preventing uncontrolled releases of contaminated water or slurry.

Recommendation 14

The Proponent or Operator shall engage an independent process safety expert, endorsed by the relevant regulator to:

a) **develop a process safety plan that details how process safety systems would be implemented to prevent the occurrence of a major process safety incident**

b) **provide oversight of the implementation of process safety via regular inspections**

c) **provide reporting of process safety oversight to the relevant regulator.**

The process safety plan must:

a) **identify major process safety hazards at the Project**

b) **document the risks and controls and identify critical controls**

c) **provide bowtie diagrams to present risks and controls for the Project's identified process safety hazards in a graphical form**

d) document the controls and associated accountabilities and active monitoring responsibilities

e) monitor and report on the effectiveness of the controls, identifying areas for improvement and actioning

f) document the independent process safety expert's oversight inspection schedule that would report on whether process safety systems are embedded into the culture of the organisation

g) provide provisions for publicly reporting the independent process safety oversight reports.

5.3 Closure and rehabilitation

The NT EPA considers that greenfield mining development in the Territory should integrate mine closure planning with mine planning, and that this should include best practice closure and rehabilitation requirements prior to authorisation of mining activities. In the absence of Mine Closure Guidelines in the Northern Territory, the NT EPA refers to the principles of mine closure planning listed in the WA Guidelines for Preparing Mine Closure Plans (DMP, 2015). The NT EPA recognises that mine rehabilitation and closure planning occurs at all stages of mining and that the Mine Closure Plan should be based on the WA Mine Closure Guidelines (or subsequent NT Mine Closure Guidelines) with regular review, development and continuous improvement throughout the life of the mine including any period of care and maintenance.

The NT EPA notes that under the MM Act, a mining security bond would be required for the Project that would be utilised by the NTG, if required, to prevent, minimise or rectify environmental harm or for the completion of rehabilitation. The NT EPA recommends the security bond be revised based on the updated Mine Closure Plan to ensure the costs of rehabilitation and post-closure liabilities are not borne by the NTG and the community, in the event of the Operator abandoning the site or becoming insolvent. From the mine approval stage throughout the mine life, the Mine Closure Plans should demonstrate that ecologically sustainable mine closure can be achieved, consistent with agreed post-mining outcomes and land uses, and without unacceptable liability to the NTG (DMP, 2015).

The Mine Closure Plan would be continually reviewed over the mine's life and further work on final rehabilitation of the final landforms can be provided during the operational phase. The mining security bond can be adjusted to reflect the proposed design and progressive rehabilitation works. The Proponent has presented alternative closure and rehabilitation strategies (Supplement, section 4.1). The NT EPA considers the Proponent should further evaluate these alternative risk based rehabilitation options in future iterations of the closure plan as site-specific information about the site and pit is collected over time and technology and management evolves. To address this, the NT EPA makes recommendation 15. This includes a comparison of the long term or residual environmental risk between the current conceptual closure plan (that includes an open pit lake with unknown extent and duration of groundwater loss/drawdown impacts, and WRDs and TSF/RSF structures on the surface) and other alternatives including backfill of the final void with any mined waste materials that may present long-term risks to the environment.

The NT EPA is of the opinion that the current closure plan (draft EIS, appendix W) presented by the Proponent is conceptual. The NT EPA makes recommendation 15 to ensure alternative rehabilitation options are considered and evaluated prior to acceptance of the Mine Closure Plan by the regulator. Conceptual closure includes five WRDs consisting of 133 million loose cubic metres of waste rock, 50 metres high and covering 460 ha in total (Supplement, section 2.10.1). The design of the WRDs is to be based on further characterisation of representative waste rock to inform selective

placement of the various waste types and must meet specific management criteria, as discussed in section 4.2. This would ensure WRD design, including cover design, is appropriate for successful closure. The NT EPA notes these WRD's are highly engineered structures in the general landscape and recommends the Proponent consider alternative landforms that may blend more with the surrounding landscape and retain stability for the long term.

