

ASSESSMENT REPORT 92

Union Reefs North Underground Mine Northern Territory Mining Operations Pty Ltd

June 2020

Environmental Impact Assessment Process Timelines

Date	Chronology	Relevant clause under the EAAP
09/04/2019	Notice of Intent received	6
07/08/2019	NT EPA decision and statement of reasons issued - Environmental Impact Statement (EIS) required	8(2)(a)
20/08/2019	Australian Government decision – Controlled Action under EPBC Act (for accredited assessment process by NT)	3A
02/10/2019	Draft Terms of Reference (TOR) released for public comment	8(3) and 8(4)
25/10/2019	Final TOR issued to Proponent	8(5)(b) and 8(6)
30/11/2019	Draft EIS released for public comment for seven weeks	9(1)
31/01/2020	NT EPA directed Proponent to prepare EIS Supplement	11A(3)(a)
11/05/2020	EIS Supplement received	12(3)
26/06/2020	Assessment Report issued	14(3) & 14(4)



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26 June 2020

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Abbreviations and glossary

adit	a horizontal passage leading into a mine for the purposes of access or drainage; serving as a roost site or roost habitat for ghost bats
advisory bodies	NT Government agencies having expertise and/or administrative responsibilities in respect of the Proposal
AHD	Australian height datum
AMD	acid and/or metalliferous drainage (including neutral mine drainage, and/or saline drainage)
ANZG	Australian and New Zealand Guidelines
artificial roost	Proposal-specific, purpose-built, above-ground structures intended as roost habitat for ghost bats. These are referred to as contingency roosts in the EIS. For the purposes of this report, does not include modified existing roost habitat.
Australian Government Minister	Australian Government Minister for the Environment
Bilateral Agreement	an agreement under section 45 of the EPBC Act between the Australian and Northern Territory Government's under which the Australian Minister for the Environment to rely on specified environmental impact assessment process of the Northern Territory
colony	two or more ghost bats that occupy a day roost, and use other nearby roosts; the number of ghost bats within a colony may vary over time
DAWE	Department of Agriculture, Water and Environment (Australian Government – formerly DOEE)
day roost	location where ghost bats rest during the day
DENR	Department of Environment and Natural Resources (NT)
DOEE	former Department of the Environment and Energy (Australian Government – now DAWE)
DPIR	Department of Primary Industry and Resources (NT)
Draft EIS	the initial part of the EIS, subject to public exhibition
EA Act	<i>Environmental Assessment Act 1982</i>
EAAP	Environmental Assessment Administrative Procedures 1984
EIA	environmental impact assessment
EIS	Environmental Impact Statement – comprises the Draft EIS and the Supplement

Environment	all aspects of the surroundings of man including the physical, biological, economic, cultural and social aspects (section 3 of the <i>Environmental Assessment Act 1982</i>)
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
ESD	ecologically sustainable development
Lady Alice Adit	old mine working located in hills 200 m east of Union North Pit and 500 m north of Prospect Pit, a previous roost site for ghost bats, since collapsed and more recently reopened
LOM	life of mine
MCP	Mine Closure Plan
MLN	Mineral Lease Number
MM Act	<i>Mining Management Act 2001</i>
night roost	location where ghost bats rest during the night between foraging and feeding events
NT	Northern Territory
NT EPA	Northern Territory Environment Protection Authority
OK Adit	old mine working located in Prospect Pit, important day roost for ghost bats
Prospect Adit	old mine working located in Prospect Pit, occasional day and night roost for ghost bats
regional population	the Pine Creek population of ghost bats, understood to be genetically distinct from ghost bats in Litchfield, Katherine and northern Kakadu
responsible Minister	Northern Territory Minister for Primary Industry and Resources
ROM	run of mine – for storing/mixing ore prior to processing
roost habitat	structures that are potentially suitable for ghost bat occupation, including natural caves, abandoned mine structures and adits, or purpose built structures
roost site	roost habitat that is known to be occupied by ghost bats, currently or within the last two years
SOCS	site of conservation significance
URPA	Union Reefs Project Area, comprising ten mineral leases at the time of this assessment (Draft EIS section 3.3) and fully incorporating the Proposal area
the Minister	Minister for Environment and Natural Resources
the Proponent	Northern Territory Mining Operations Pty Ltd; the company intending to undertake the proposed action

the Proposal	the Union Reefs North Underground Mine; the proposed action undergoing environmental impact assessment
the Proposal area	the area as defined by the Proposal components (Figure 3)
the / this Report	Assessment Report 92, for the Union Reefs North Underground Mine
the Supplement	the second part of the EIS, addressing comments on the Draft EIS
TSF	tailings storage facility
Union North Adit	old mine working located in Union North Pit, important day roost for ghost bats
Union Reefs colony	the group of about 50 ghost bats known to occupy roost sites in the URPA. While likely to comprise two or more distinct colonies, it is collectively referred to as the Union Reefs colony.
WDL	waste discharge licence
WRD	waste rock dump

Units and symbols

%	percent
CO ₂ -e	carbon dioxide equivalent
ha	hectare
km	kilometre
km ²	square kilometre
kV	kilovolt
L	litre
L/s	litres per second
m	metre
mm	millimetre
m ³	cubic metre
m AHD	metres above Australian Height Datum
m bgl	metres below ground level
ML	megalitre = 1x10 ⁶ litres or 1x10 ³ m ³
Mtpa	million tonnes per annum
MW	megawatt
MWh	megawatt hours

oz	ounces
t	tonne
tpa	tonnes per annum
$\mu\text{S/cm}$	micro-Siemens per centimetre

Summary and recommendations

Environmental impact assessment (EIA) is a process for identifying potential environmental impacts and risks of a proposed action, evaluating the significance of those impacts and risks, and determining appropriate avoidance, minimisation and mitigation measures to reduce those impacts and risks to acceptable levels.

This Assessment Report (this Report) examines the environmental impacts and risks of the Union Reefs North Underground Mine (the Proposal), proposed by Northern Territory Mining Operations Pty Ltd (the Proponent). This Report concludes the assessment process by the Northern Territory Environment Protection Authority (NT EPA).

The Report is provided to the Northern Territory Minister for Environment and Natural Resources (the Minister) and to the Minister for Primary Industry and Resources (the responsible Minister) for consideration in the development of conditions and approvals for the Proposal under the *Mining Management Act 2001* (MM Act). This Report is not an environmental approval although it will guide the decision by the Responsible Minister. The Report will also inform approvals under the Northern Territory *Water Act 1992*.

The Proposal is a controlled action under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) with the controlling provision being listed threatened species and communities due to the potential for significant impacts on the vulnerable ghost bat (*Macroderma gigas*). The Proposal is being assessed in accordance with the Bilateral Agreement made under section 45 of the EPBC Act and will therefore require separate approval from the Australian Government. This Report will guide the decision under the EPBC Act.

The Proponent proposes to commence underground mining and on-site processing of gold ore at the Union Reefs Project Area (URPA), located about 175 km south-east of Darwin and 20 km north-west of Pine Creek. The URPA is an existing authorised mine site containing an active processing facility. It is a highly modified brownfield site that has been mined for gold since 1873. The Proposal has a disturbance footprint of 153 ha.

The Proposal involves the development of the underground mine within an existing pit, including dewatering of the existing pit lake and temporary above-ground storage of waste rock. Ore will be mined using a combination of up-hole benching and Avoca stoping. Processing will use the existing authorised Carbon in Leach processing plant and associated tailings storage facility in Crosscourse Pit. The Proposal life is two to three years and expected to produce 39 232 gold ounces for export.

The NT EPA has assessed the Proposal at the level of an Environmental Impact Statement (EIS) under the *Environmental Assessment Act 1982*. The NT EPA identified potential impacts and risks to: local and regional ghost bat populations; surface water and groundwater quality due to contamination from mining wastes; hydrological regimes of both surface and groundwater from tailings storage and dewatering; and downstream aquatic ecosystems of the McKinlay River as a result of surface water and groundwater contamination and groundwater drawdown. Consequently, the NT EPA assessed the Proposal against the NT EPA's objectives for the key environmental factors of:

- Terrestrial flora and fauna
- Inland water environmental quality
- Hydrological processes
- Aquatic ecosystems.

The Proponent has proposed substantial measures to avoid, minimise and mitigate disturbance and thus potential loss of 50 ghost bats from the URPA. The NT EPA considers that even with the avoidance and mitigation measures proposed, the Proposal

may have a significant residual impact on ghost bats. The NT EPA supports the Proponent's commitment to offset residual impacts through an applied and academic research program, and the protection of known off-site colonies which belong to the regional ghost bat population. The NT EPA has recommended the regional population of ghost bats be protected from impacts associated with implementation of the Proposal. This will require the implementation of all the Proponent's commitments including measures to maximise the viability of the local Union Reefs colony.

The Proposal is adjacent to the McKinlay River, the major tributary in the upper Mary River catchment, which has declared beneficial uses (values) of aquatic ecosystems. In recognition of these values, the NT EPA has recommended that the McKinlay River downstream from the Proposal area is to be protected at all times from mine-related and legacy impacts, and that the Proponent publicly report on the quality of water and the health of ecosystems in the river.

The Proponent proposes the controlled discharge of mine-affected water into the McKinlay River. This would be subject to a Waste Discharge Licence issued under the *Water Act 1992*. The Proponent will need to demonstrate it can achieve the NT EPA's environmental protection outcome for the McKinlay River at all times from mine-related impacts. The NT EPA has recommended the Proponent consider alternative options, other than direct discharge to receiving waters, for the management of mine-affected water. The NT EPA has also recommended that the appropriate target for water quality at the downstream compliance point is the protection of 95% of aquatic species to protect values in the McKinlay River.

The Proposal requires dewatering of the underground void, which is expected to draw down groundwater (by about one metre) in the riparian areas along the McKinlay River and its tributaries. The associated ecosystems are likely to depend on groundwater for some of their water requirements and may be impacted by dewatering activities. The NT EPA has made recommendations for the Proponent to prepare and implement an aquatic ecosystems monitoring program to identify and quantify impacts of the Proposal on the aquatic ecosystems and riparian vegetation of the McKinlay River. The NT EPA has also made recommendations for the Proponent to develop and implement a groundwater monitoring program that is able to detect any changes to groundwater quality and levels to ensure that all potential groundwater impacts due to the Proposal are identified, avoided, mitigated and monitored.

Groundwater connectivity between the existing Crosscourse Pit lake and the receiving environment, and a potential rise in water levels, present a risk of rapid and continuous uncontrolled discharge of mine-affected water to the McKinlay River. The NT EPA has recommended that Crosscourse Pit lake levels are managed to minimise outflows to the receiving environment. Recommendations have also been made to monitor the water quality and rate of groundwater seepage from the pit lake to the McKinlay River, to inform management.

Both controlled and uncontrolled discharges would contribute contaminants to the receiving environment during the Proposal, and uncontrolled discharges could continue post-mining, including to the McKinlay River. The NT EPA has made recommendations for water quality monitoring and a post-mining groundwater assessment to inform the revised mine closure plan, and a Life of Mine tailings study and whole-of-mine capping design, to inform longer-term closure planning for the Crosscourse Pit. The NT EPA's recommendations are made to ensure that uncontrolled discharges of mine-affected water are avoided and any controlled discharge is undertaken in a manner that protects the downstream environmental values of the McKinlay River, and enables early detection and correction of potential water quality impacts.

The NT EPA has made seven comprehensive recommendations as an outcome of the EIA of the Proposal. These recommendations are for decision-makers and the

Proponent to consider in development of approval conditions and execution of the Proposal.

The NT EPA has the view that the environmental commitments, safeguards and recommendations outlined in the EIS (including management and action plans) and in this Report must be implemented by the Proponent, and reviewed and enforced by the relevant regulators throughout the life of the Proposal, to deliver acceptable environmental outcomes.

The NT EPA considers that, subject to the implementation of all recommendations, the Proposal can be managed in a manner that is likely to meet the NT EPA's objectives, reduce current impacts and risks (from current but separately authorised mining activities) on the site and avoid significant or unacceptable environmental impacts and risks in the future.

List of Recommendations

Recommendation 1

That approvals for the Proposal impose binding legal obligations on the Proponent to implement the Proposal in accordance with, and to meet, all environmental commitments and safeguards:

- 1. identified in the Environmental Impact Statement (EIS) for the Union Reefs North Underground Mine (including the Draft EIS and the Supplement to the Draft EIS)**
- 2. recommended in this Assessment Report 92**
- 3. to the satisfaction of the relevant regulator**
- 4. throughout all stages of implementation of the Proposal including during any period of inactivity or care and maintenance**
- 5. including timely public reporting, on the website of the Proponent, the Operator and the relevant regulator, of performance against the plans and reports addressed in the recommendations in this Assessment Report 92**

Where there is conflict between the commitments in the EIS and the recommendations in this report, the latter are to take precedence.

Recommendation 2

That the Proponent or Operator provides written notice in advance to the Northern Territory Environment Protection Authority and the Responsible Minister if it alters or proposes to alter the Proposal, environmental commitments or safeguards in the Environmental Impact Statement in such a manner that the environmental significance of the action may change, in accordance with the *Environment Protection Act 2019* and *Environment Protection Regulations 2020*.

Recommendation 3

1. That the Proposal is implemented to achieve the following environmental protection outcome:
 - a. that impacts attributable to the Proposal on the local population of ghost bats do not affect the viability of the Pine Creek regional population of ghost bats.
2. To contribute to achieving the outcome at part 1 of this recommendation, the Proponent:
 - a. creates the proposed purpose-built roosts in advance of commencing bat-disturbing activities and closure of OK and Prospect adits, in consultation with the Department of Agriculture, Water and the Environment and the Department of Environment and Natural Resources
 - b. conducts genetic studies to identify the gene flow, connectedness, and significance of the local Union Reefs colony in relation to the Pine Creek regional population of ghost bats
 - c. reviews the Ghost Bat Action Plan and Ghost Bat Management Plan (Plans) prior to commencing the proposed activities, to ensure they align with part 1 of this recommendation (above), based on advice of a specialist expert, and to the satisfaction of the Department of Environment and Natural Resources' Flora and Fauna Division and the Department of Agriculture, Water and the Environment
 - d. implements the updated Plans that contain the following as a minimum:
 - i. monitoring procedures and protocols, including monitoring location points and timeframes, for all roost sites and roost habitat that the Proponent has committed to monitor in the Proposal area and used by the regional population of ghost bats
 - ii. contingency measures to be implemented if monitoring identifies unfavourable parameters or trends for local Union Reefs colony and/or Pine Creek regional population, over statistically meaningful timeframes
 - iii. annual reports, including analysis of monitoring data, that assess the use of all roost sites and roost habitats that the Proponent has committed to monitor
 - iv. funding of a research program, based on the priorities identified in the Conservation Advice (TSSC 2016), including the preparation of a National Ghost Bat Recovery Plan informed by this research and in consultation with the Department of Agriculture, Water and the Environment
 - v. further protection measures identified in the Recovery Plan (identified above) to the extent practicable

Recommendation 4

1. That the Proposal is implemented to achieve the following environmental protection outcome:
 - a. preserve and/or improve the health of the McKinlay River to maintain downstream environmental values
2. To contribute to achieving the outcome at part 1 of this recommendation, the proponent is to apply the waste mitigation hierarchy (avoid, reduce, reuse, recycle, recover, treat and dispose of mine-affected water – in preferential order)

to the generation and management of all mine-affected water, including implementation of:

- a. measures to separate mine-affected water from clean (or non-contaminated water)
 - b. measures to maintain or improve water quality in water storages, mine-affected run-off and groundwater seepage
 - c. a continual improvement process that includes identifying new opportunities for avoiding or minimising the volume of mine-affected water requiring discharge to the McKinlay River.
3. That the Water Management Plan, prepared by the Proponent, is implemented to contribute to the outcome at 1a, and contains the following key elements as a minimum:
 - a. a water management system for the site, including procedures and methods for:
 - i. water storage, transfer, treatment, monitoring and discharge
 - ii. tracking the movement of water within the Proposal area and the URPA
 - iii. recording the time, rate and volume of controlled discharges to the surrounding environment
 - b. measures to minimise, manage and prevent acid and/or metalliferous and/or saline drainage
 - c. management of reject water from the proposed reverse osmosis plant, including predicted water quality of any receiving water body (e.g. Crosscourse Pit)
 - d. that prior to commencement of mining and annually thereafter for the life of the proposal, the Water Management Plan is reviewed based on monitoring data and on the advice of a specialist expert and to the satisfaction of the relevant regulator and the revised Plan implemented accordingly.
4. That an annual water report is prepared to report on:
 - a. how the waste mitigation hierarchy (at part 2) has been applied
 - b. results of the comprehensive monitoring at part 10 of this recommendation
5. That the level of water in Crosscourse Pit is reduced and maintained below a threshold level, as soon as possible and throughout the life of the Proposal, where the threshold is determined from groundwater seepage monitoring data, to:
 - a. prevent rapid groundwater seepage and surface water overflow
 - b. retain sufficient freeboard for a 1 in 1000 annual exceedance probability, 72 hour flood event
 - c. enable effective management of any discharge (in accordance with part 7 of this recommendation) required to achieve and maintain this level
6. That treated water from storage in Dam B is transferred, for proposed authorised discharge in the McKinlay River, in such a manner that it is not released to the environment undiluted, including that:
 - a. treated water from Dam B will not be discharged to land and will remain 'in pipe', or other containment, until it reaches the authorised discharge point (end of pipe)
 - b. the discharge is directly into the water body on which the dilution algorithm is based
 - c. the authorised discharge point is identified based on water quality and flow data from the McKinlay River and designed to meet downstream water quality criteria in accordance with part 8 of this recommendation
 - d. the timing of water removal from Crosscourse Pit, treatment, and final discharge to the McKinlay River is determined in accordance with the