In current Project plans, the TSF would have a footprint of 195 ha, height of 22 to 25 m and total storage of ~27 Mt of dry tailings. The RSFs encompass 356 ha, embankment height up to 14 m and total storage of ~17 Mt of dry residues (Supplement, section 2.9.1). Both of these facilities would contain radionuclides and metals. The Proponent has committed to cover both with a minimum of two metres of benign waste rock to limit infiltration of rainfall and prevent the dissolution and mobilisation from within the facilities. The final closure and cover design is to be further developed during the detailed design phase (Supplement, section 2.9).

The pit would remain an open void and contain a pit lake that would become hypersaline and require restricted access by people and fauna post closure. It would also be a permanent groundwater sink with increasing radius of groundwater drawdown for at least 1000 years. This may impact groundwater dependent vegetation. The NT EPA considers that an increasing area of impact is not acceptable and this issue is to be addressed in the Mine Closure Plan as outlined in recommendation 15. The NT EPA recommends further studies into this drawdown and potential impacts in section 4.2.2 of this Report. Kerosene Camp Creek would be permanently diverted, with flood-protection levees to ensure water from the catchment is delivered downstream and does not enter the pit.

The NT EPA recommends that the Proponent demonstrates that these proposed final landforms and rehabilitation closure strategies support the principle closure objectives for rehabilitated mines in accordance with the WA Guidelines. This would also include consultation between the Proponent and stakeholders as outlined in recommendation 12 on the agreed rehabilitation objectives and post mining land uses. The Mine Closure Plan should demonstrate that the rehabilitated mine would be safe to humans and animals, geo-technically stable, geo-chemically stable, non-polluting/non-contaminating and capable of sustaining an agreed post-mining land–use (DMP, 2015).

Recommendation 15

Approvals and decisions for the Project shall have conditions that require the Mine Closure Plan to progressively include:

a) **alternative risk based rehabilitation options that identify a range of closure scenarios and strategies for the Waste Rock Dumps, Tailings Storage Facility, Residue Storage Facility and the pit and provide justification that the preferred closure option minimises environmental risks**

b) **identification and management of knowledge gaps relating to closure-specific technical information; including environmental baseline data, waste characterisation, pit lake characterisation, and review of monitoring data; to inform sustainable mine closure**

c) **details of pre-closure research trials, investigations and modelling aimed at closing knowledge gaps to inform detailed rehabilitation design. These are to include, but not be limited to, revegetation trials, final cover materials, capping design and groundwater studies particularly in respect of drawdown in the vicinity of the mine pit.**

The Mine Closure Plan is to be peer reviewed by an appropriately qualified independent professional prior to submission to the relevant regulator.

The NT EPA is of the opinion that **progressive rehabilitation** should be implemented as part of Project planning and operations, as suggested by the Proponent (Supplement, section 4.1.1, #6). Effective early planning would minimise rehabilitation costs and **progressive rehabilitation** would provide an early indication of rehabilitation success to aid in meeting closure outcomes (Australian Government, 2016). It is known that domains such as WRDs and TSFs can be rehabilitated progressively during the operational phase outcomes (Australian Government, 2016). The NT EPA notes that current plans for the TSF and RSF include an option for multiple cell configurations that would allow for progressive rehabilitation and capping. The Proponent has committed to locating and staging WRDs such that progressive rehabilitation would be feasible (draft EIS, appendix W). Staged completion of WRD landforms and TSF/RSF sections would enable rehabilitation works to be completed and rehabilitated during operations, rather than commencing rehabilitation works a few years pre-closure.

The Proponent has stated that the Mine Closure Plan (draft EIS, appendix W) would be updated as part of the mining authorisation process when further information is available to refine plans. The NT EPA expects **progressive rehabilitation** to be an integral part of the Project and makes recommendation 16 to ensure sustainable closure and rehabilitation includes **progressive rehabilitation** of WRDs and TSF/RSFs during operations. This would allow learnings from research, site investigations and rehabilitation performance monitoring to be responded to adaptively throughout the mine life. The NT EPA considers that mining authorisation should include conditions for **progressive rehabilitation**. This would reduce the disturbance footprint of the Project at any one time and could correspondingly reduce the mining security bond held by the relevant regulator. This would reduce the potential financial and environmental risks and post closure liabilities to the NTG and the community in the event of unforeseen closure or the Operator abandoning the site or becoming insolvent.