- capacity of Dam B and the dilution algorithm for discharge to the McKinlay River, which is to be based on:
 - i. baseline surface water stream flows in the McKinlay River
 - ii. appropriate dilution to achieve water quality targets specified in part 8 of this recommendation (below), taking into consideration any cumulative impacts from the URPA
 - iii. a predictive assessment of various discharge volumes under low, moderate and high background flow conditions
- e. the water inventory in Dam B is managed to avoid overflow via the spillway.
- 7. That water quality in the McKinlay River is to meet 95% species protection level, in accordance with the Australian and New Zealand Guidelines for Fresh and Marine Water Quality and in accordance with the following:
 - a. the compliance point for this is to be determined as part of the assessment of the Waste Discharge Licence, and be downstream of the proposed discharge point and upstream of potential influence from other mining activities in the area
 - b. the extent of the mixing zone (between the discharge point and the compliance point) must be calculated based on the minimum dilution capacity of the receiving waters and the stressors identified as having the greatest potential impact on the aquatic ecosystem, and must not exceed 5 km in length
 - c. the dilution algorithm for the discharge must be appropriate for all flow conditions, and account for dispersion within the mixing zone, to meet this water quality criteria at the compliance point
- 8. That load-based assessment is conducted to identify and quantify impacts to the receiving environment from the Proposal area, and their trends, to contribute to assessing performance against the outcome at 1a, including:
 - a. modelling, prior to implementation of the Proposal, of the annual loads of contaminants of potential concern to be discharged into the McKinlay River over the life of the Proposal
 - b. assessment, prior to implementation of the Proposal, of the sustainable assimilative capacity of the McKinlay River and the surrounding catchment
 - c. verification, over the life of the Proposal and based on monitoring data, of the observed loads of contaminants of potential concern entering the McKinlay River each year
 - d. assessment of the observed loads against the sustainable assimilative capacity of the McKinlay River as a measure of impacts to water quality
 - e. assessment of the effectiveness of source controls and contingency measures for reducing contaminant loads to meet the sustainable assimilative capacity of the McKinlay River
- 9. That a comprehensive monitoring program is implemented, prior to and during the life of the Proposal, including closure. The monitoring program is to identify and quantify impacts from Proposal activities and inform continuous improvement and effective application of source controls and contingency measures for achieving the outcome at 1a, and include:
 - a. a process for program review and modification, subject to the satisfaction of the relevant regulator/s
 - b. a groundwater monitoring plan, subject to review and modification that includes:
 - i. groundwater quality monitoring to detect and measure any contaminated seepage from Crosscourse Pit and Prospect Pit
 - ii. predictive groundwater quality modelling including a contaminant transport model

- iii. requirements for a post-mining groundwater assessment to inform the revised mine closure plan
- iv. new monitoring bores established as proposed in the EIS
- v. monitoring of groundwater levels, flows, and connectivity to account for seasonal variability and changes due to the Proposal and improve the predictive capacity of hydrogeological modelling and monitoring
- vi. monitoring the extent and magnitude of groundwater drawdown and depressurisation from mine dewatering during operations, recovery and post closure and predicted impacts on other groundwater users and environmental and riparian values
- vii. a network of monitoring bores to determine the hydraulic gradient, seepage and flow rates, within the Proposal area and between the Proposal area, the McKinlay River and the Pine Creek water supply borefield
- viii. make-good/contingency actions if monitoring results indicate potential water availability impacts to either the McKinlay River or Pine Creek water supply borefield
- c. a surface water monitoring plan that includes:
 - i. installation, operation and maintenance of stream flow gauging stations (co-located with water quality monitoring stations) to determine and record stream flows prior to and during proposed controlled releases
 - ii. monitoring at appropriate sites in the Proposal area; in receiving waters, to account for controlled and uncontrolled discharges; and at control sites unaffected by the Proposal and representative of background conditions
- d. an aquatic ecosystems monitoring plan that:
 - i. provides for monitoring of the aquatic ecosystems and riparian vegetation of the McKinlay River
 - ii. Integrates with water quality, water flow and groundwater level monitoring
 - iii. establishes the degree of the hydraulic connection between groundwater and permanent pools (e.g. including monitoring of groundwater and surface water levels measured in m AHD and comparison of ionic composition of groundwater and surface water)
 - iv. enables analysis of observed impacts on flora and fauna and monitoring of indicators against possible causes from Proposal-related water quality or groundwater drawdown
 - v. enables assessment of riparian condition based on annual monitoring events and baseline data
 - vi. initiates monitoring of groundwater and surface water levels as early as possible prior to the commencement of mining
 - vii. incorporates a new groundwater monitoring site at site URSW04, to pair with surface water monitoring and aquatic ecosystems monitoring (at pool MRWET08), which could replace the proposed groundwater monitoring site at MRBILL02
 - viii. includes details on indicators for sediment sampling, habitat assessment, bioassessment, fish and other fauna surveys, and vegetation surveys

Recommendation 5

That approvals for the Proposal require that the Proponent's Offset Package or Offset Management Plan, if required by the Australian Government with respect to the significant residual impact to the ghost bat (*Macroderma gigas*), is to the satisfaction of the Flora and Fauna Division of the Department of Environment and Natural Resources.

Recommendation 6

1. That closure of the Proposal is implemented to achieve the environmental protection outcomes specified in recommendations 3 and 4.
2. That mine closure planning is implemented such that it contributes to the outcomes at part 1 of this recommendation, and addresses the following prior to the commencement of mining:
 - a. be developed according to leading edge practice guidance and an appreciation of the principles of the International Council of Mining and Metals (ICMM 2019), unless more stringent guidance has been provided on specific matters by the NT EPA, which should take precedence
 - b. be informed by refined and updated geochemical, hydrogeological and water quality modelling
 - c. demonstrates that post-closure, Proposal areas would be safe to humans and animals, geotechnically stable, non-polluting and non-contaminating, and capable of sustaining the agreed post-mining land use
 - d. provides for ongoing monitoring and maintenance of the Proposal areas and the receiving environment after closure and relinquishment of the Proposal
 - e. provides for ongoing monitoring and management for all roost sites and roost habitats of the regional population of ghost bats, that the Proponent has committed to monitor
3. That the Mine Closure Plan, as updated from time to time, must be made publicly available on a timely basis on the websites of the Proponent, the Operator and the relevant regulator.

Recommendation 7

That closure planning for the Proposal, and as it integrates with closure planning for the URPA, enables future closure of Crosscourse Pit such that, within ten years of its closure as a tailings storage facility, it becomes a stable and non-polluting landform, requiring no active water management into the long term. This is to be informed by completion of the following prior to closure of the Proposal:

1. a Life of Mine tailings study
2. a whole of mine capping design
3. a groundwater assessment, including seepage assessment, for tailings and waste rock, and the North Underground mine.

1 Introduction

1.1 Purpose of this Report

Northern Territory Mining Operations Pty Ltd (the Proponent) proposes the Union Reefs North Underground Mine (the Proposal). This would be a new gold mining activity within an existing mine site, the Union Reefs Project Area (URPA), a highly modified brownfield mine site that encompasses an active gold processing facility. It is located about 175 km south-east of Darwin.

The Proposal has been assessed by the NT EPA at the level of an Environmental Impact Statement (EIS) under the *Environmental Assessment Act 1982* (EA Act). 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 1984 (EAAP).

The purpose of this Report is to ensure that matters with the potential to affect the environment to a significant extent are fully examined and reported. This Report will be taken into account in decisions to be made by the Northern Territory (NT) Government.

This Report is also provided to the Australian Government Minister for the Environment (Australian Government Minister) in accordance with the Bilateral Agreement made under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) to assist with the consideration of an approval decision under the EPBC Act (by the relevant delegate).

This Report is not an environmental approval; however, it will guide the decisions and conditions of approvals, authorisations and other matters relating to the Proposal.

1.2 Scope of the assessment

The NT EPA assessed the potentially significant environmental impacts and risks associated with the Proposal in line with the NT EPA's environmental factors and objectives (NT EPA, 2018) and in accordance with the requirements under the EA Act.

The matters relating to the environment that the NT EPA considered necessary to be dealt with in the EIS for the Proposal were identified in the Terms of Reference (NT EPA, 2019), which were developed in accordance with clauses 8(3) to (6) of the EAAP.

Based on the Notice of Intent the NT EPA identified the following potential environmental impacts and risk categories that contributed to the decision to assess the Proposal at the level of an EIS:

- uncertainty about the significance of Union Reefs ghost bat colony and impacts to the local colony and regional ghost bat population, including from proposed closure of mine adits
- contamination of surface water and groundwater from acid, metalliferous and saline drainage from surface waste rock storage
- contamination of surface water and groundwater from contaminated mine waste
- impacts to hydrological processes through altered surface water and groundwater flows from dewatering the mine and pit lakes
- impacts to downstream aquatic ecosystems of the McKinlay River as a result of surface water and groundwater contamination and groundwater drawdown
- adequacy of monitoring and management measures to detect, avoid and mitigate potentially significant impacts.

1.3 Information before the NT EPA

In making this Report, the NT EPA had regard to:

- the Notice of Intent (April 2019)
- the Terms of Reference (October 2019)
- the EIS, comprising:
 - the Draft EIS (November 2019)
 - the Supplement to the Draft EIS (May 2020)
- comments from NT Government advisory bodies on the Draft Terms of Reference, the Draft EIS and the Supplement
- comments from the public on the Draft EIS
- comments from the Australian Government (Department of the Environment and Energy / Department of Agriculture, Water and the Environment) on the Draft Terms of Reference, the Draft EIS and the Supplement
- technical and other reports and guidelines that are noted as References (section 9) in this Report.

1.4 Approval and regulatory framework

The Proposal will require approval and regulation by the NT Government and the Australian Government. The framework for the approval and regulation of the Proposal is summarised below, with an emphasis on the obligations and requirements of the NT Government.

The NT EPA provides this Report to the Minister. The Minister is required to provide a copy of this Report to the Responsible Minister, together with any written comments made by the Minister in relation to this Report. If the Minister makes a comment in relation to this Report, the Minister must comply with reporting obligations to the NT EPA, under section 8B of the EA Act.

Northern Territory approvals

The Responsible Minister, taking into consideration this Report, will decide whether to grant an authorisation under the *Mining Management Act 2001* (MM Act) and the conditions that may be applied. The MM Act is the primary legislation for the authorisation of mining activities and the regulation of mining sites in the NT.

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 Proponent has an Authorisation under the MM Act to process ore and manage the URPA, which encompasses the area to be used for the Proposal. Under the authorisation, the Mining Management Plan (MMP) for Union Reefs Project Area dated 30 September 2013, was approved by the Responsible Minister on 9 April 2014. This MMP remains in force until replaced with an approved amended MMP.

The Proposal includes the treatment and discharge of water to the environment to manage poor-quality water that results from the Proposal and the URPA. This will require a Waste Discharge Licence (WDL) in accordance with the *Water Act 1992*.

Other regulatory approvals are required to protect sacred sites and for storing or transporting hazardous chemicals.

The provision of this Report to the Minister concludes the examination of the EIS by the NT EPA. The EIS and supporting documents can be viewed on the NT EPA website at: <https://ntepa.nt.gov.au/environmental-assessments/register/union-reefs-north-underground-mine>

If the Proponent alters or proposes to alter the Proposal, environmental commitments or safeguards in the EIS in such a manner that the environmental significance of the action may change, referral to the NT EPA in accordance with the new *Environment Protection Act 2019* and Environment Protection Regulations 2020 would be required.

Australian Government

The Proposal (EPBC 2019/8469) is a controlled action and is being assessed in accordance with the Bilateral Agreement made under section 45 of the EPBC Act. This Report will be provided to the Australian Government Minister for the Environment and it will inform the considerations for a decision under the EPBC Act.

The delegate of the Australian Government Minister for the Environment identified that one matter of national environmental significance, the listed threatened species, ghost bat (*Macroderma gigas*), has the potential to be significantly impacted by the Proposal and required assessment.

1.5 Background to the Proposal

1.5.1 History of the Union Reefs Project

The Union Reefs gold deposit was discovered in 1873 and worked by Chinese immigrants. Extensive mapping and exploration were undertaken between 1963 and 1988. Mining and processing of alluvial ore occurred between 1987 and 1992. Development and mining of Crosscourse Open Pit and Union North Open Pit commenced in 1994, by the Shell Company of Australia, following an EIA (CCNT, 1993). Since 1994, development has included 11 more open pits, three waste rock dumps (WRDs), evaporation ponds (EPs), three tailings storage facilities (TSFs), three mine water dams and construction of a processing plant. During this period at least six other operators have been responsible for the URPA. In 2003 the site was partly rehabilitated (WRDs and old tailings dam) and the processing plant placed into care and maintenance. The mine has been re-opened twice since 2003; from 2006 to 2008 and from 2009 to 2017. The processing plant has operated for 23 of the 27 years since it was commissioned, including processing of ore from other mine sites. At the time the Draft EIS was submitted, the processing plant was in operation, testing process material mined from the Cosmo Deeps Mine. Further details are provided in section 4.3 of the Draft EIS.

1.5.2 Environment condition at the URPA and surrounds

This section of the Report presents the current condition of the environment, as a basis for quantifying and assessing the significance of any potential future impacts from implementation of the Proposal, and for understanding cumulative impacts. The site has a number of potential environmental issues from previous and current activities. The main issues arise from potential leaching of acid and/or metalliferous drainage (AMD; including neutral and saline drainage) from waste rock and tailings, and altered hydrological processes and water quality from mining activities, infrastructure and landforms, including mine pit lakes.

Existing landforms and infrastructure

Existing infrastructure and landforms are shown in Table 1. The layout of existing mine infrastructure is shown in Figure 1.

Table 1: Existing components at the URPA

	Component	Size ¹ /capacity
Shared infrastructure – to be used by the Proposal	Crosscourse Pit – contains tailings covered by water Current tailings level = 123 m AHD Current water level = 174 m AHD Spill level = 189 m AHD	Established: 2002 40 ha – pit extent 27 ha – water extent At 2020: 10 190 ML tailings 12 605 ML water
	Prospect (North and South) Pit Lakes	2.5 ha / 79.8 ML
	Processing plant	4 ha / 2 Mtpa
	ROM pad	5.5 ha
	Haul road	1 km
	Truck workshop	1.8 ha
	Fuel bay	1 ha
	Laydown area	0.6 ha
	Landfill	0.8 ha
	Magazine	0.3 ha
	Office and workshop complex	1.7 ha
	Power – existing power lines and substation	9 MW
Other infrastructure – not used by Proposal	Storage area	0.1 ha
	Orica compound	0.3 ha
Pits / Lakes – not used by the Proposal	Union North (North and South) Pit Lakes	3.3 ha
	Lady Alice Pit Lake	2 ha / 290 ML
	Ping Que Pit Lake	0.2 ha
	Big Tree Pit Lake	0.95 ha
	Millars Pit Lake	1.7 ha
	Temple Pit	0.45 ha
	Two pits submerged in Dam A	See Dam A
Mine water dams	Dam A	11 ha / 507 ML
	Dam B	2 ha / 38 ML
	Dam C	26 ha / 1495 ML
	Union Dam	1.7 ha
	Decant Pond Dam	13 ha / 328 ML
	Plant Spill Pond	0.5 ha
Rehabilitated areas – WRD and tailings storage	North WRD	31.5 ha
	West WRD	67.5 ha
	East WRD	100 ha
	Old Tailings Dam	71 ha
Total area of existing disturbance		494 ha (with 354 ha rehabilitated/revegetated)

¹ Component size has been estimated using the Proponent's spatial data overlain on NR Maps (DENR, 2020).

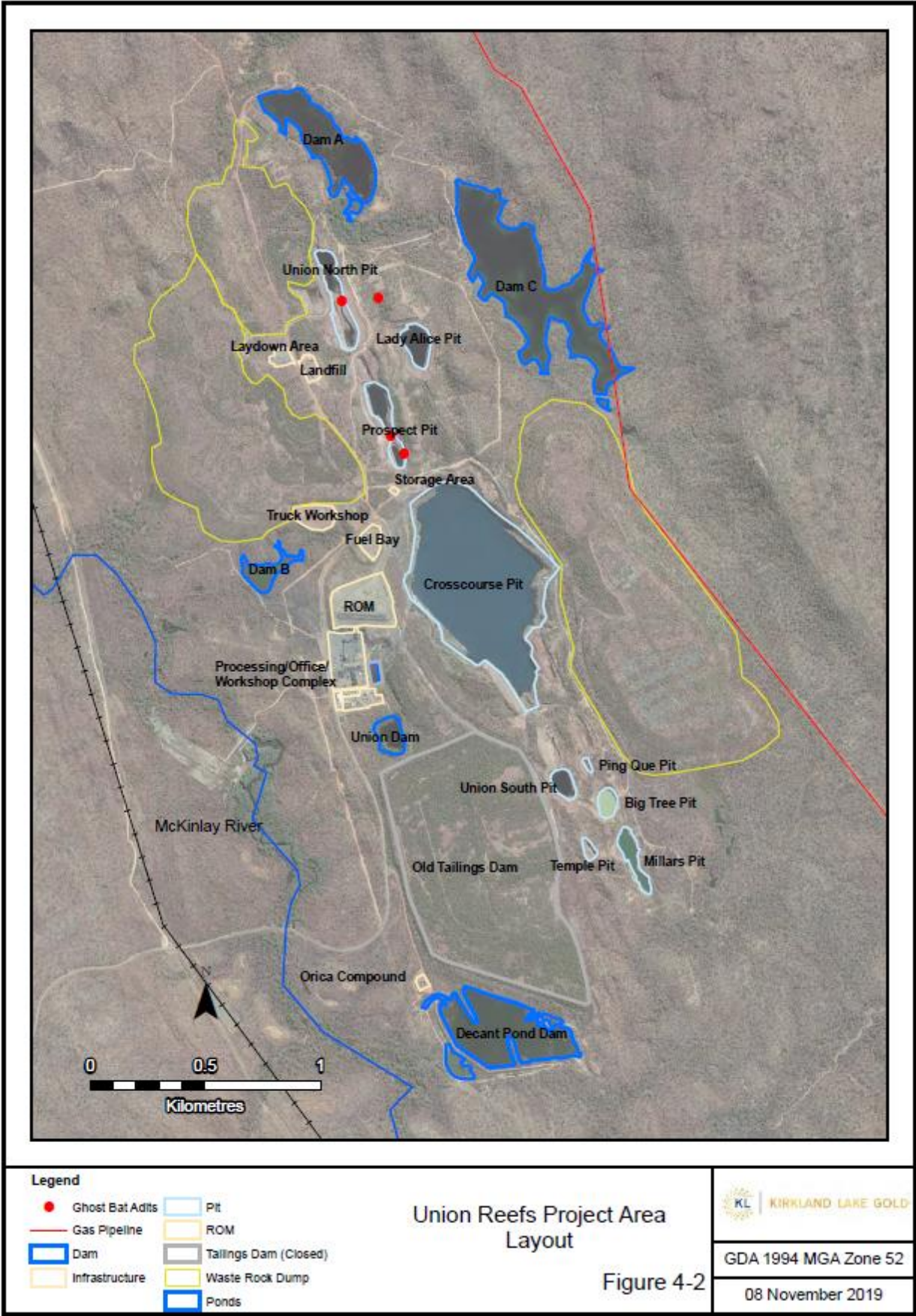


Figure 1: Layout of existing infrastructure (source: Draft EIS)

Sources of acid and metalliferous drainage

Material stored in the WRDs, old TSF and Run-of-Mine (ROM) pad stockpiles is a known source of AMD. The bulk of potential and retained acidity is in the WRDs. AMD generation occurs at a slow rate and has been transported from the WRDs and ROM pad stockpiles to water storages across the site (Dam B, decant pond dam and spill pond dam). As a result, water and sediments in these storages contain contaminants including sulfates, metals and acid.