Recommendation 16

Before approvals or decisions are given or made for the Project, the Proponent or Operator shall provide to the relevant regulator a conceptual Mine Closure Plan that must be reviewed and updated every three to five years. The Mine Closure Plan must:

a) **provide details on progressive rehabilitation works and incorporation of progressive rehabilitation in mine planning activities**

b) **address all aspects of rehabilitation and mine closure, including stakeholder agreed post mining land use, rehabilitation objectives, completion criteria and rehabilitation monitoring**

c) **include details of the pre-closure research trials and investigations that would inform, guide and support appropriate cover systems and rehabilitation of ecosystems for closure**

d) **include final landform designs that are consistent with surrounding topography of the area and consistent with current standards and best practice**

e) **include a commitment to ensure all landforms, including the pit lake, are safe and stable**

f) **include an adaptive management approach in response to progressive rehabilitation performance monitoring results to ensure rehabilitation is successful**

g) **establish ongoing monitoring and maintenance of the site post mining in accordance with an approved monitoring and maintenance program until such time as the relevant regulator directs.**

Approvals and decisions in relation to the Project shall include conditions that require reporting to the relevant regulator on progressive rehabilitation works and performance.

6 Matters of national environmental significance

The Australian Government Minister for the Environment and Energy has determined that the proposal is a controlled action under the EPBC Act as it is likely to have a significant impact on one or more MNES. It was determined that the proposed action is likely to have a significant impact on the following matters protected by the EPBC Act:

- Listed threatened species and communities (sections 18 and 18A)
- Nuclear actions (section 21 and 22A).

The NT EPA has assessed the controlled action on behalf of the Australian Government under the Bilateral Agreement made under section 45 of the EPBC Act. The proposed action has been assessed by the NT EPA in a manner consistent with Provision 6 of the Bilateral Agreement.

This assessment report is provided to the Australian Government Minister for the Environment and Energy who will decide whether or not to approve the proposal under the EPBC Act. This is separate from any Northern Territory approval/s that may be required.

6.1 Threatened species

The EPBC Act requires the protection and conservation of threatened native species (sections 18 and 18A). The potential for impact on relevant threatened species has been assessed in detail in section 4.3.3 of this report.

The NT EPA makes the following conclusions regarding the acceptability of any impacts on the five species listed under the EPBC Act that have suitable habitat in the Project area.

Vulnerable species

- The black-footed rock wallaby (*Petrogale lateralis*, McDonnell Ranges Race) is likely to be impacted by Project activities at the proposed mine site. The NT EPA considers that these impacts would be unlikely to have a significant impact on the population of *P. lateralis* occupying the Reynolds Range. The NT EPA considers that the potential impacts to this species would be acceptable.
- The great desert skink (*Liopholis kintorei*) has a significant active warren within the borefield that could be potentially impacted by the Project, but this is highly likely to be mitigated by the proposed 200m buffer. The NT EPA has recommended further survey that would enable the identification and management of any additional warrens in suitable habitat in the borefield area. The NT EPA considers it is unlikely that the known warren of this species would be impacted by the siting of a bore and access track at 1710 m and 200 m distance respectively. The NT EPA considers that the impacts to this species from clearing of suitable habitat would be acceptable.

- The greater bilby (*Macrotis lagotis*) was not detected in targeted surveys, and is unlikely to occur in the area to be impacted by the Project. The NT EPA considers it is unlikely the Project would have an impact on this species.

- The princess parrot (*Polytelis alexandrae*) was not detected in targeted surveys, and is unlikely to be significantly impacted by the Project due to the extremely limited proportion of the species' area of occupancy. The NT EPA considers it is unlikely the Project would have an impact on this species.

Endangered species

- The night parrot (*Pezoporus occidentalis*) was not detected in targeted surveys, and is unlikely to occur in the area to be impacted by the Project. The NT EPA considers it is unlikely the Project would have an impact on this species.

The NT EPA considers that any potential impacts of the Project on species listed under the EPBC Act can be adequately avoided or managed, or are not significant on a regional scale. Any residual impacts to these species are likely to be acceptable.

6.2 Nuclear actions

The EPBC Act requires the protection of the environment from nuclear actions (sections 21 and 22A, EPBC Act), and this Project is considered to be a nuclear action. In this case, the Matter of National Environmental Significance is 'the environment (sections 22(1)(a) and (e), EPBC Act). The 'environment' is defined in section 528 of the EPBC Act as including:

(a) ecosystems and their constituent parts, including people and communities; and

(b) natural and physical resources; and

(c) the qualities and characteristics of locations, places and areas; and

(d) Heritage values of places; and

(e) the social, economic and cultural aspects of a thing mentioned in paragraph (a), (b), or (c).

The NT EPA has assessed the main potential impacts of the Project on the environment in sections 4 and 5 of this Report. Other potential impacts have been addressed in Appendix 1. Specifically, each aspect above has been addressed in sections of this Report as follows:

(a) sections 4.3, 4.4 and 4.5

(b) sections 4.1 and 4.2 and Appendix 1 (Terrestrial environmental quality; Air quality and greenhouse gases)

(c) section 4.4 and Appendix 1 (Landforms; Air quality and greenhouse gases)

(d) section 4.4

(e) section 4.4

The NT EPA considers that, with the implementation of the recommendations in this Report, the Project could be managed in a manner such that environmental impacts would be acceptable.

7 Conclusion

In making this Report, the NT EPA had regard to the information provided by the Proponent, submissions on the draft EIS and Supplement, advice from specialists from the Northern Territory Government as well as relevant guidelines and standards. The NT EPA has assessed the Project against the NT EPA's objectives for the key environmental factors of: Hydrological processes; Inland water environmental quality; Terrestrial flora and fauna; Social, economic and cultural surroundings; and Human health.

The NT EPA acknowledges rare earth elements are key components in many green and sustainable products such as wind turbines for the clean energy industry and hybrid vehicles. Developing and enhancing responsible mining practices of these rare earths is critical to ensure mining operations and the waste products that remain after mining do not result in ongoing environmental impact or an environmental legacy for the NTG.

The project is in an arid zone of Australia where groundwater is a scarce and valuable resource. The proposed borefield would abstract water from a groundwater resource that is poorly understood. There is uncertainty around the potential impacts of this abstraction to groundwater dependent vegetation and potential future users of the resource. The NT EPA recommends that the Proponent be required to implement practices for the sustainable use of groundwater for this Project. This includes minimising water consumption, applying corporate water governance and providing open and transparent reporting of the use of that groundwater resource. The NT EPA makes the recommendation for the development of a **Water Abstraction Management Plan** to ensure monitoring and updated groundwater models are used for adaptive management responses to achieve sustainable groundwater use. The NT EPA also recommends transparent reporting of water management in an annual Water Management Report.

A permanent diversion of Kerosene Camp Creek is proposed as part of the Project. The NT EPA makes the recommendation for an updated creek diversion design to demonstrate that the diversion and levee would effectively permanently deliver creek flows to the downstream tributary. This would include maintaining water quality regimes and sediment transport.

The NT EPA also notes that mine wastes would contain naturally occurring radioactive materials (NORM) that has the potential to impact on the environment if not effectively contained for the long term. Some uncertainty remains on the acid and metalliferous drainage (AMD) testing of waste rock and waste from the phosphoric acid pre-leach (PAPL) processing. The NT EPA considers the results of additional test work is required to inform detailed design of the waste rock dumps, tailings storage facility and residue storage facility to ensure appropriate management of wastes and minimise potential leachates. The NT EPA makes the recommendation for this further work to be conducted to inform detailed designs of the waste storage facilities.

The NT EPA notes the Proponent's commitment to design, construct, maintain, operate and decommission the TSF and RSF to the Australian National Committee on Large Dams (ANCOLD) guidelines. The NT EPA is of the opinion that waste storage facilities should be designed, constructed and operated in a manner that facilitates the meeting of the relevant closure objectives. To demonstrate this objective has been met, the NT EPA recommends periodic inspection, review and auditing of the waste facilities by independent technical experts, including an **independent certifying engineer.** This would include performance monitoring of these facilities and an assessment of the overall performance and long-term integrity, as part of a rigorous regulatory process.

The NT EPA considers that significant environmental impacts may occur as a result of the Project if a major incident were to occur at the Project. This could include, but is not limited to, TSF/RSF failures and overflows, generation of AMD and leachate, and

uncontrolled releases of contaminated water or tailings/residue slurry that is likely to include radioactive elements in concentrations that may be higher than NORM associated with the deposit. To add certainty that these risks to the environment from the Project would be appropriately prevented and managed, the NT EPA recommends the development and implementation of a **process safety plan**. This would enable the regulator to ensure critical controls are implemented that would most likely prevent such an incident or mitigate consequences should it occur.