Water quality

Surface water quality varies across water storages at the URPA. Dam A and Dam C have relatively good quality water (albeit impacted by runoff from the URPA). Prospect (North and South) Pits have moderately poor water quality. Crosscourse Pit contains poor water quality due to tailings storage. It has elevated electrical conductivity (EC), aluminium, arsenic, cadmium, cobalt, cyanide, sulfate and zinc.

The Proponent has previously treated water at various locations across the URPA to manage contaminant levels prior to discharge. Modification of pH in mine affected water is achieved using caustic soda, limestone or lime. Most pit lakes have low pH (3.0 – 4.7) and elevated levels of many metals except arsenic, chromium, iron and lead.

Groundwater quality has also been influenced by previous mining activity. Monitoring has been undertaken at ten bores across the URPA (since 2010 or 2015 at various sites). Results indicate that EC is elevated (1000 – 2000 $\mu\text{S}/\text{cm}$) below the old TSF and moderately elevated (200 to 700 $\mu\text{S}/\text{cm}$) near Crosscourse Pit and Union North Pit, and pH is circum-neutral across all bores (pH 6 to 7) (Draft EIS section 13.2.1). Concentrations of metals are generally low, however elevated concentrations of cobalt, manganese, zinc and arsenic have been recorded in some bores.

Water quality monitoring has been undertaken since 2010 at two key sampling locations on the ephemeral McKinlay River (Figure 2). Results from sites URSW09 and URSW08, upstream and about 12 km downstream of a historical discharge point respectively, indicate that the McKinlay River is consistently impacted by neutral mine drainage from historic mining activities (EGI, 2019). In summary:

- there is no significant difference in upstream and downstream values for pH, dissolved oxygen concentration, aluminium, arsenic, manganese and zinc
- there are consistently higher downstream values for sulfate, calcium and magnesium, compared with upstream
- EC ranged from 25 – 100 $\mu\text{S}/\text{cm}$ upstream and from 50 – 200 $\mu\text{S}/\text{cm}$ downstream of the Proposal.

1.6 The Proponent

The Proponent is Northern Territory Mining Operations Pty Ltd (ABN: 64 136 525 990). It is 100% owned by Kirkland Lake Gold (ABN: 30 136 505 587), an Australian and Canadian gold mining and exploration company trading on the Australian, New York and Toronto Stock Exchanges.

The Proponent has an Environmental and Social Responsibility Management System, and states that no past or existing proceedings exist under a Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources.

The Proposal is part of a larger regional mining strategy that is currently operational and will continue after the Proposal is completed. The Proponent has a five year plan for NT operations that involves the continued use of the URPA, particularly the processing plant and Crosscourse Pit (for tailings storage), as the central hub for processing ore from surrounding mines. Currently, the primary sources of ore for gold production are the

Cosmo Howley Project Area (40 km north-west), Pine Creek Project Area (12 km south), and the URPA (which includes, but is not limited to, the Proposal). This Proposal is seen as being necessary to fund this five year program to provide enough ore to the processing plant to run it cost effectively.

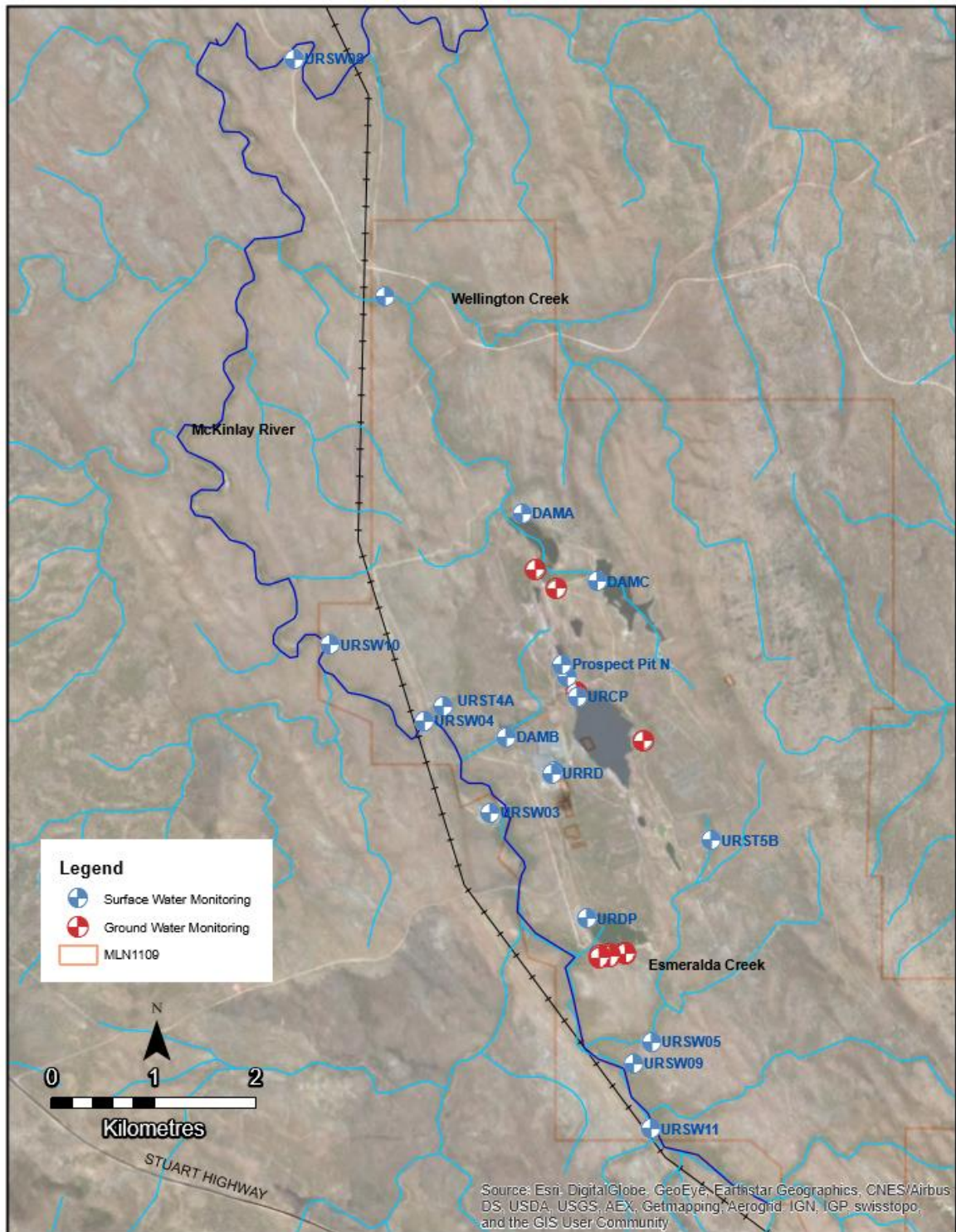


Figure 2: Location of existing surface water monitoring sites (source: Draft EIS)

2 The Proposal

2.1 Overview

The Proposal includes the following key activities across primary and secondary mine features¹ (Figure 3):

- dewatering of Prospect (North and South) Pit
- construction of a portal and decline on the eastern face of Prospect North Pit and an extension of the existing haul road to access the portal
- underground mining
- processing of ore at the existing processing plant over a 2 to 3 year period
- placement and storage of wastewater and tailings in the existing Crosscourse Pit over the life of mine (LOM)
- permanent storage of non-acid forming waste rock as the portal bench
- temporary storage of waste rock in Prospect South Pit until later placement in the disused underground mine
- direct backfill of waste rock to recently mined underground stopes to minimise aboveground storage of waste rock
- rehabilitation and closure of primary mine components (see Figure 3).

The Proposal schedule includes the following key phases:

- mine development; 2 to 3 months, 2020
- mine operations (mining and processing); 2 to 3 years, 2020 to 2023
- mine closure and rehabilitation; 1 year, 2022 to 2023
- post closure monitoring; 5 years, 2023 to 2028.

2.2 Location

The Proposal is located 175 km south-east of Darwin and 20 km north-west of Pine Creek.

The Proposal lies entirely within granted MLN 1109 within Mary River West Station (Pastoral Lease 815, NT Portion 1630). MLN 1109 covers an area of 3998 ha. The Proposal area is the area within MLN 1109 as defined by the primary and secondary mine features (Figure 3), and extends over about 153 ha (source: Notice of Intent).

¹ Primary components are those existing mine features primarily associated with the underground mine that are proposed to be constructed/upgraded. Secondary components are active an ongoing mine features within the URPA that will be used by the Proposal, but both pre-date and will be operated beyond the life of the Proposal.

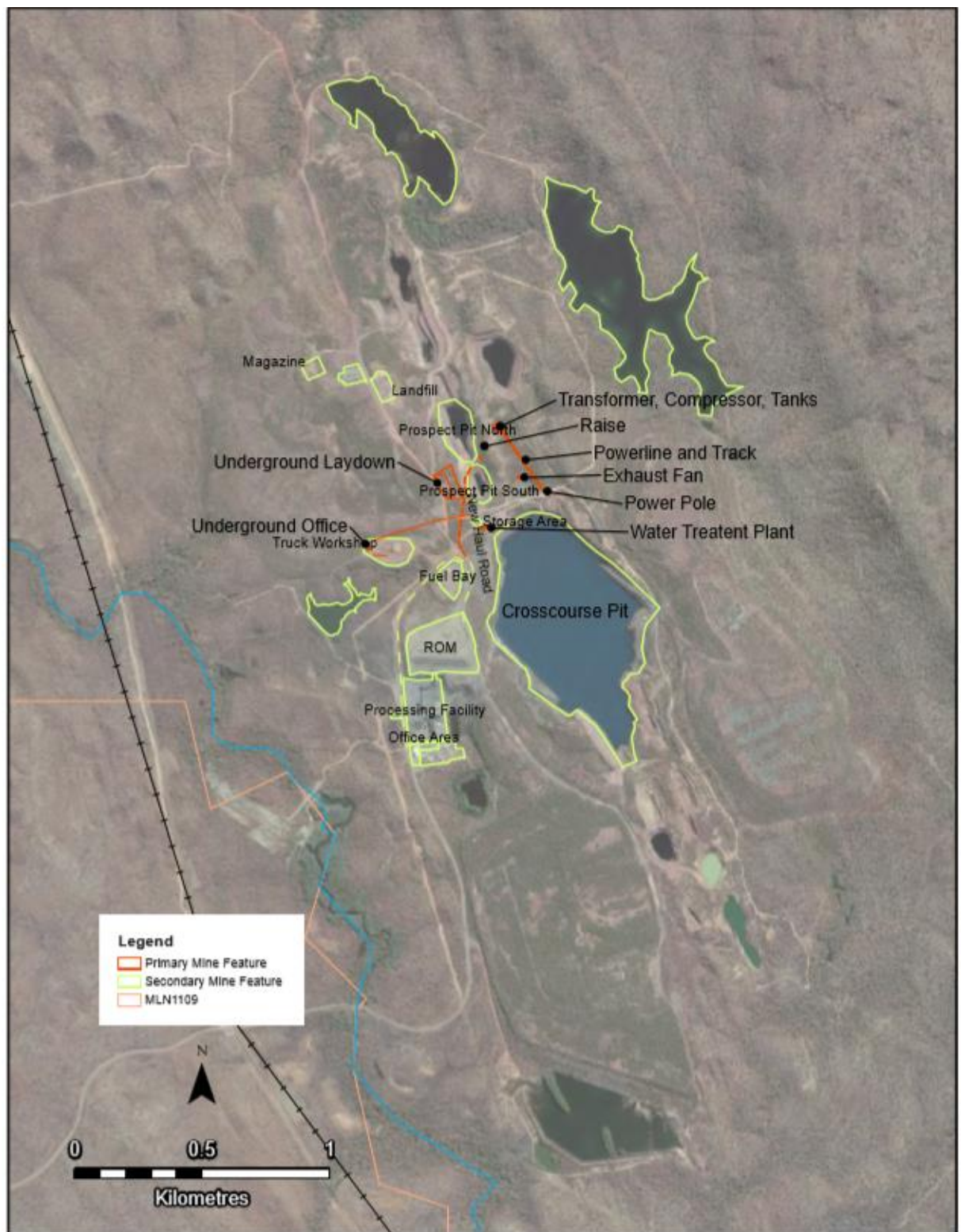


Figure 3: Primary and secondary mine features (source: Supplement)

2.3 Regional context

The climate of the region is tropical, characterised by distinct wet and dry seasons with an average rainfall of 1274 mm. The majority of rainfall occurs in the wet season (October to April). Annual average pan evaporation is 2400 mm.

The Proposal lies within the Pine Creek Bioregion which consists of hilly to rugged ridges with undulating plains. The Proposal area is situated in the upper reaches of the McKinlay River Catchment Area, at an elevation of 230 m AHD. The current topography

is modified from previous open cut mining and comprises small ridges, dissected hills, rehabilitated WRDs, mine pit lakes and mine water dams. It is drained by small stream channels and lower lying areas.

The geology of the URPA is dominated by the north-west striking Pine Creek Shear Zone and comprises folded and sheared sediments of the Burrell Creek Formation over inliers of the Mount Bonnie Formation. The aquifer system is elongated in the same direction in fractured and weathered rocks.

2.4 Key components and footprint

The components of the Proposal are summarised in Table 2 and Table 3 and their location is shown in Figure 4.

Table 2: Key infrastructure (primary and secondary features) of the Proposal

		Component	Size/capacity
<i>Primary mine features</i>	Proposed new infrastructure – underground mine	Portal location – eastern wall of Prospect North Pit	177 m AHD
		Mine depth	220 m
		Portal bench materials (non-acid forming) sourced from: – existing surface stockpiles – underground waste rock	7000 – 12 000 t 50 000 t
		Underground mine supporting infrastructure: – ventilation system – haul road – explosives magazine – substation – two 30 000 L water tanks	1 ha clearing of regrowth vegetation required
	Alterations to existing infrastructure	Power infrastructure	Increase from 9 to 12 MW
		Haul road extension to connect Prospect Pit ramp to the existing haul road	400 m
<i>Secondary mine features</i>	Existing infrastructure to be used and altered	Prospect Pit: – dewatering – construction of portal bench (permanent storage of waste rock in the portal)	100 ML, diverted to Crosscourse Pit over 2 –3 weeks prior to construction
		Crosscourse Pit - addition of tailings and mine affected water from Prospect Pit and underground workings	Over LOM: – 800 ML dewater – 2400 ML process water – 1600 ML tailings
	Existing infrastructure to be used and not altered	Processing plant and spill pond, ROM pad, truck workshop, magazine, fuel bay, office and workshop, laydown and landfill area, dams A, B and C	~97 ha

Table 3: Key features of the Proposal

	Component	Size/capacity
Whole of Proposal	Proposal area	153 ha
	LOM	2 – 3 years
	Increase in existing workforce	12 people (construction) 80 people (operation)
	Closure period	1 year
Mining	Mining method – combination of up-hole benching and Avoca stoping, in a three-lift, bottom-up sequence. Ore production commences at the depth of three levels	
	Mining rate	92 000 t/year
	Ore to be extracted	280 000 t over LOM
	Waste rock extracted from underground	291 000 t over LOM
Waste rock management	Temporary above ground storage in Prospect South Pit, and then progressive return to underground as backfill with cement rock fill	241 000 t over a period of ~1.5 years
Processing	Gold to be extracted	39 232 oz over ~2 years
	Tailings generated – to be placed in Crosscourse Pit	276 000 t = 1600 ML over ~2.5 years
Water Management	Water requirement of 1.5 to 2 L/s for underground drilling and dust suppression. Sourced from Dam C via existing pipelines and two new 30 000 L water tanks	47 to 63 ML/year
	Underground wastewater and groundwater ingress (7 to 18 L/s) pumped by sump to Prospect North Pit then dewatered to Crosscourse Pit	800 ML over LOM
	Process water: – sourced from Crosscourse Pit and Dam C – wastewater to Crosscourse Pit	290 to 315 ML/year Total 2400 ML over LOM
	Operational water discharge	6000 ML over LOM
	Proposed WDL compliance points	URSW10 and URSW08

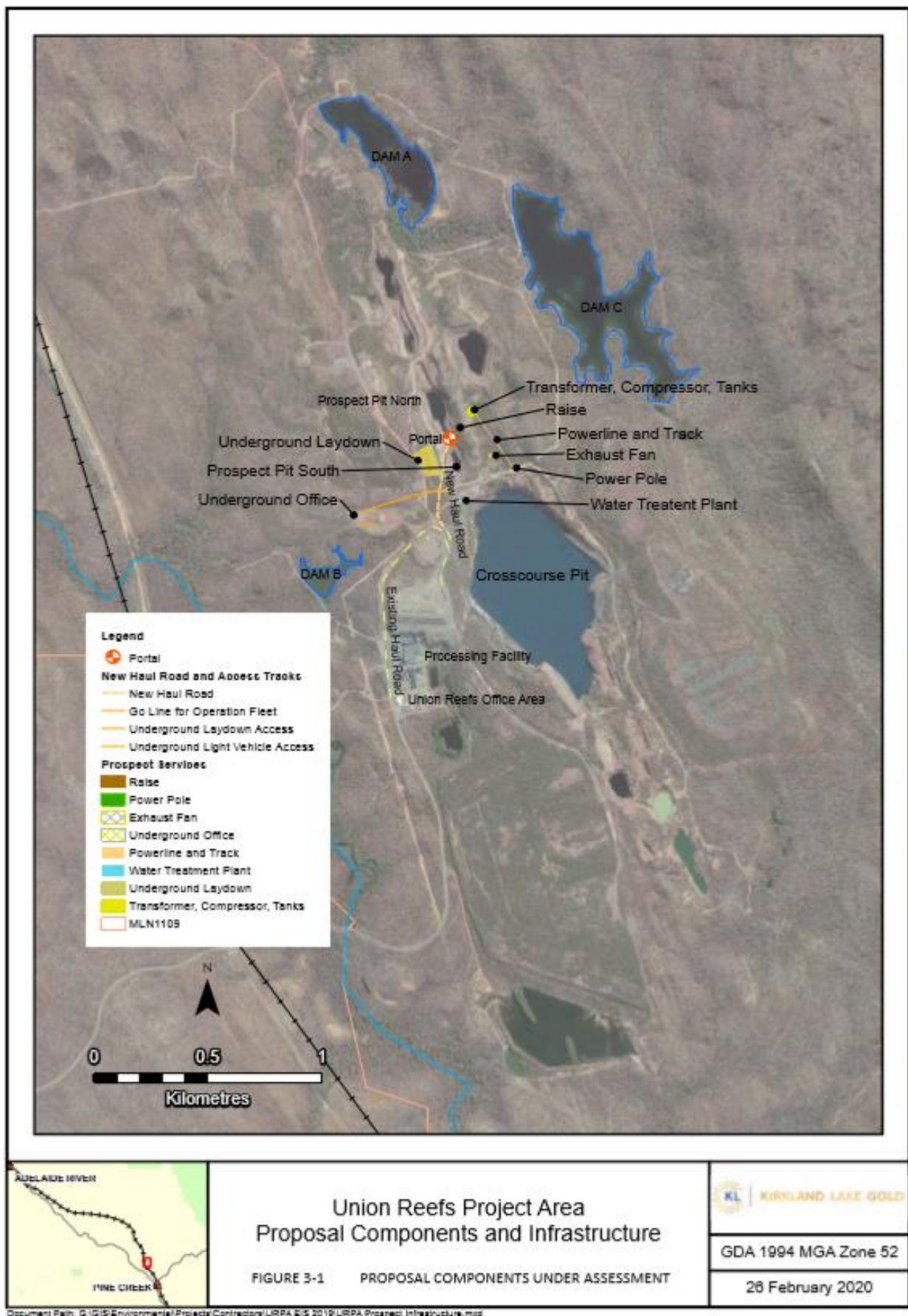


Figure 4: Location of Proposal components (source: Supplement)

2.5 Mining and ore processing

The underground mine is to develop the orebody to around 220 m below ground surface, similar in depth to the adjacent Crosscourse Pit (prior to the deposition of tailings in it). Mining will be conducted using a combination of up-hole benching and Avoca stoping, in a three-lift, bottom-up sequence. This method requires the decline to be advanced at three levels. Underground mining will use conventional jumbo development drills, underground loaders and trucks, and tele-remote boggers to move ore.

Ore will be trucked to the exiting ROM pad and then fed into the processing plant crusher using existing infrastructure. Ore will be processed using a crushing, grinding, gravity concentration and carbon in leach extraction process.

The Proponent identified the maximum capacity of the processing plant as 2 Mtpa. The Proposal will contribute a total of 280 000 tonnes of ore to be processed at a rate of up to 92 000 tonnes per year. Ore processing will remove about one percent, as gold dore, such that the quantity of tailings is similar to the quantity of ore (276 000 tonnes).

2.6 Disposal of waste rock and tailings

During development of the underground mine, 291 000 tonnes of waste rock will be brought to the surface. Subsequent waste rock will remain underground and be combined with cement rock fill to backfill the stope above using the up-hole benching method. Initial underground waste rock (non-acid forming) will be used to form the permanent portal bench and access ramps in Prospect Pit (50 000 t). Remaining waste rock will be tested and stored in the dewatered Prospect South Pit prior to progressive return to underground as backfill (241 000 t). This would reduce the long term potential for AMD generation.

Tailings from the Proposal will be piped from the processing plant and deposited sub-aqueously in Crosscourse Pit under the same authorisation as for the deposition of current tailings derived from processing ore sources from other mines.

The volume of Crosscourse Pit is sufficient to store all Proposal-related tailings material, maintaining an approximate water cover of 40 m (source: Supplement ID #39 and Draft EIS figure 4-7). Water management requirements to maintain water levels are discussed further in section 2.7 below.

2.7 Water management

The Proposal includes dewatering Prospect (North and South) Pits prior to portal construction, as well as the underground mine. All mine dewater would be stored in Crosscourse Pit. The Proponent has committed to updating the water management of the URPA to manage the quantity, quality and movement of water associated with the Proposal. This is to ensure that there is no uncontrolled discharge via overflow points (Sediment Traps, Dam A and Decant Pond). The intent of the water management system is to contain all mine-affected water on site and also to contain all water over the dry season so that any excess water is treated, (as described below), and discharged to the McKinlay River in a controlled manner, only when natural flows are occurring in the wet season. Volumes in each storage will be managed using pumped transfers between the storages. The Proposed water management schematic is at Figure 4-8 of the Draft EIS. Crosscourse Pit is the main water storage for mine-affected water.

In February 2020 the water level in Crosscourse Pit was 174.3 m AHD (Supplement ID #116). This water level is expected to rise through the addition of dewater from Prospect Pit and underground workings and through the displacement of water through deposition of tailings into Crosscourse Pit. As water levels rise in Crosscourse Pit, seepage via groundwater is expected to increase towards other water storage dams and ultimately to the McKinlay River. To manage water levels the Proponent intends to remove water from Crosscourse Pit, for treatment to decrease contaminant levels in the discharge water

and enable controlled release offsite during the wet season from Dam B. The Proponent will need to apply for a WDL for this. It is estimated that about 6000 ML of water would need to be removed during operations in order to maintain the current water level, and minimise seepage from Crosscourse Pit. The proposed water treatment method is a two-stage in-pipe dose system using a Caustic50 treatment to raise the pH to 9.0 followed with a ferric chloride dose to remove the arsenic and reduce the pH to 8.0. Water management is further discussed in section 5.4.4.

2.8 Energy use

The Proposal will use the existing mains 66 kV power supply from the substation located at the processing / workshop / office complex, providing power to the existing mine and processing facility. The Proponent estimated power usage at about 1 MWh per month for the Proposal. A new internal power line to the underground mine will be installed.

Diesel fuel consumption (mostly for underground equipment) is estimated to be about 60 000 L per month and will be stored and distributed on-site at the existing fuel bay.

The Proponent has estimated greenhouse gas emissions from the Proposal to be 9639 t CO₂-e which equates to 0.06% of the total emissions produced in the NT in 2017 (DISER, 2017). There is no proposal to reduce or offset these emissions (refer Appendix 1).

2.9 Workforce

The Proposal would provide about 80 new jobs during operations. This builds on the Proponent's existing workforce comprising mainly local residents. Existing accommodation camps at Pine Creek Camp and Cosmo Village Camp will be used, and workers would travel to and from the Proposal area for each shift.

2.10 Rehabilitation and closure

Closure will occur over about one year, with the primary aim for the Proposal area to be a stable, non-polluting landform.

At the end of Proposal mine operations, any remaining waste rock stockpiled in Prospect South Pit would be backfilled into underground stopes, and all pumps and infrastructure associated with the Proposal would be decommissioned and removed. Within 12 months of closure, a bund wall would be constructed around the perimeter of Prospect Pit to delineate the zone of pit instability and for public safety. Prospect Pit and the underground void would be allowed to fill with water to the groundwater equilibrium level, recharged by groundwater ingress and surface runoff. Equilibrium is anticipated to be reached in six years following closure of the Proposal.

Crosscourse Pit is proposed to be used as a tailings and wastewater repository for continued mining and processing after closure of the Proposal. This will require the pit to be managed into the future as a treat and release regime under a WDL. The Proponent is investigating capping methodologies to close the Crosscourse Pit when it is no longer needed, to avoid the need for ongoing active discharge.

3 Consultation

3.1 Proponent consultation

The Proponent stated it has developed relationships and maintains communication with the owners of Mary River West Station, government, industry, community groups and leaders through its extended operations in the region. The Proponent has consulted with a range of stakeholders on the Proposal, as outlined in the Draft EIS. The Proponent has developed a Memorandum of Understanding with Charles Darwin University to support

regional research projects for the threatened ghost bat, chemistry research and wellness programs.

3.2 Consultation by NT EPA

The NT EPA consulted with 12 NT Government advisory bodies and the Australian Government in respect to the Terms of Reference, Draft EIS and Supplement when preparing this Report. The NT Government advisory bodies consulted include Department of Environment and Natural Resources (DENR), Department of Primary Industry and Resources (DPIR), Department of Infrastructure, Planning and Logistics, Department of Tourism and Culture, NT Police, Fire and Emergency Services, Department of Health, Department of the Attorney-General and Justice, Department of the Chief Minister, Aboriginal Areas Protection Authority and Power Water Corporation.

The NT EPA consulted with the Australian Department of Agriculture, Water and Environment (DAWE) on matters of national environmental significance under the EPBC Act.

The NT EPA consulted with the Proponent and visited the Proposal area on 12 February 2020 during NT EPA Meeting 47. Further consultation with the Proponent was conducted in March 2020 following Meeting 47.

3.3 Submissions

There were two formal opportunities for public comment under the EIA process. The first opportunity was to inform the development of the EIS Terms of Reference and secondly to comment on the Draft EIS.

The Draft Terms of Reference were advertised for comment between 2 and 16 October 2019. No comments were received from the public on the Draft Terms of Reference.

The Draft EIS for the Proposal was on public exhibition for seven weeks between 30 November 2019 and 17 January 2020. A total of 48 submissions were received, 12 from NT Government advisory bodies, one from the Australian Government, one from a non-government organisation and 34 from the public.

The key concerns expressed by the Environment Centre NT were:

- estimation of greenhouse gas emissions, consideration of offsetting emissions and the use of solar power
- alternative options to undertaking the Proposal and for components of the Proposal, for example, use of solar and a thiosulfate refit for the processing plant
- unintended environmental harm from inadequate waste rock characterisation
- potential impacts from dewatering due to inadequate geochemical modelling and water quality prediction modelling
- lack of detail and therefore adequacy of early closure planning
- lack of public access to important detail informing the management of significant impacts on water quality and mine closure.

The remaining 34 comments from the public were expressions of support for the Proponent and the Proposal from industry, contractors and staff.

All submissions were forwarded to the Proponent and they responded to the submissions in section 2 of the Supplement.

In preparing this Report, the NT EPA has considered each submission in relation to the Proposal's potential environmental impacts and risks.

The NT EPA acknowledges that the Proponent proposes to continue to engage with relevant stakeholders during implementation of the Proposal.

4 Key environmental factors

Having regard to the Notice of Intent, the Draft EIS, Supplement and comments from the public exhibition and advisory bodies during the EIS review, the NT EPA assessed the Proposal for its potential impacts on the NT EPA's factors and objectives. The NT EPA identified the following key environmental factors that may be significantly impacted by the Proposal, and that are assessed in this Report (Table 4):

Table 4: Key environmental factors

Theme	Key environmental factor	Objective
Land	Terrestrial flora and fauna	Protect the Northern Territory's flora and fauna so that biological diversity and ecological integrity are maintained.
Water	Hydrological processes	Maintain the hydrological regimes of groundwater and surface water so that environmental values are protected
	Inland water environmental quality	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.
	Aquatic ecosystems	Protect aquatic ecosystems to maintain the biological diversity of flora and fauna and the ecological functions they perform.

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 that may be significantly impacted by the Proposal, or that were addressed through consideration of the above factors, are summarised at Appendix 1.

The key environmental factors are discussed in section 5. The description of each factor shows why it is relevant and how it would potentially be affected by the Proposal. The assessment of each environmental factor contains recommendations for implementing the Proposal in a manner which protects the values associated with the factor. It concludes with a judgement by the NT EPA about whether or not the Proposal can meet the NT EPA's environmental objective for each factor.

5 Assessment of environmental factors

5.1 Overview

This section evaluates the Proposal and presents the views of the NT EPA on the environmental acceptability of the Proposal. The environmental acceptability of this Proposal was considered with regard to the principles of Ecologically Sustainable Development (ESD), through analysis of:

- the Proposal (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 of the Proposal and the evaluation of the significance of those impacts and risks

- the proposed avoidance or minimisation / mitigation measures to reduce potential impacts and risks to acceptable levels and to meet NT EPA objectives.

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 Proposal. 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 Proposal have not been finalised. Minor and insubstantial changes are expected in the design specifications of the Proposal following the conclusion of the EIA process. It is necessary for approval mechanisms to accommodate subsequent changes to the environmental safeguards described in the 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 Proposal has not substantially commenced in this period, the NT EPA requests that it be notified in writing by the Proponent.

The NT EPA considers that commitments made by the Proponent in the EIS are binding and must be fulfilled for the duration of the Proposal. The NT EPA makes Recommendations 1 and 2.

Recommendation 1

That approvals for the Proposal impose binding legal obligations on the Proponent to implement the Proposal in accordance with, and to meet, all environmental commitments and safeguards:

- 1. identified in the Environmental Impact Statement (EIS) for the Union Reefs North Underground Mine (including the Draft EIS and the Supplement to the Draft EIS)**
- 2. recommended in this Assessment Report 92**
- 3. to the satisfaction of the relevant regulator**
- 4. throughout all stages of implementation of the Proposal including during any period of inactivity or care and maintenance**
- 5. including timely public reporting, on the website of the Proponent, the Operator and the relevant regulator, of performance against the plans and reports addressed in the recommendations in this Assessment Report 92**

Where there is conflict between the commitments in the EIS and the recommendations in this report, the latter are to take precedence.

Recommendation 2

That the Proponent or Operator provides written notice in advance to the Northern Territory Environment Protection Authority and the Responsible Minister if it alters or proposes to alter the Proposal, environmental commitments or safeguards in the Environmental Impact Statement in such a manner that the environmental significance of the action may change, in accordance with the *Environment Protection Act 2019* and *Environment Protection Regulations 2020*.

The remainder of this section identifies and discusses, in relation to each key environmental factor (NT EPA, 2018), the environmental values and potential impacts and risks to these values based on the likely significance of potential impacts, the Proponent's investigations and studies, and the Proponent's commitments to identify, avoid, mitigate, monitor, manage and offset the potential impacts and risks.

In defining its environmental objectives, the NT EPA also had regard to the principles of ESD articulated in the Intergovernmental Agreement on the Environment (DoEE, 1992). The NT EPA has summarised its consideration of ESD in Appendix 2.

The NT EPA considers it essential that good mine closure planning for primary and secondary components of the Proposal be integrated into Proposal development and operations planning. The NT EPA's assessment of the Proponent's approach to mine closure is discussed in Section 7.

5.2 Terrestrial flora and fauna

5.2.1 Environmental objective

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

5.2.2 Environmental values

The Proponent conducted environmental monitoring and targeted fauna surveys of the URPA. One species, the ghost bat (*Macroderma gigas*), listed as vulnerable under the EPBC Act, has the potential to be significantly impacted by the Proposal.

The ghost bat is a large, carnivorous, cave-dwelling bat that forages at night, generally within 2 km from its daytime roost site (TSSC, 2016). Habitat loss and degradation due to mining are identified as key threatening processes, contributing to an ongoing decline of ghost bat distribution and population in Australia and the NT and therefore the species' listing under the EPBC Act. There are at least six geographically separated ghost bat populations across Northern Australia (TSSC, 2016). Within the NT there are multiple genetically distinct regional populations, one of which is located around Pine Creek (EMS, 2019). This genetic separation elevates the importance of regional ghost bat populations for conservation of the species. Within a regional population, ghost bats occur in colonies that move between roost sites seasonally or as dictated by weather conditions (TSSC, 2016). In the NT, ghost bat individuals have been known to travel up to 10 km (EMS, 2019). It is unclear if whole colonies can move between roost sites separated by more than a few kilometres. The genetic importance of local colonies is uncertain (EMS, 2019).

Targeted ghost bat surveys have been conducted intermittently at the URPA since 1993. More intensive monitoring of the local colony (the Union Reefs colony) occupying abandoned mine adits, left from mining during the 1800s, has occurred since 2018. Based on this survey and monitoring effort, the Proponent estimates that ghost bats have occupied the URPA for over 32 years and currently comprises up to 50 individual ghost bats. The Union Reefs colony represents 4% of the Pine Creek regional population, 1.4% of the NT population, and 0.5% of the national population. Given the known genetic separation of populations and uncertain genetic importance of ghost bat colonies, it is considered that the Union Reefs colony, while relatively small, may be significant to the viability of the regional population.

The Proposal area contains four mine adits that are suitable roost habitat for the ghost bat and provide access to multiple foraging sites in and surrounding the URPA. The adits (see Figure 1) are:

- Union North Adit – one of two main day roosts, located in Union North Pit and about 650 m north of proposed aboveground works and blasting

- OK Adit – one of two main day roosts, located in Prospect Pit and coincident with the proposed works area
- Prospect Adit - an occasional day and night roost, located in Prospect Pit and coincident with the proposed works area
- Lady Alice Adit - a previous roost site, since collapsed and later reopened, located in hills to east of Union North Pit and about 500 m north of proposed aboveground works and blasting.

Ghost bats using the adits of the URPA are known as the Union Reefs colony and are assumed to move between the two main day roosts; OK Adit and Union North Adit. Individual ghost bats may also move to or from surrounding colonies, either directly or via transitory roosts in the area (for example, shallow mine workings, culverts and small cave features).