The NT EPA considers that effective long term containment of mining waste, post-closure or following unforeseen closure, is essential to ensure protection of the environment, including radiological protection. The NT EPA has recommended that mine closure planning be an integral part of mine planning and that **progressive rehabilitation** is undertaken according to an approved schedule during Project operations. This would lower the risk of environmental harm during and after the life of the Project including any period of care and maintenance. The NT EPA recommends the Mine Closure Plan be updated prior to any approvals or decisions for the Project to inform the mining security bond required under the *Mining Management Act* (MM Act) and that it be regularly reviewed and updated throughout the life of the Project. The NT EPA recommends that security bond be revised based on the updated Mine Closure Plan to ensure the costs of rehabilitation and post-closure liabilities are not borne by the NTG and the community, in the event of the Operator abandoning the site or becoming insolvent.

The NT EPA makes 16 recommendations as an outcome of the EIA. These recommendations are for the Proponent and decision-makers to consider with respect to conditions of future approval processes and for the execution of the proposed action. The NT EPA emphasises that due to the lack of site-specific information (including baseline data), considerable uncertainty remains around the potential for significant environmental impacts over the life of the Project. The NT EPA emphasises that the environmental commitments, safeguards and recommendations outlined in the EIS, this Assessment Report and in the final management plans, must be implemented by the Proponent and oversighted and enforced by the relevant regulator throughout the life of the Project to deliver acceptable environmental outcomes.

The NT EPA considers that, subject to the implementation of the recommendations, the Project can be managed in a manner that is likely to meet the NT EPA's objectives and avoids significant or unacceptable environmental impacts and risks.

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Appendix 1 – Other environmental factors

Environmental Factor	Description of the Project's likely impacts on the environmental factor	Evaluation of why the factor is not a key environmental factor
Terrestrial environmental quality Objective: Maintain the quality of land and soils so that environmental values are protected	Impacts to terrestrial environmental quality would occur through erosion and sediment movement resulting from Project activities (draft EIS, appendix M). These have been addressed in section 4.2 (Inland water environmental quality). Terrestrial environmental quality may also be impacted by soil contamination resulting from: • uncontrolled release, spill or passive discharge of hazardous substances including hydrocarbons or reagents • spills from pipelines • water used for dust suppression • leachate from landfill (non-mineralised waste), • potential acid and metalliferous drainage (AMD; including elevated radioactivity) resulting from waste rock, ore, tailings or residues.	Terrestrial environmental quality was not identified as a preliminary key environmental factor for this assessment. Having regard to the following: • The loss of containment of hazardous substances has been addressed in section 4.2.3 (Inland water environmental quality – surface water) and in section 5.2 (process safety) • The Proponent has committed to develop a develop a response for potential pipeline spills and associated potential environmental impacts (Supplement, section 5) • The Proponent has committed to undertake suppression of dust on roads and at the crushing circuit (Supplement, section 5) • Soil contamination from landfill or potential AMD from waste storages has been addressed in section 4.2.2 (Inland water environmental quality – groundwater). The NT EPA considers that it is unlikely that the Project would have a significant impact on Terrestrial environmental quality and can be managed to meet the NT EPA's environmental objective. The NT EPA does not consider that Terrestrial environmental quality is a key environmental factor at the conclusion of its assessment.