The Union Reefs colony is one of multiple distinct roosting colonies that are known in the Pine Creek area, comprising the regional population of ghost bats considered in this assessment. The largest known colonies in the region include the nearby:

- Spring Hill colony - contains up to 200 individuals in a potentially active mine area, 10 km to the north of the Proposal area
- colony in the Kohinoor Adit at Pine Creek - contains up to 800 individuals and is located 13 km south of the Proposal area at an abandoned mine site.

The DENR Flora and Fauna Division considers that these larger colonies are critical to the conservation of the species and its genetic diversity. It is unknown whether the Union Reefs colony is connected to, or contributes to the viability of these other colonies. It is possible that the Union Reefs colony could provide a link between the larger colonies, making it important to the regional population; however, this is uncertain.

5.2.3 Potential impacts

Development and operation of the Proposal has the potential to significantly impact on the local and regional ghost bat population, through:

- reduction or loss of the local Union Reefs colony from noise and vibration impacts potentially causing:
 - loss of habitat (damage to roost habitat through internal collapse or entrance blockage) and/or
 - individual mortality through exposure to noise and vibration and/or
 - daytime abandonment of roosts due to excessive noise or vibration with potential for predation by raptors and exposure to hot conditions while trying to find alternative roosts and/or
 - relocation of bats to suboptimal roosts on nights following noise or vibration disturbance with potential for increased mortality due to use of inferior, energy draining roosts
- reduction or loss of the local Union Reefs colony from adit closure causing:
 - loss of roost sites during temporary closure of OK and Prospect adits
 - permanent abandonment of some, or all roost habitat in the Proposal area
- decline of the Pine Creek regional ghost bat population from the reduction or loss of the Union Reefs colony
- cumulative impacts from other mining activity in the region.

5.2.4 NT EPA assessment

The NT EPA has made its assessment to address the requirements of the EA Act and in accordance with the Bilateral Agreement. Section 6 summarises the NT EPA's assessment of potential impacts to matters of national environmental significance.

Key to the NT EPA's assessment of potentially significant impacts on the ghost bat is the Proponent's action to close two adits in the Prospect Pit when developing the underground mine within this pit. The closure of these adits is to avoid significant impact on ghost bats from noise and vibration impacts. The mitigation measure of adit closure leads to further potential for significant impact on the ghost bat at the level of both the local Union Reefs colony and regional Pine Creek population. The Proponent has committed to mitigation measures in a Ghost Bat Action Plan and a Ghost Bat Management Plan (the Plans).

To maintain biological diversity and ecological integrity, the NT EPA's environmental protection outcome for the ghost bat is to maintain the viability of the Pine Creek regional population at all times, and protect the Union Reefs colony through implementation of the Plans, to the extent reasonably practicable. This is addressed in Recommendation 3.

Noise and vibration

The proposed above and underground works, including blasting, are within 50 m of OK and Prospect adits and will create substantial noise and vibration at these roost sites. The mineralisation being targeted is located directly beneath the OK and Prospect adits, so it is not possible to implement the Proposal in a manner that would eliminate noise and vibration impacts at these sites. The Proponent considered an alternative location for the portal access; however, this would not sufficiently lower the noise and vibration effects from underground works at the roost sites. To preserve the structure of adits the Proponent has committed to minimising vibration by reducing and limiting blast intensity. The Proponent considered that risks to individual ghost bats remain high with these measures in place and propose to exclude bats from their roost habitat by closing OK and Prospect Pit adits, the two adits closest to the portal access and underground mining, for the LOM.

Adit closure and alternative roost habitat

The temporary closure of the OK and Prospect adits is anticipated to cause a temporary loss of roost habitat and restrict the Union Reefs ghost bat colony to a single remaining adit (Union North Adit) for the period of underground mining. Possible damage to Union North Adit (which would be the last remaining known roost site) could cause a further loss of habitat for the colony, and this would require the ghost bats to seek alternative habitat. The Proponent recognised that this could result in the permanent loss of the Union Reefs colony, with potentially significant impact on the regional ghost bat population. The Proponent proposed creating a range of new habitat to mitigate both the temporary and potentially permanent loss of habitat as a result of the Proposal.

The temporary closure of two roost sites (OK and Prospect adits) increases the importance of protecting and maintaining the last known roost site of the colony (Union North Adit) within the URPA. Damage or loss of this adit, through natural collapse or other means unrelated to the Proposal, could result in the loss of all known roosts in the Proposal area. The Proponent has identified mitigation measures to limit access and activity near Union North Adit and to improve the condition of the adit for use by ghost bats. The NT EPA is satisfied with the proposed management measures to protect Union North Adit.

To further mitigate the temporary loss of the roost sites by closing OK and Prospect adits, the Proponent has committed to providing alternative roost habitat by reopening a previously used roost (Lady Alice Adit) and creating two artificial roosts as long term, alternative habitat. The NT EPA is supportive of the opening of Lady Alice Adit and early development of artificial roosts.

The artificial roosts would be located within the URPA, more than 1 km from gold mineralisation and not likely to be impacted by existing or future mining activity. The artificial roosts will be located above ground, constructed from concrete culverts, and based on structural and microclimate characterisation of existing on-site roost sites (Supplement Appendix 9). The design of the artificial roosts would build on existing knowledge from similar actions across Northern Australia combined with the Proponent's on-site characterisation and modelling. To date there is no publicly recorded ghost bat usage of artificial roosts constructed elsewhere. Uncertainty remains about the effectiveness of the proposed artificial roosts in providing comparable habitat and whether ghost bats would occupy these roosts. To maximise the opportunity for the proposed new artificial roost habitat to be effective, the NT EPA considers these must be built as soon as practicable. This is addressed in Recommendation 3.

Uncertainty remains about the success of these proposed mitigation measures for protecting the Union Reefs colony. Mitigation measures could be unsuccessful, for example Union North Adit could be damaged or disturbed during mining; there may be no uptake of Lady Alice Adit or two artificial roosts; and/or there may be no uptake of the reopened OK and Prospect adits. In the worst case, this could result in the loss of all roost habitat at the URPA, causing the individuals in the Union Reefs colony to move elsewhere or perish. If this were to happen, it is unclear if there would be an impact on the Pine Creek regional population, due to uncertainties about ghost bat ecology and behaviour. The NT EPA considers it is not possible to predict the outcome or success of roost uptake by the Union Reefs ghost bats with a high level of precision.

The DENR Flora and Fauna Division advised that uncertainty remains about the significance of the Union Reefs colony in the context of the Pine Creek regional population. For this reason, the NT EPA has assessed the residual impact based on the (unlikely) worst case of losing the Union Reefs colony, with potential resulting impact to the Pine Creek regional population colony.

Genetic studies

There is a gap in genetic understanding that contributes to uncertainty about the significance of the Union Reefs colony, the effectiveness of mitigation measures, and the significance of residual impact from the Proposal. Genetic studies would help narrow this gap. The Proponent has committed to undertaking genetic studies prior to construction of the mine to determine the regional movement and connectedness of the Union Reefs colony. The results of genetic studies would provide context and inform the significance of the Union Reefs colony within the regional context and guide mitigation and management actions.

Long term monitoring and closure

Long term monitoring of known roost sites and new roost habitat is required to inform outcome-based management of the Proposal and for future management of the Pine Creek regional ghost bat population. The Proponent's detailed baseline monitoring for the Proposal provides a strong base to enable mitigation, management and monitoring of Proposal related impacts on the ghost bat. The NT EPA acknowledges that the uncertainty about ghost bat movements and connectedness has implications for managing closure of the Proposal. A key closure objective of the Proposal is to convert a portion of the underground mine to create a new ghost bat roost to maintain habitat stability. The combined outcome of management actions relating to ghost bat roost sites and habitat, as a result of implementation and closure of the Proposal, remain uncertain. Closure is addressed in section 7.1.2.

Ghost Bat Action and Management plans (the Plans)

The Proponent describes its mitigation, management and closure actions, including the monitoring and research protocols to support these actions, in the Plans. Collectively the Plans provide the Proponent's commitments to reduce the residual impact on ghost bats

from the Proposal. The NT EPA considers the implementation of the Plans and all commitments in their entirety is necessary, given the uncertainty associated with the outcome of mitigation measures. The NT EPA is satisfied that the Plans, implemented in their entirety, will improve understanding of the local Union Reefs colony and the Pine Creek regional population, and provide a knowledge base that will assist in future management decisions.

Offsets

The Proponent has proposed substantial measures to avoid, minimise and mitigate the potential loss of the Union Reefs colony from the URPA. However, uncertainty around the outcomes of these actions remains. The EIS acknowledges that there may be a significant residual impact to the ghost bat and subsequently the Proponent has proposed to offset these impacts. The NT EPA considers that the residual impact is sufficiently significant for an offset to be appropriate, noting that this mechanism is available under the EPBC Act, rather than the EA Act, and is therefore a decision for the Australian Government.

The Proponent proposes to offset the potentially significant residual impact through an applied and academic research program, and the protection of known off-site colonies which belong to the regional ghost bat population. Both are clear outcome-based offsets. The Proponent has committed to fund the academic research plan based on the priorities identified in the Conservation Advice (TSSC, 2016) and to prepare a National Ghost Bat Recovery Plan. The proposed offset research would significantly increase the understanding of ghost bat ecology and conservation status, leading to improved management of threats in the region. The NT EPA notes that the successful implementation of this offset will require the Proponent to consult with DENR and DAWE on the aims, methods and desired outcomes of the research program.

The Proponent has also committed to implementing management and protection measures at known off-site roosting colonies at Pine Creek and Spring Hill, pending stakeholder agreement and title acquisition, respectively. The protection of these roost sites would support the viability of the regional ghost bat population and represents a valuable offset. The NT EPA acknowledges there is a degree of uncertainty associated with the implementation of this offset given that the Proponent does not have control over these sites.

The NT EPA considers that the Proponent's commitments to offset actions as outlined in the EIS, if implemented in full, and in parallel with mitigation measures, could adequately compensate for any significant residual impacts from the proposal. This is addressed in Recommendation 3.

Cumulative impact

The regional population of ghost bats may be resilient to disturbances associated with one off actions, such as this Proposal. However, this resilience would be challenged if multiple resources in the region are targeted simultaneously, for example in an economic environment favourable for gold mining. The cumulative impact arising from multiple actions could result in disturbances to known occupied and unoccupied ghost bat roost sites and may test the resilience of the regional population to these disturbances. To achieve the NT EPA's environmental protection outcome for protecting the ghost bat (Recommendation 3), it will be important for proponents and decision makers to consider and avoid these cumulative impacts.

Recommendation 3

1. That the Proposal is implemented to achieve the following environmental protection outcome:
 - a. that impacts attributable to the Proposal on the local population of ghost bats do not affect the viability of the Pine Creek regional population of ghost bats.
2. To contribute to achieving the outcome at part 1 of this recommendation, the Proponent:
 - a. creates the proposed purpose-built roosts in advance of commencing bat-disturbing activities and closure of OK and Prospect adits, in consultation with the Department of Agriculture, Water and the Environment and the Department of Environment and Natural Resources
 - b. conducts genetic studies to identify the gene flow, connectedness, and significance of the local Union Reefs colony in relation to the Pine Creek regional population of ghost bats
 - c. reviews the Ghost Bat Action Plan and Ghost Bat Management Plan (Plans) prior to commencing the proposed activities, to ensure they align with part 1 of this recommendation (above), based on advice of a specialist expert, and to the satisfaction of the Department of Environment and Natural Resources' Flora and Fauna Division and the Department of Agriculture, Water and the Environment
 - d. implements the updated Plans that contain the following as a minimum:
 - i. monitoring procedures and protocols, including monitoring location points and timeframes, for all roost sites and roost habitat that the Proponent has committed to monitor in the Proposal area and used by the regional population of ghost bats
 - ii. contingency measures to be implemented if monitoring identifies unfavourable parameters or trends for local Union Reefs colony and/or Pine Creek regional population, over statistically meaningful timeframes
 - iii. annual reports, including analysis of monitoring data, that assess the use of all roost sites and roost habitats that the Proponent has committed to monitor
 - iv. funding of a research program, based on the priorities identified in the Conservation Advice (TSSC 2016), including the preparation of a National Ghost Bat Recovery Plan informed by this research and in consultation with the Department of Agriculture, Water and the Environment
 - v. further protection measures identified in the Recovery Plan (identified above) to the extent practicable

5.2.5 Conclusion against the NT EPA objective

With the implementation of relevant management plans and recommendations in this Report, the NT EPA considers that the Proposal could be conducted in such a manner that its objective for Terrestrial flora and fauna is likely to be met.

5.3 Hydrological processes

5.3.1 Environmental objective

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

5.3.2 Environmental values

Groundwater

The Proposal is located within the Pine Creek Bioregion, characterised by the highly mineralised Pine Creek Geosyncline. The Prospect deposit occurs within the Union Reefs shear zone of the Burrell Creek Formation; containing a shallow, higher permeability, fractured rock aquifer (up to 50 m bgl) overlying a deep, low permeability, fractured rock mass aquifer (up to 220 m bgl). The average depth to groundwater at the Prospect Pit fluctuates from about 16m bgl in the dry season to 10m bgl in the wet season.

Groundwater in the region has environmental value for aquatic ecosystems and riparian vegetation and is an important water source for human drinking water, domestic use and stock consumption. The Burrell Creek Formation aquifer has minor groundwater resources and low bore yields, typically less than 0.5 L/s. The closest active production borefield is about 8 km from the proposed underground mine and is used to supply potable water to the Pine Creek township. The nearest third party independent bore is located at the former Frances Creek Mine rail siding (RN036105 about 4 km north-west) and is not currently in use.

Groundwater at the URPA is a source of inflow to the McKinlay River. The existing hydrogeological regime was altered by historical mining undertaken below the natural water table. Existing pits, dams and ponds are considered to be unlined and in direct hydrological connection with the aquifer. The general direction of groundwater flow from the URPA is towards the McKinlay River (Figure 5).

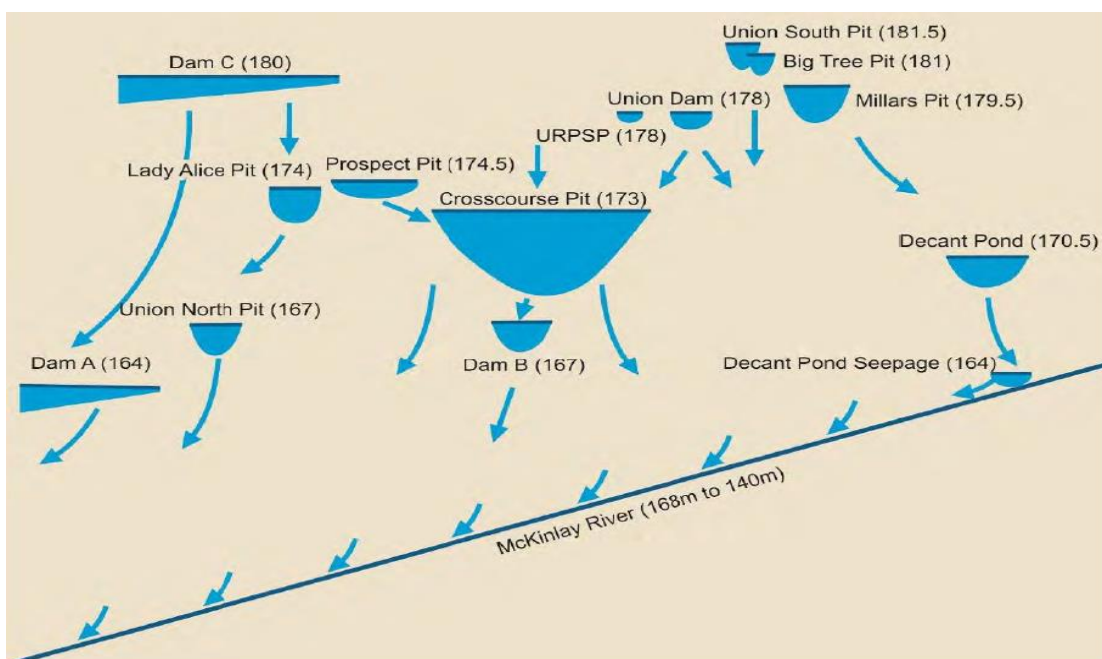


Figure 5: Conceptual groundwater flows with Crosscourse Pit outflow under current conditions. Water level is provided in m AHD (source: Draft EIS)

The Proposal is located within the Mary River groundwater catchment boundary for declared beneficial uses and objectives under the *Water Act 1992*. In this catchment the beneficial uses are environmental, riparian and agriculture; and the associated water quality objectives are for the protection of aquatic ecosystems and agricultural water use.

Surface water

The Proposal is located in the upper McKinlay River subcatchment of the Mary River catchment, between two ephemeral creeks; Wellington Creek to the north and Esmeralda Creek to the south. Both creeks flow west into the McKinlay River. The Proposal is characterised by hilly terrain. North of the Proposal, the terrain levels out to form extensive alluvial plains associated with the McKinlay and Mary River systems.

The Mary River flows year round; however, many of its catchment tributaries, including the McKinlay River, are ephemeral, typically experiencing flow only after sustained or intense rainfall and runoff in the catchment. The McKinlay River, a tropical lowland river with a total catchment area of 1812 km², flows northwards just inside the western edge of the URPA, and eventually reaches a confluence with the Mary River near Mount Bunday, about 85 km north of the Proposal. Stream flows are highly variable in response to localised wet season rainfall. The river ceases to flow soon after the last wet season rains and becomes a series of disconnected pools, some of which persist throughout the dry season (see section 5.5.2).

Surface water runoff from the URPA flows into the McKinlay River as overland sheet flow and concentrated drainage from mine water storages, some via Wellington Creek to the north or Esmeralda Creek to the south.

All surface waters of the McKinlay River catchment have aquatic ecosystem protection as the declared beneficial use under the *Water Act 1992*. Surface water flows in the McKinlay River are important to support its riparian vegetation and sustain its aquatic ecosystems.

5.3.3 Potential impacts

The Proposal has potential for significant impact on environmental values through:

- groundwater drawdown from mine dewatering
- altered groundwater inflows to the McKinlay River.

5.3.4 NT EPA assessment

Protection of the receiving environment

The receiving environment of all potential water-related impacts of the Proposal comprises the minor tributaries that drain the Proposal area, and the McKinlay River with its dependent aquatic ecosystems. Groundwater is also part of the receiving environment, contributing inflows to the McKinlay River and its aquatic ecosystems. Therefore, the ultimate values requiring protection are associated with the McKinlay River. Accordingly, the NT EPA emphasises the importance of protecting the environmental values of the McKinlay River, as expressed in Recommendation 4 (in section 5.5.4).

Groundwater drawdown from mine dewatering

The Proponent conducted a groundwater study, including hydrogeological modelling, to identify the potential impacts of dewatering the existing Prospect (North and South) Pits prior to mining; and the underground mine during construction and operation (GHD, 2019). Predictions of groundwater inflows to the underground mine ranged from 2 L/s during decline development to a worst case scenario of about 18 L/s (568 ML/year) during mining, although a rate of 7 L/s was adopted in the water balance to represent the expected inflow during operation under average conditions.

The predicted maximum level of groundwater drawdown, at the end of mining, is about 220 m below the existing water table, centred on the underground mine and diminishing with increased distance from it (Draft EIS Figure 12-7). The predicted zone of depressurisation at two years post-mining is 1 m at about 1.6 km west of the

underground mine and 5 m at about a 500 m radius (Draft EIS Figure 12-8). The Proponent's modelling indicates groundwater drawdown of 1- 3 m in the riparian areas along the McKinlay River and its tributaries. Recovery of water levels to final equilibrium level is predicted within six years following closure of the Proposal. The Proponent considered it unlikely that any predicted localised drawdown of groundwater caused by dewatering activities would affect the hydrogeological recharge regime outside the extent of predicted drawdown.

Management of the water level in Crosscourse Pit would influence groundwater flow and drawdown. The Proposal includes managing the lake at its current water level (about 173 m AHD). It is noted that a higher water level, closer to the spill level at 188 m AHD, would increase inflows to the aquifer thus masking drawdown impacts. The modelled drawdown from mine dewatering (while keeping the pit lake level at about 173 m AHD) predicts that:

- drawdown (<1 m) would extend to the McKinlay River from the end of year 2 of underground mining to 3 years post closure
- drawdown would extend to the nearest groundwater user bore (Territory Iron bore RN036105), peaking at 0.08 m at 3 years post closure
- drawdown would not extend to the Pine Creek town water supply borefield.

The potential for depressurisation of the adjacent Territory Iron bore (currently not in use) and the Pine Creek town water supply borefield (active) was considered in the EIS. The Proponent concluded that the predicted changes would not measurably impact any groundwater users, and committed to implement measures outlined in the Water Management Plan (Supplement Appendix 11) to manage the level and extent of drawdown and avoid any reduction in groundwater availability for other users. The NT EPA is generally supportive of this approach; however, has limited confidence in the predictions of the extent and magnitude of depressurisation post-mining, and considers that the predicted impacts to other users and the receiving environment are uncertain. The NT EPA addresses this uncertainty in Recommendation 4.

Altered groundwater inflows to the McKinlay River

The Proponent modelled the potential impacts of drawdown on groundwater availability contributing to the McKinlay River shallow alluvial and surface flows. The majority (about 60%) of loss of groundwater availability would be along two short sections of the McKinlay River, as follows:

- section 1: URSW04 to URSW03: Maximum percentage loss of 12%, reducing to <2% at 6 years after mining
- section 2: URSW10 to URSW04: Maximum percentage loss of 17%, reducing to <4% at 6 years after mining

It is predicted that by ten years post-mining groundwater availability would return to pre-Proposal levels and there would be no long-term changes to the existing groundwater regime as a result of the Proposal. The predicted short-term impacts on groundwater inflows to the McKinlay River could impact aquatic ecosystems. This is addressed in section 5.5.

The Proponent acknowledged that further development of its hydrogeological model is required to improve its predictive capacity and validate modelled predictions; and has committed to implement a groundwater monitoring program to further assess potential hydrological impacts of the Proposal. The Proponent has committed to develop trigger values for groundwater drawdown levels for inclusion in the Water Management Plan, as well as high frequency monitoring to allow early detection of any drawdown impacts on water availability and yield for other human and environmental uses.

The NT EPA has evaluated the impacts of groundwater drawdown from the Proposal and acknowledges the Proponent's conclusion that this creates a low risk of impact on

other groundwater uses (excluding aquatic ecosystems, which are addressed separately in section 5.5). The NT EPA supports the Proponent's commitments to avoid and mitigate potential impacts of dewatering induced drawdown. In Recommendation 4 the NT EPA includes the requirement to implement a comprehensive groundwater monitoring program for the duration of the Proposal using dedicated groundwater monitoring bores to accurately measure any actual drawdown impacts from the underground mine as it is developed, and remedial action if required.

5.3.5 Conclusion against the NT EPA objective

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

5.4 Inland water environmental quality

5.4.1 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.

5.4.2 Environmental values

The water quality of both groundwater and surface water in the vicinity of the Proposal influences the quality of water in the McKinlay River, which has significant environmental values, as described in section 5.3.2.

Both groundwater and surface water at the URPA have been influenced by previous mining activity, as outlined in section 1.5.2. Following on from this, the quality of water in the McKinlay River has been affected by neutral mine drainage. As outlined in section 1.5.2, water quality downstream of the URPA has elevated EC, sulfate, calcium and magnesium, compared with upstream.

5.4.3 Potential impacts

Water quality surrounding the Proposal may be affected by contaminants (including sediments) entering surface water or groundwater from:

- proposed controlled water discharges into the McKinlay River
- uncontrolled water discharges from seepage and/or runoff resulting from the Proposal, including after closure of the Proposal
- cumulative impacts from the above combined with uncontrolled seepage and/or runoff from the URPA.

Any contaminants released from the Proposal that impact downstream water quality could have adverse impacts on the downstream aquatic ecosystems. This is addressed in section 5.5.

Dam A and Dam C are not considered further in this section of the Report. While they are components of the Proposal, their use is related to water supply. These storages are upstream of potentially contaminating sources via surface water or groundwater and their water quality is unlikely to be impacted by the Proposal.

5.4.4 NT EPA assessment

The Proponent's objectives for water quality are set out in the Water Management Plan (Supplement Appendix 11). These objectives are to reduce the generation and discharge of low-quality water and avoid and control adverse impacts to the surrounding environment. The NT EPA supports these general objectives and emphasises the

importance of protecting the environmental values of the McKinlay River, in accordance with the environmental protection outcome in Recommendation 4 (in section 5.5.4).

Substantial management of water and mine waste materials will be required to achieve this outcome in relation to water quality. The measures considered necessary by the NT EPA to achieve this are discussed and addressed below.

Sources of poor quality water

Mine drainage

The Proposal will require the exposure of ore, tailings and waste rock to air and water, and this could result in AMD. Any contaminated mine drainage could lower the water quality of surface runoff, groundwater and surface water bodies. All of these could ultimately lower the quality of water in the McKinlay River.

The Proponent's geochemical assessment (Supplement Appendix 12) indicated that about 5% of waste rock and about 20% of ore will produce significant AMD when exposed to the atmosphere. Some material in the walls of the mined stopes is also expected to be reactive and produce mine drainage.

The Proposal includes temporary storage of waste rock at the surface, with most to be returned underground where it would eventually be protected from further reaction when submerged by groundwater. During underground mining, waste rock stored at the surface will be contained in Prospect South Pit. All water pumped out of the underground mine will be collected in Prospect North Pit. This mine-affected water will be pumped to Crosscourse Pit, which already contains poor-quality water. This is further discussed below.

Ore will be stored at the surface for short periods prior to processing, thereby limiting the opportunity for the generation of non-benign drainage from ore. As this risk cannot be completely eliminated, it will be important for the Proponent to contain, test, manage and treat surface runoff from the ROM Pad and processing area appropriately so that contaminants are not released to the environment.

It will also be important for the Proponent to manage waste rock and ore and runoff/seepage using an appropriate method of geochemical classification and a water management system. The Proponent will need to adapt management as required in response to testing and characterisation of waste rock and ore throughout mining. Accordingly, the NT EPA has addressed this in Recommendation 4.

The NT EPA considers that it will be important for the Proponent to identify any exceedances of the defined water quality criteria in mine-affected water within the Proposal area, which will then trigger the implementation of contingency measures to prevent the generation and release of contaminants, to comply with its WDL conditions. This will require the implementation of a water quality monitoring program in accordance with Recommendation 4.

Crosscourse Pit

The Proponent's strategy for managing substantial quantities of mine-affected water and tailings associated with the Proposal is to transfer it to Crosscourse Pit, including:

- groundwater pumped from the underground mine (via Prospect Pit)
- surface water stored in Prospect Pit (including leachate from stored waste rock)
- tailings deposition (which will displace water)
- processing water.

As described in section 1.5.2, the quality of water in Crosscourse Pit is already poor. The water quality prediction modelling provided by the Proponent (EGI, 2020) showed that concentrations of some metals are predicted to increase from 2020 to 2025 under all scenarios modelled. This includes copper: about 0.0 to about 0.07 mg/L; nickel: about 0.01 to about 0.05 mg/L; and zinc: about 0.02 to about 0.08 mg/L (EGI, 2020; section 4.2). It is also noted that some aspects of the water quality are predicted to improve through dilution, including significantly lowered salinity and slightly lowered concentrations of arsenic and cobalt. Overall, the modelling report concluded that the Proposal is not likely to have a major effect on the water quality in Crosscourse Pit in comparison to current and historical water quality records.

The EIS acknowledges that Crosscourse Pit has a positive water balance, and is gradually filling, even without the addition of water to be pumped to it during implementation of the Proposal (EGI, 2020). As described in section 5.3.4, water from the pit lake generally migrates via groundwater towards the McKinlay River. The Proponent's site water balance indicates that seepage from Crosscourse Pit for the year ending April 2020 was 8 ML; however, this is forecast to reduce to zero in subsequent years (2021 – 2024) in line with the increased volume of discharge under a proposed WDL. The rate of groundwater migration reportedly increases when the lake level rises above about 173 m to 176 m AHD (Supplement Appendix 11 Figure 6-3). It is understood that, at levels close to the spillway height (about 189 m AHD), Crosscourse Pit would be a significant water source, with rapid groundwater loss to down gradient receptors, particularly the McKinlay River. Resultant water quality expressing to the McKinlay River is not expected to differ significantly from pit lake quality due to limited attenuation of contaminants in the aquifer. Surface water overflow would occur above the spill level of about 189 m AHD.

Due to this hydrological connectivity between the pit lake and surrounding groundwater and the McKinlay River, increases in contaminant concentrations in the pit lake could impact downstream water quality and environmental values. The EIS recognised this risk, and the Proponent has proposed to treat and discharge water to the McKinlay River (as outlined in section 2.7). This proposed controlled discharge is discussed below. The NT EPA asserts that it is critical for the Proponent to minimise the volume of water and the loading of contaminants entering the pit lake to minimise both controlled discharges and uncontrolled overflow and seepage to the McKinlay River into the future.

The EIS provided limited consideration of alternative water management approaches to minimise the volume of mine-affected water and contaminants added to Crosscourse Pit (one proposed approach is addressed below). The NT EPA considers that the Proponent's strategy for management of mine-affected water should apply the waste management hierarchy including options for avoidance, reduction, reuse, recycling, recovery, treatment and disposal. The NT EPA considers wastewater discharge should only be considered after all reasonable and practicable efforts have been taken to prevent or minimise pollutant discharge to the receiving environment. The NT EPA addresses the waste hierarchy in Recommendation 4.

The Proponent has made a commitment to reducing the net volume of water input to Crosscourse Pit by recycling water from the pit lake and using reverse osmosis (RO) to treat water to an appropriate quality (Supplement section 2.2). This water would be used for processing only; not prior to discharge into McKinlay River. Treatment and recycling for use in processing would reduce the volume of clean water required from Dam C and reduce the net volume of mine-affected water disposed into Crosscourse Pit. The NT EPA is aware that RO treatment would generate highly saline reject water. The fate of this reject water has not been addressed in the EIS. If the reject water is disposed into Crosscourse Pit, it would likely alter the water quality in the pit lake. Before proceeding with this commitment, the Proponent would need to update the predictive modelling of pit water quality to take into account the addition of this brine waste. The NT EPA addresses this in Recommendation 4.

To prevent seepage or overflow of Crosscourse Pit, and to meet the NT EPA's environmental protection outcome for the health of the McKinlay River, the water level in Crosscourse Pit must be maintained below the threshold level at which the pit becomes a net groundwater source. While this has been stated at about 173 m AHD (below the current water level), the Proponent has not provided solid data demonstrating this threshold. Lowering the pit level and maintaining it below a threshold will require active discharge or other means. The Proposal includes the management of the water level in Crosscourse Pit by removing water for treatment and controlled discharge. This proposed controlled discharge also has the potential to impact on water quality in the McKinlay River, and this is discussed below. The NT EPA considers that a controlled discharge of treated water has the potential to minimise impacts on water quality compared to an uncontrolled release of untreated pit lake water via seepage or overflow, which would have higher levels of contaminants.

While the NT EPA is generally supportive of the Proponent's approach to manage Crosscourse Pit water levels to minimise discharge via seepage to the McKinlay River, it considers that uncertainty remains on the actual rate of seepage and contaminant transport to the river from Crosscourse Pit and that it is important that the Proponent monitor, measure and assess the rate of seepage and contaminant transport. The NT EPA addresses this in Recommendation 4.

Sediments and other materials

During implementation of the Proposal there is potential for sediments to be eroded and/or mobilised by water, and for the spillage of other materials, including fuels and hazardous substances. The NT EPA considers that these sources can be effectively managed using standard measures in accordance with Australian standards, regulatory requirements for hazardous substances, and implementation of an Erosion and Sediment Control Plan prepared by a certified practitioner.

Controlled water discharge

As discussed above, the Proposal includes the removal, treatment and discharge of water from Crosscourse Pit. This is required to address the naturally positive water balance of the pit lake (due to rainfall), which is compounded by the addition of mine-affected water and tailings to the pit lake from implementation of the Proposal. The proposed water treatment method is basic, as described in section 2.7. The EIS describes the Proponent's intention to apply for a WDL for the discharge of treated water into the McKinlay River during the wet season when the river is already flowing. The intention is to use dilution in the river to achieve acceptable water quality downstream of the discharge point.

The EIS states that the treated discharge water would enter the McKinlay River at monitoring site URSW04 (Draft EIS section 8.5.1), and that syphons would transfer this water, at a controlled rate, from its storage in Dam B (Supplement section 3.12). The Proponent further clarified that it intends to syphon the water out of Dam B to a 'rock energy dissipater' adjacent to the dam, to form overland sheet flow that would proceed downhill to the McKinlay River. This would amount to overland flow over at least 300 m, to reach the McKinlay River about 500 m upstream of URSW04. The NT EPA does not support this approach and asserts that discharge water must not enter the environment during its transfer from Dam B to the McKinlay River, as addressed in Recommendation 4.

The Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018) emphasise that Site Specific Guideline Values (SSGVs) should be derived and used in preference to Default Guideline Values (DGVs). The Proponent has developed proposed SSGVs for two downstream compliance points (Supplement section 3.13). The first proposed compliance point is about 3 km downstream of the discharge point (URSW10), with SSGVs equivalent to 80% species protection in accordance with the

Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018). The second proposed compliance point is about 12 km downstream (URSW08), with SSGVs equivalent to 95% species protection in accordance with the guidelines (ANZG, 2018). In sum, this is a mixing zone of 12 km in length, with a zone of higher impact (about 3 km), and a zone of lower impact (about 9 km).

The NT EPA is of the view that a 12 km mixing zone is excessive in length, is not consistent with best practice, impacts on beneficial uses, and is not likely to meet Recommendation 4 for the protection of the environmental values in the McKinlay River. The NT EPA considers that water quality in the McKinlay River receiving environment should meet 95% species protection, as expressed in Recommendation 4.

Trial water treatment results indicate that discharge water would be high in salinity (about 2800 $\mu\text{S}/\text{cm}$), could be slightly acidic and could potentially contain some elevated concentrations of metals (Supplement Appendix 11 Section 9). Actual treatment results are likely to differ from this trial, especially as the water quality in Crosscourse Pit changes over time due to seasonal variability and the inputs associated with the Proposal. The pit lake water quality is also likely to deteriorate if brine waste from the committed RO plant is added to the pit lake, adding uncertainty to the quality of discharge water.

Further, there is uncertainty regarding the capacity for dispersion and dilution of the discharge water in the McKinlay River. The NT EPA notes that the Proponent is in the process of developing an algorithm for appropriate dilution, based on river flow data. This adds to the uncertainty of whether the proposed mixing zone and proposed SSGV's are appropriate for meeting Recommendation 4 for the protection of the McKinlay River. Therefore, the NT EPA encourages the Proponent to investigate other options for water storage and treatment that would achieve a reduction in the volume of water required to be discharged and a higher quality of water at the discharge point. This is addressed in Recommendation 4.

Regardless of the dilution of discharge water, the NT EPA considers that it will be necessary for contaminant loads entering the McKinlay River to be limited to as low as reasonably practicable. This is considered necessary for the protection of environmental values in the McKinlay River (Recommendation 4). The NT EPA has also addressed contaminant loads in Recommendation 4. This Recommendation also reinforces the importance of monitoring water quality in the receiving environment to assess performance against the environmental outcome in Recommendation 4.

According to the Proponent's site water balance, controlled discharge of 2,037 ML/year would be required for the year ending April 2021 to prevent seepage from the Crosscourse Pit, and that annual discharge volumes would gradually reduce to 931 ML/year in 2024. This range of discharge rate is equivalent to 2.6 - 5.6 ML/day for all days of the year (about 30 - 65 L/s). When calculated over the average annual number of days of rain ≥ 1 mm (when the river is likely to be flowing during the wet season), the mean daily discharge range is 9.9 – 21.7 ML/day (115 – 250 L/s). Being an ephemeral system, the Proponent would only be able to discharge when flow rates in the McKinlay River are sufficient to limit contaminant concentrations in the receiving environment.