Environmental Factor	Description of the Project's likely impacts on the environmental factor	Evaluation of why the factor is not a key environmental factor
Landforms Objective: Conserve the variety and integrity of distinctive physical landforms so that environmental values are protected	Impacts to landforms would occur through the following Project activities: • Creation of a permanent open-pit (~225 m deep) • Diversion of the ephemeral Kerosene Camp Creek • Creation of permanent waste storage landforms at the mine site, (~50 m above ground level) • Creation of permanent residue storage facilities at the processing site (~14 m high)	Landforms were not identified as a preliminary key environmental factor for this assessment. Having regard to the following: • The landforms surrounding the mine site are not considered to be physically distinctive. • The intended post-closure land-use is broad-scale pastoralism that would not be significantly affected by the presence of an open pit that is effectively isolated. • The mine site is adjacent to the southern end of the Reynolds Range, where hills rise to ~120 – 160 m above the height of the proposed pit ground level and within 4 – 6 km of it. The waste storage landforms would be lower than these hills (maximum 50 m high) and not visible from the Stuart Highway, 10 km to the east. • Infrastructure at the processing site, including the RSFs at 14 m high, would be likely to be visible from Napperby Road. This is unlikely to be considered significant on a regional, Territory or national scale. The NT EPA considers that it is unlikely that the Project would have a significant impact on Landforms and can be managed to meet the NT EPA's environmental objective. The NT EPA does not consider that Landforms is a key environmental factor at the conclusion of its assessment.

Environmental Factor	Description of the Project's likely impacts on the environmental factor	Evaluation of why the factor is not a key environmental factor
Air quality and greenhouse gases Objective: Maintain air quality and minimise emissions and their impact so that environmental values are protected	Potential impacts to air quality and greenhouse gas (GHG) emissions would occur through the following Project related activities: • Clearing of 4161 ha of vegetation • Transport of all materials, reagents, products and personnel to, from and within the site • Emissions from the processing plant and gas fired power generator. • Gaseous emissions from the mine pit, including radionuclides. • Dust generated by the Project, which may include radionuclides	Air quality and greenhouse gases were not identified as a preliminary key environmental factor for this assessment. Having regard to the following: • The clearing of 4161 ha of vegetation would be unlikely to result in GHG emissions that are significant on a national scale. • Transport related emissions, including GHG, would be unlikely to be significant on a national scale. • The implementation of the Dust Management Plan would minimise the generation and mobilisation of dust and impacts on sensitive receptors. • Reporting on emissions to air from the mine would be required under the National Pollutant Inventory, if reporting criteria are triggered • Registration and reporting on energy use would be required under the National Greenhouse and Energy Reporting Act 2007, due to the production and use of more than 100 terajoules of energy annually. The NT EPA considers that it is unlikely that the proposal would have a significant impact on Air Quality and Greenhouse Gases and this factor can be managed to meet the NT EPA's environmental objective. The NT EPA does not consider that Air Quality and Greenhouse Gases is a key environmental factor at the conclusion of its assessment.

Appendix 2 – Project area

Geographic coordinates defining the Project area (datum: GDA94).

Project component	Mineral Lease	Point	Latitude	Longitude
Mine site	ML26659	1	22° 33' 58" S	133° 13' 02" E
		2	22° 33' 59" S	133° 14' 43" E
		3	22° 34' 12" S	133° 14' 29" E
		4	22° 34' 13" S	133° 15' 32" E
		5	22° 35' 51" S	133° 15' 31" E
		6	22° 35' 51" S	133° 14' 32" E
		7	22° 36' 22" S	133° 14' 31" E
		8	22° 36' 21" S	133° 13' 18" E
		9	22° 35' 17" S	133° 13' 36" E
		10	22° 34' 44" S	133° 13' 36" E
		11	22° 34' 44" S	133° 13' 02" E
	proposed extension (# 12 and #15 adjoin ML26659)	12	22° 34' 58" S	133° 15' 31" E
		13	22° 36' 14" S	133° 16' 00" E
		14	22° 36' 14" S	133° 15' 29" E
		15	22° 35' 51" S	133° 15' 14" E
Processing site	ML30703	20	22° 37' 51" S	133° 11' 45" E
		21	22° 37' 58" S	133° 12' 08" E
		22	22° 38' 44" S	133° 13' 20" E
		23	22° 39' 17" S	133° 13' 54" E
		24	22° 40' 29" S	133° 12' 32" E
		25	22° 38' 46" S	133° 10' 38" E
	ML30704	26	22° 38' 12" S	133° 13' 55" E
		27	22° 38' 44" S	133° 14' 32" E
		28	22° 39' 17" S	133° 13' 54" E
		29	22° 38' 44" S	133° 13' 20" E
Accommodation village	ML30702	16	22° 39' 13" S	133° 16' 32" E
		17	22° 39' 32" S	133° 16' 52" E
		18	22° 39' 52" S	133° 16' 31" E
		19	22° 39' 32" S	133° 16' 10" E