The Proponent provided insufficient information in the EIS to enable flow triggers to be calculated. It also has not demonstrated that the proposed rate of water discharge could be undertaken in a manner that protects the McKinlay River beneficial uses and local values. The NT EPA considers that the Proponent should implement a baseline water quality and flow monitoring program prior to the Proposal commencing, in order to assess impacts on the McKinlay River receiving environment. Data collected from the baseline water quality and flow monitoring program would enable the calculation of water quality objectives for the receiving waters, including flow conditions and criteria for the release of mine-affected water and would be used by the NT EPA in its assessment of a WDL application and in drafting WDL conditions.

A water quality and flow monitoring program would determine:

- water quality objectives for the McKinlay River
- flow conditions for the receiving waters
- flow criteria for discharge, maximum release rates, and release limits.

The NT EPA addresses this in Recommendation 4.

The NT EPA considers that there is potential for impact on the McKinlay River from increased river flows from a controlled discharge of treated wastewater if that controlled discharge altered the natural timing, rate, frequency or duration of seasonal flows. Considering that the wastewater discharge will require dispersion and dilution in the river when it is already flowing, the NT EPA considers the likelihood of this impact is low. It is likely to increase flow volumes by only a small proportion that would be less than the contribution from a heavy rain event in the catchment.

The Proponent has committed to minimising the required discharge volume by recycling water using a RO plant to achieve a suitable water quality to allow more re-use. The NT EPA is supportive of this intent but notes that this approach may have implications for water quality. The NT EPA considers that any releases of water to the McKinlay River should be managed to avoid significant changes to the timing, rate, frequency and duration of seasonal surface water flows.

Potential for uncontrolled discharge of untreated water

There is potential for the uncontrolled discharge of untreated mine-affected water from the Proposal area via surface water overflow and groundwater seepage. The EIS included a draft Water Management Plan (Supplement Appendix 11) addressing the management of surface water and groundwater to manage risks of offsite contamination. The NT EPA has addressed the implementation of this Plan in Recommendation 4.

The NT EPA acknowledges that there is potential for increased seepage via groundwater from Crosscourse Pit and other water storages in the Proposal area to significantly impact water quality in the McKinlay River. This could contribute to cumulative impacts from the URPA and is a substantial concern for the implementation of this Proposal and the ongoing management of the URPA. It will be important for the Proponent to manage water levels in Crosscourse Pit, as addressed in Recommendation 4. Longer term management of Crosscourse Pit is addressed in section 7.1.3.

The Proponent has committed to monitoring groundwater and surface water quality at sites within the Proposal area and at upstream and downstream sites in the McKinlay River, in accordance with their Water Quality Management Plan (Appendix D of the Water Management Plan). The NT EPA notes that the Plan includes 11 additional groundwater monitoring sites that would inform assessment of groundwater seepage from Crosscourse Pit, the underground mine (including Prospect Pit) and other components of the URPA, and would enable the early identification of any increase in the rate of contaminated seepage entering the McKinlay River. The Plan also includes reporting on water quality at various intervals until five years post-mining. Trigger responses for increased seepage are not included but will be defined prior to commencement of the Proposal and then updated to preliminary trigger responses in the first water quality report due at the commencement of mining. The NT EPA addresses this in Recommendation 4.

5.4.5 Conclusion against the NT EPA objective

With the implementation of relevant management plans and recommendations in this Report, the NT EPA considers that the Proposal could be conducted in such a manner that its objective for inland water environmental quality is likely to be met.

5.5 Aquatic ecosystems

5.5.1 Environmental objective

Protect aquatic ecosystems to maintain the biological diversity of flora and fauna and the ecological functions they perform.

5.5.2 Environmental values

The aquatic ecosystems of the upper McKinlay River are typical of seasonal streams in the NT. The Proponent's consultant (AES, 2019) identified resilient fish and macroinvertebrate fauna that are adapted to intermittent flows; and recorded twelve species of fish in the McKinlay River between 1993 and 2019. The macroinvertebrate fauna of the McKinlay River is typical of intermittent streams in the NT and consists predominantly of disturbance-tolerant species. Several aquatic species of conservation significance potentially occur in the area, including freshwater and saltwater crocodiles and three species of water monitor that are listed as vulnerable under the *Territory Parks and Wildlife Conservation Act 1976*.

Riparian vegetation along the McKinlay River and its tributaries provides important refuge habitat for terrestrial and semi-aquatic species in the area and is an important component of aquatic ecosystems. The local riparian vegetation is typical for seasonal streams in the NT and is considered to be in good condition. An extensive area of riparian paperbark swamp has established upstream of a weir that was constructed as part of historical mining activities, increasing water retention upstream. The weir is upstream of the site of the Proposal's controlled discharge of treated wastewater, and downstream of uncontrolled seepage from Crosscourse Pit.

An assessment of habitat condition of 14 sites within and downstream of the URPA resulted in scores of fair to good for all sites (AES, 2019). Four of these sites contain permanent water, and therefore are of particular value to aquatic flora, fauna and ecological processes (Figure 6). Other persistent pools are likely to exist downstream of the area assessed.

Water quality in the McKinlay River and its tributaries is affected by legacy contamination of groundwater and surface water due to historic mining activity (see Section 5.4.2). The impact of this on current ecosystem health is poorly understood due to a paucity of biological monitoring data. Studies on the macroinvertebrate fauna (AES, 2019) were inconclusive regarding impacts of mine-related contamination due to differences in habitat upstream and downstream of existing mine features.

5.5.3 Potential impacts

Development and operation of the Proposal has the potential to impact on aquatic ecosystems within and downstream of the URPA through:

- deterioration of surface water quality due to controlled and/or uncontrolled discharges or groundwater seepage, leading to contamination of aquatic habitat and reduction in the health or biodiversity of aquatic ecosystems
- drawdown of groundwater and reduced dry season water availability for potentially groundwater dependent ecosystems.

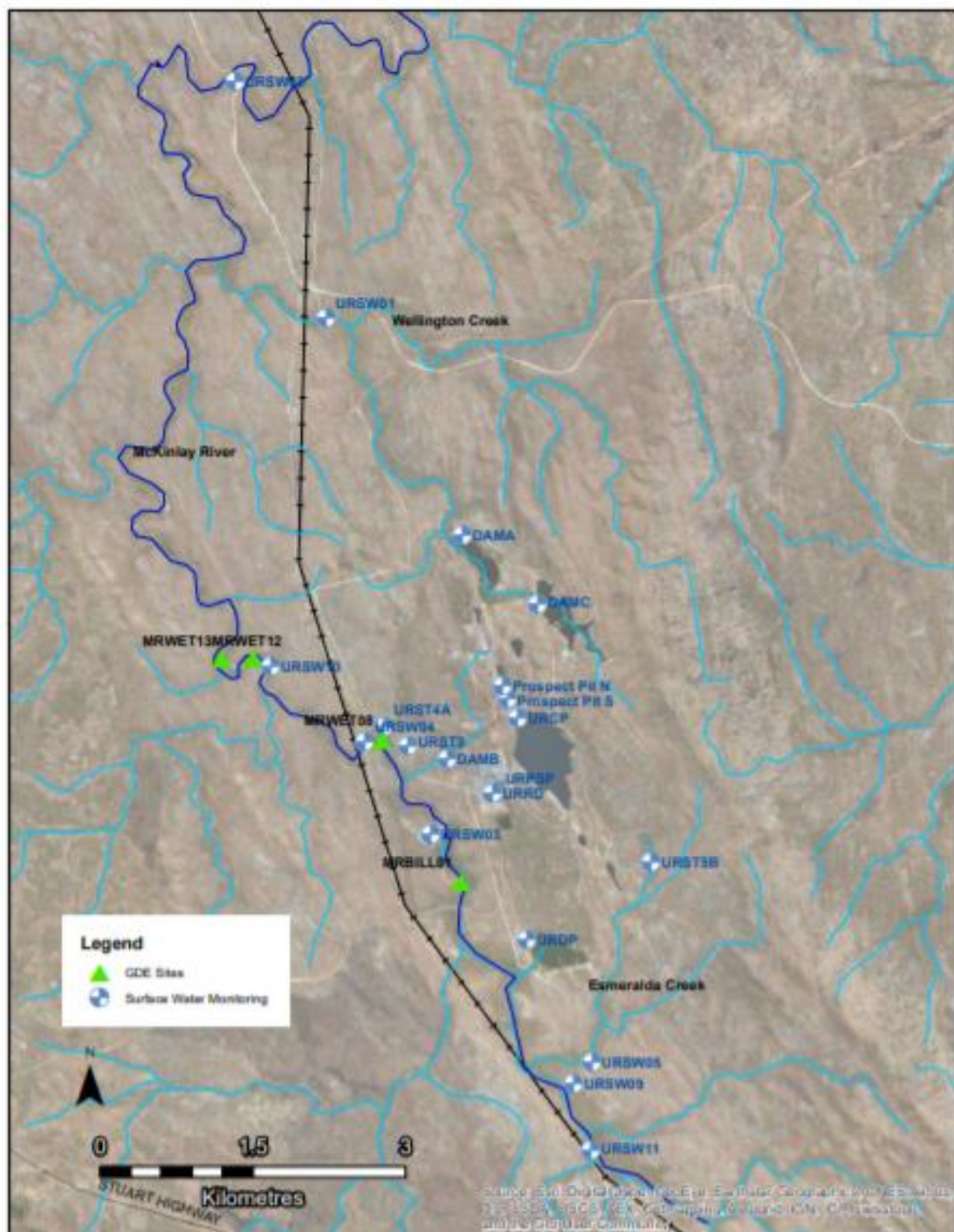


Figure 6: Location of identified permanent waterholes (“GDE sites”) in the Proposal area (source: Draft EIS)

5.5.4 NT EPA assessment

Contamination of aquatic habitat

The NT EPA’s requirement (in Recommendation 4) is to protect the environmental values of the McKinlay River downstream from the Proposal area from mine related impacts, including any impacts arising from hydrological connectivity with Crosscourse Pit. Managing activities to meet this environmental outcome is likely to satisfy the NT EPA’s environmental objective for aquatic ecosystems.

There is potential for the Proposal to contribute contaminants to the McKinlay River, including metals and sulfate, from controlled and uncontrolled discharges including

groundwater seepage. Elevated metal concentrations can be toxic to aquatic biota such as algae, macroinvertebrates, fish and riparian vegetation. Therefore the protection of aquatic ecosystems is dependent on the maintenance of good water quality, which is discussed in section 5.4.4.

The NT EPA considers that managing contaminant sources from controlled and uncontrolled surface and groundwater discharges to the McKinlay River or its tributaries will be critical in preventing impacts on aquatic ecosystems in the McKinlay River. The matters relating to water quality in Recommendation 4 are expected to provide sufficient protection for aquatic ecosystems from potential impacts arising from altered water quality.

Groundwater drawdown

As described in section 5.3, groundwater from the URPA contributes inflows to the McKinlay River, and these inflows will be reduced during operation of the underground mine due to groundwater drawdown. It is possible that these groundwater inflows contribute to maintaining permanent pools and riparian vegetation along the otherwise dry river during the dry season, which could be impacted by reduced water availability.

The NT EPA notes that the connection between groundwater and permanent pools has not been verified and the importance of groundwater inflow to permanent pools and riparian ecosystems is unclear. However, the Proponent has adopted a precautionary approach, considering all permanent pools, natural off-stream water bodies and riparian vegetation as being potentially dependent on groundwater. The NT EPA is supportive of this precautionary approach.

As noted in section 5.3.4, groundwater availability in the sections of the McKinlay River closest to the underground mine could decrease locally by a maximum of 12-17% during mining and in the following two years, returning to pre-proposal levels within ten years of the end of mining activities (Draft EIS Table 14-3). This would correspond to a temporary reduction for the potentially groundwater dependent ecosystems, including riparian vegetation, in these sections of the McKinlay River, which include three permanent pools (MRWET08, MRWET12 and MRWET13; Figure 9).

It will be important for the Proponent to monitor groundwater levels and groundwater quality to verify the groundwater model predictions and provide early warning of potential impacts. The Proponent has committed to the installation of 13 new monitoring bores to augment the mine's current monitoring bore network. Four new bores will be located in close proximity of identified potentially groundwater dependent ecosystems. These bores will enable the Proponent to investigate the potential connection between groundwater and permanent surface water pools. Further bores will be located down-gradient of the underground mine to allow detection of drawdown or migration of contaminant seepage.

The NT EPA considers that potential impacts of temporary (about 5 years) groundwater drawdown on the aquatic systems of the ephemeral McKinlay River are uncertain. They are not likely to result in the drying of permanent pools, but may lead to reduced water volume, especially towards the end of the dry season when evaporation is high. In years of low rainfall, this may impact on aquatic flora and fauna relying on the pools for refuge.

The NT EPA supports the Proponent's commitment to ongoing monitoring of groundwater levels and ecosystem condition to ensure adverse effects of the drawdown are detected and can be addressed with contingency measures. The Proponent has provided a framework for aquatic ecosystem monitoring and a commitment to the development of a comprehensive Aquatic Ecosystem Monitoring Program within the Water Management Plan (Supplement Appendix 11). The NT EPA addresses this in Recommendation 4.

The Proponent's suggested temporary contingency measures include providing a one-off flush discharge to the McKinlay River from existing mine water storages or targeted

irrigation of riparian vegetation. The NT EPA considers that any such supplementary flow would need to be approved by the relevant regulator/s and sources must be of appropriate quality, sufficient, and identified early.

Recommendation 4

- 1. That the Proposal is implemented to achieve the following environmental protection outcome:**
 - a. preserve and/or improve the health of the McKinlay River to maintain downstream environmental values**
- 2. To contribute to achieving the outcome at part 1 of this recommendation, the proponent is to apply the waste mitigation hierarchy (avoid, reduce, reuse, recycle, recover, treat and dispose of mine-affected water – in preferential order) to the generation and management of all mine-affected water, including implementation of:**
 - a. measures to separate mine-affected water from clean (or non-contaminated water)**
 - b. measures to maintain or improve water quality in water storages, mine-affected run-off and groundwater seepage**
 - c. a continual improvement process that includes identifying new opportunities for avoiding or minimising the volume of mine-affected water requiring discharge to the McKinlay River.**
- 3. That the Water Management Plan, prepared by the Proponent, is implemented to contribute to the outcome at 1a, and contains the following key elements as a minimum:**
 - a. a water management system for the site, including procedures and methods for:**
 - i. water storage, transfer, treatment, monitoring and discharge**
 - ii. tracking the movement of water within the Proposal area and the URPA**
 - iii. recording the time, rate and volume of controlled discharges to the surrounding environment**
 - b. measures to minimise, manage and prevent acid and/or metalliferous and/or saline drainage**
 - c. management of reject water from the proposed reverse osmosis plant, including predicted water quality of any receiving water body (e.g. Crosscourse Pit)**
 - d. that prior to commencement of mining and annually thereafter for the life of the proposal, the Water Management Plan is reviewed based on monitoring data and on the advice of a specialist expert and to the satisfaction of the relevant regulator and the revised Plan implemented accordingly.**
- 4. That an annual water report is prepared to report on:**
 - a. how the waste mitigation hierarchy (at part 2) has been applied**
 - b. results of the comprehensive monitoring at part 10 of this recommendation**
- 5. That the level of water in Crosscourse Pit is reduced and maintained below a threshold level, as soon as possible and throughout the life of the Proposal, where the threshold is determined from groundwater seepage monitoring data, to:**
 - a. prevent rapid groundwater seepage and surface water overflow**
 - b. retain sufficient freeboard for a 1 in 1000 annual exceedance probability, 72 hour flood event**
 - c. enable effective management of any discharge (in accordance with part 7 of this recommendation) required to achieve and maintain this level**

6. That treated water from storage in Dam B is transferred, for proposed authorised discharge in the McKinlay River, in such a manner that it is not released to the environment undiluted, including that:
 - a. treated water from Dam B will not be discharged to land and will remain ‘in pipe’, or other containment, until it reaches the authorised discharge point (end of pipe)
 - b. the discharge is directly into the water body on which the dilution algorithm is based
 - c. the authorised discharge point is identified based on water quality and flow data from the McKinlay River and designed to meet downstream water quality criteria in accordance with part 8 of this recommendation
 - d. the timing of water removal from Crosscourse Pit, treatment, and final discharge to the McKinlay River is determined in accordance with the capacity of Dam B and the dilution algorithm for discharge to the McKinlay River, which is to be based on:
 - i. baseline surface water stream flows in the McKinlay River
 - ii. appropriate dilution to achieve water quality targets specified in part 8 of this recommendation (below), taking into consideration any cumulative impacts from the URPA
 - iii. a predictive assessment of various discharge volumes under low, moderate and high background flow conditions
 - e. the water inventory in Dam B is managed to avoid overflow via the spillway.
7. That water quality in the McKinlay River is to meet 95% species protection level, in accordance with the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG, 2018) and in accordance with the following:
 - a. the compliance point for this is to be determined as part of the assessment of the Waste Discharge Licence, and be downstream of the proposed discharge point and upstream of potential influence from other mining activities in the area
 - b. the extent of the mixing zone (between the discharge point and the compliance point) must be calculated based on the minimum dilution capacity of the receiving waters and the stressors identified as having the greatest potential impact on the aquatic ecosystem, and must not exceed 5 km in length
 - c. the dilution algorithm for the discharge must be appropriate for all flow conditions, and account for dispersion within the mixing zone, to meet this water quality criteria at the compliance point
8. That load-based assessment is conducted to identify and quantify impacts to the receiving environment from the Proposal area, and their trends, to contribute to assessing performance against the outcome at 1a, including:
 - a. modelling, prior to implementation of the Proposal, of the annual loads of contaminants of potential concern to be discharged into the McKinlay River over the life of the Proposal
 - b. assessment, prior to implementation of the Proposal, of the sustainable assimilative capacity of the McKinlay River and the surrounding catchment
 - c. verification, over the life of the Proposal and based on monitoring data, of the observed loads of contaminants of potential concern entering the McKinlay River each year
 - d. assessment of the observed loads against the sustainable assimilative capacity of the McKinlay River as a measure of impacts to water quality
 - e. assessment of the effectiveness of source controls and contingency measures for reducing contaminant loads to meet the sustainable assimilative capacity of the McKinlay River

9. That a comprehensive monitoring program is implemented, prior to and during the life of the Proposal, including closure. The monitoring program is to identify and quantify impacts from Proposal activities and inform continuous improvement and effective application of source controls and contingency measures for achieving the outcome at 1a, and include:
- a. a process for program review and modification, subject to the satisfaction of the relevant regulator/s
 - b. a groundwater monitoring plan, subject to review and modification that includes:
 - i. groundwater quality monitoring to detect and measure any contaminated seepage from Crosscourse Pit and Prospect Pit
 - ii. predictive groundwater quality modelling including a contaminant transport model
 - iii. requirements for a post-mining groundwater assessment to inform the revised mine closure plan
 - iv. new monitoring bores established as proposed in the EIS
 - v. monitoring of groundwater levels, flows, and connectivity to account for seasonal variability and changes due to the Proposal and improve the predictive capacity of hydrogeological modelling and monitoring
 - vi. monitoring the extent and magnitude of groundwater drawdown and depressurisation from mine dewatering during operations, recovery and post closure and predicted impacts on other groundwater users and environmental and riparian values
 - vii. a network of monitoring bores to determine the hydraulic gradient, seepage and flow rates, within the Proposal area and between the Proposal area, the McKinlay River and the Pine Creek water supply borefield
 - viii. make-good/contingency actions if monitoring results indicate potential water availability impacts to either the McKinlay River or Pine Creek water supply borefield
 - c. a surface water monitoring plan that includes:
 - i. installation, operation and maintenance of stream flow gauging stations (co-located with water quality monitoring stations) to determine and record stream flows prior to and during proposed controlled releases
 - ii. monitoring at appropriate sites in the Proposal area; in receiving waters, to account for controlled and uncontrolled discharges; and at control sites unaffected by the Proposal and representative of background conditions
 - d. an aquatic ecosystems monitoring plan that:
 - i. provides for monitoring of the aquatic ecosystems and riparian vegetation of the McKinlay River
 - ii. Integrates with water quality, water flow and groundwater level monitoring
 - iii. establishes the degree of the hydraulic connection between groundwater and permanent pools (e.g. including monitoring of groundwater and surface water levels measured in m AHD and comparison of ionic composition of groundwater and surface water)
 - iv. enables analysis of observed impacts on flora and fauna and monitoring of indicators against possible causes from Proposal-related water quality or groundwater drawdown

- v. enables assessment of riparian condition based on annual monitoring events and baseline data
- vi. initiates monitoring of groundwater and surface water levels as early as possible prior to the commencement of mining
- vii. incorporates a new groundwater monitoring site at site URSW04, to pair with surface water monitoring and aquatic ecosystems monitoring (at pool MRWET08), which could replace the proposed groundwater monitoring site at MRBILL02
- viii. includes details on indicators for sediment sampling, habitat assessment, bioassessment, fish and other fauna surveys, and vegetation surveys

5.5.5 Conclusion against the NT EPA objective

With the implementation of relevant management plans and recommendations identified in this Report, the NT EPA considers that the Proposal could be conducted in such a manner that its objective for aquatic ecosystems is likely to be met.

6 Matters of national environmental significance

A delegate of the (former) Australian Government Minister for the Environment has determined that the proposal is a controlled action under the EPBC Act and required assessment and approval before proceeding. The decision was based on potential for significant impacts on listed threatened species and communities (sections 18 and 18A), specifically the ghost bat (*Macroderma gigas*).

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.

The information used in this assessment was provided by the Proponent in the EIS and/or provided by NT and Australian government advisory agencies. This assessment has included consideration of the following documents²:

- Conservation Advice *Macroderma gigas* ghost bat (TSSC, 2016)
- Environmental Management Plan Guidelines (DOE, 2014)
- EPBC Act Environmental Offsets Policy (DSEWPaC, 2012).

There are no Australian Government or Northern Territory survey guidelines for detecting the ghost bat. DENR's Flora and Fauna Division advised that the survey methods used by the Proponent for detecting this species are timed appropriately and undertaken for a suitable period by qualified people.

The Proponent considered three feasible alternatives for the Proposal. These alternatives include two locations for the underground mine portal (in Lady Alice Pit or through box cut operation adjacent to Prospect Pit) and maintaining a 130 m underground buffer from the roost sites in Prospect Pit. The alternatives were found by

² The following plan, referenced by (TSSC, 2016), was not considered due to the absence of this threat in northern NT: Threat abatement plan for predation by the European red fox (DEWHA, 2008)

the proponent to be largely prohibitive from an economic perspective and not considered sustainable for the Proposal. Detail is provided in the EIS (Draft EIS section 4.11 and Supplement section 3.15). The NT EPA is satisfied that the Proponent has adequately addressed the likely impact of all feasible alternatives.

The nature and extent of likely impacts of the Proposal on the ghost bat have been assessed in sections 5.2 and 7.1.2. The Proposal has been assessed against the Principles of Ecologically Sustainable Development in Appendix 2.

The NT EPA has made recommendations for the mitigation and management of potentially significant impacts to the Union Reefs ghost bat colony and the Pine Creek regional population. The NT EPA considers that there is potential for residual impact on the ghost bat as a result of implementation of the Proposal, even with the implementation of the Proponent's Ghost Bat Action and Management plans and all recommendations identified in this Report.

To compensate for the potentially significant residual impacts to ghost bats, the Proponent has committed to provide offsets. The NT EPA agrees that the Proposal may result in a significant residual impact to the Union Reefs colony and that offsets are therefore appropriate. Noting that the ability to apply offsets is available under the EPBC Act, the NT EPA considers it is appropriate that offsets directly contribute to the conservation security of the species and that offsets meet the requirements of the Australian Government's Offset Policy. The NT EPA acknowledges that the Offset Policy allows for indirect offsets, such as the proposed applied and academic research program, where they are likely to have a greater conservation gain. The NT EPA makes Recommendation 5 in this regard.

Recommendation 5

That approvals for the Proposal require that the Proponent's Offset Package or Offset Management Plan, if required by the Australian Government with respect to the significant residual impact to the ghost bat (*Macroderma gigas*), is to the satisfaction of the Flora and Fauna Division of the Department of Environment and Natural Resources.

7 Whole of environment considerations

7.1 Closure and rehabilitation

7.1.1 Mine closure planning

The Proponent provided a Draft Mine Closure Plan (Draft MCP) outlining closure completion criteria for the underground mine and the haul road, which are the primary components of the Proposal. Details on the closure of the URPA, including the secondary components of the Proposal, that would continue to operate after the life of the Proposal, are contained in an MCP (2015) for the URPA, which was not included in the EIS.

The Draft MCP nominated post-mining land use as natural habitat compatible with pastoral use and outlines broad closure objectives and completion criteria for the underground mine and haul road domains.

The Proponent's key closure objective for the Proposal area is long term public safety, to be achieved by inhibiting public access to the underground workings through construction of an abandonment bund, and sealing portals and ventilation shafts. The Proponent's other closure objectives include: creating ghost bat roosts to maintain habitat stability; recovery of groundwater levels to pre-mining levels with down-gradient groundwater monitoring to detect contaminated seepage; and removal of all surface infrastructure associated with the underground mine. In the short term, the Proposal area

would form part of the broader URPA and is likely to be closed in conjunction with other Proposal area domains.

The NT EPA has a broader view of the closure objectives, which should include viability of the regional ghost bat population, a site that is safe to humans and animals and able to sustain an agreed post-mining land use, that should not contribute significantly to invasive pests or fire risk in surrounding areas, and presents no long term, significant environment, social or economic impacts or costs for the local community or the taxpayer at the end of the Proposal's economic life.

The closure of secondary components of the Proposal is discussed in the EIS; however, completion criteria have not been provided as these components would continue to operate beyond the life of the Proposal and would be subject to closure requirements for the URPA. The NT EPA accepts that the URPA is likely to support authorised mining, processing and associated activities into the future that are outside the scope of the Proposal but that affect or are affected by closure of the Proposal.

The Proponent has committed to an integrated MCP for the URPA to meet new guideline requirements (DMP & EPA, 2015) and to capture aspects relating specifically to the secondary components of the Proposal. The NT EPA considers that the level of detail contained within the integrated MCP for primary components, and secondary components that form part of the Proposal, should be commensurate with the timing of component/domain closure. Features that are not required for continued mining activities in the URPA should be progressively rehabilitated. The closure strategy in the integrated MCP for these features must be very specific and well-advanced prior to providing this MCP to the relevant regulator for approval. The NT EPA suggests the Proponent refer to the closure principles within the International Council on Mining and Metals guidance (ICMM, 2019) and other leading edge guidance when preparing the integrated MCP. The NT EPA makes Recommendation 6 relating to the MCP.

Recommendation 6

- 1. That closure of the Proposal is implemented to achieve the environmental protection outcomes specified in recommendations 3 and 4.**
- 2. That mine closure planning is implemented such that it contributes to the outcomes at part 1 of this recommendation, and addresses the following prior to the commencement of mining:**
 - a. be developed according to leading edge practice guidance and an appreciation of the principles of the International Council of Mining and Metals (ICMM 2019), unless more stringent guidance has been provided on specific matters by the NT EPA, which should take precedence**
 - b. be informed by refined and updated geochemical, hydrogeological and water quality modelling**
 - c. demonstrates that post-closure, Proposal areas would be safe to humans and animals, geotechnically stable, non-polluting and non-contaminating, and capable of sustaining the agreed post-mining land use**
 - d. provides for ongoing monitoring and maintenance of the Proposal areas and the receiving environment after closure and relinquishment of the Proposal**
 - e. provides for ongoing monitoring and management for all roost sites and roost habitats of the regional population of ghost bats, that the Proponent has committed to monitor**
- 3. That the Mine Closure Plan, as updated from time to time, must be made publicly available on a timely basis on the websites of the Proponent, the Operator and the relevant regulator.**

7.1.2 Ghost bat habitat

A closure objective of the Proposal is to convert a portion of the underground mine to create a new ghost bat roost to maintain habitat stability. This commitment is outlined by Action 8 in the Ghost Bat Action and Management plans (the Plans). The Proponent will be managing the Proposal to minimise impacts to the local ghost bat colony and the regional population, as discussed in section 5.2.4. The Proponent must ensure that it fulfils all commitments outlined in the Plans to monitor and manage the Union Reefs colony and their habitat, both newly established and pre-existing, as part of closure of the Proposal. The MCP should include provisions for ongoing monitoring and management of ghost bat habitat during and following closure of the Proposal in accordance with Recommendation 6.

7.1.3 Pit closure

Following closure of the Proposal, Prospect Pit would be allowed to fill with water to the groundwater equilibrium level, recharged by groundwater ingress and surface runoff. Equilibrium is anticipated to be reached within six years after mining in North Underground ceases. Prospect Pit equilibrium water level is expected to fluctuate between 170 to 180 m AHD subject to variability in wet season rainfall, based on historical trends. The Prospect Pit overflow level is 193 m AHD, providing 15 m freeboard, which is considered adequate to avoid surface discharge in a 1 in 100 year rainfall event without pumping.

An updated geochemical characterisation report and a predictive water quality modelling report were provided in the EIS (Supplement Appendix 12 and Appendix 15 respectively). These reports predict an overall low risk of AMD from the Proposal.

Rebounding of groundwater levels in Prospect Pit will largely cover the main potential sources of AMD (waste rock and to a lesser extent the pit walls) and prevent further oxidation. Water quality will be impacted by any oxidation products that are already present as the pit fills. Historic monitoring of Prospect Pit water indicates relatively good quality water, and the Proponent expects this to represent the long term water quality at equilibrium after closure. Further geochemical, hydrogeological and water quality modelling is required to confirm this (in accordance with Recommendation 4 and discussed below).

Crosscourse Pit at closure is expected to contain water of poor quality, similar to that observed in the historical monitoring record. However, the continual addition of tailings and, potentially, reject water from the proposed RO plant may exacerbate water quality issues as the pit continues to be used for processing waste for the Proposal and beyond.

The EIS indicates that the Proposal would contribute a small percentage (<2%) of the current volume of tailings in the pit, with the tailings surface at completion of the Proposal remaining well below the steady-state level of the pit lake (assumed boundary between being a net groundwater sink and net source at about 173 m AHD) and a water cover maintained over the tailings to prevent oxidation.

Currently, the Proponent does not regard Crosscourse Pit as a significant source of contaminants to the river, arguing that the contaminant characteristics in water at the McKinlay River compliance point do not match those in the pit water. However, as discussed in section 5.4.4, water quality modelling for the Proposal predicts that with increased water levels in the pit above the assumed steady-state level, pit water is likely to report to the river through groundwater expression, with maximum outflow of 13 L/s occurring if the pit level reaches 188 m AHD. Beyond the Proposal life, the Proponent must be certain that continued deposition of tailings and process water in Crosscourse Pit will not result in contamination of the McKinlay River into the long term, in accordance with Recommendation 4.

The key uncertainties that affect the predictions for Crosscourse Pit include:

- the nature of hydraulic connections with other dams and pits within the existing site and the McKinlay River
- the capacity of groundwater aquifers to attenuate pit water contaminants before expression to surface waterways
- the properties of deposited tailings, and the chemistry of tailings pore water and supernatant
- the effect on pit water quality and groundwater aquifers if Crosscourse Pit continues to be used as a tailings storage facility and to store RO reject water beyond the life of the Proposal.

There are also significant uncertainties in the water quality modelling used to predict the effects of the Proposal on Crosscourse Pit water quality. The model has not been calibrated against empirical values on site and hence there is uncertainty associated with some of the inputs. While the model uses a mass balance approach and the Proponent considers it conservative, further refinement of the modelling is required with inputs from underground mine block modelling, geochemical testing and modelling, mine water quality analysis, and seepage analysis such as kinetic leach testing.

Proposed management of Crosscourse Pit during Proposal operation entails the removal, treatment and active discharge of water into the McKinlay River (see section 5.4.4), to prevent water levels in the pit rising above 173 m AHD. The NT EPA is of the view that continuation of discharge after closure of the mine site is not a sustainable option into the long term and is a significant ongoing liability risk. The EIS indicates that capping is the most likely mitigation and management approach with both “hardpan” and conventional backfill capping methodologies being considered.

Ongoing tailings deposition, dewatering, backfilling and capping of the Crosscourse Pit are major uncertainties for closure of the URPA. The Proponent has committed to conducting a LOM tailings study which would include:

- determining the proposed maximum tailings and water levels over time
- closure and capping designs
- seepage assessments.

The LOM tailings study would provide input to the integrated MCP for the URPA. It is unclear whether data from the tailings study would be available to inform decisions relating to management of the Proposal, including whether tailings should be deposited in Crosscourse Pit. However, given the Proposal’s relatively small contribution of tailings to Crosscourse Pit in relation to the pit’s steady-state water level (with managed discharge) and the remaining freeboard to the overflow level, the potential impacts to surface water and the groundwater aquifer (and the McKinlay River) from the pit are considered manageable.

The operational phase of the Proposal will be an opportunity to conduct the LOM tailings study and determine the most effective closure strategy and cover type for Crosscourse Pit and other landforms on the URPA. The strategies adopted for closure of the primary and secondary components of the Proposal should meet the Proponent’s closure objectives and the NT EPA’s environmental protection outcome for protecting the environmental values of the McKinlay River downstream of the Proposal area from mine related impacts at all times. There must be no unacceptable long term impacts and costs for the local community or the taxpayer at the end of the mine’s economic life, as determined through consultation with the local community and the relevant regulator.

The NT EPA makes Recommendation 7 for studies to inform closure planning.

Recommendation 7

That closure planning for the Proposal, and as it integrates with closure planning for the URPA, enables future closure of Crosscourse Pit such that, within ten years of its closure as a tailings storage facility, it becomes a stable and non-polluting landform, requiring no active water management into the long term. This is to be informed by completion of the following prior to closure of the Proposal:

1. a Life of Mine tailings study
2. a whole of mine capping design
3. a groundwater assessment, including seepage assessment, for tailings and waste rock, and the North Underground mine.

8 Conclusion

The NT EPA has considered the Proposal by Northern Territory Mining Operations Pty Ltd to develop the Union Reefs North Underground Mine. The Proposal is for a 2-3 year LOM encompassed within an authorised mine site. The NT EPA's assessment of the Proposal identified potentially significant environmental impacts and risks associated with the environmental factors of Terrestrial flora and fauna, Inland water environmental quality, Hydrological processes and Aquatic ecosystems.

The NT EPA considers that, subject to the implementation of the 7 recommendations in this Assessment Report and the commitments and safeguards listed by the Proponent in the EIS, the Proposal can be implemented and managed in a manner that is likely to meet the NT EPA's objectives and avoid significant or unacceptable environmental impacts and risks.

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Appendix 1– Assessment of the NT EPA’s environmental factors

The NT EPA assessed the environmental impact of the Proposal in line with its environmental factors and objectives (NT EPA, 2018). The following table presents environmental factors for the Proposal which, based on current knowledge, were assessed as not significant. The NT EPA considers it unlikely that implementation of the Proposal would have a significant impact on these factors and they can be managed to meet the NT EPA’s environmental objectives.

Environmental factor	Assessment of the potential impacts on the environmental factor	Explanation of why the factor is not a key environmental factor
LAND		
Terrestrial Environmental Quality Objective: Maintain the quality of land and soils so that environmental values are protected.	There is potential for erosion and sediment deposition in and downstream from the URPA to potential instability of landforms (existing and new). The Proposal could increase or decrease the potential for significant impacts to downstream values.	The Proposal is within the URPA. Erosion on site is similar to that which occurs in the surrounding environment and the Proponent will continue to operate the existing site in accordance with its approved Mine Management Plan. The NT EPA considers that if the proposed management measures are implemented and the key environmental factors are addressed, the Proposal is unlikely to have a significant impact on terrestrial environmental quality.
Landforms Objective: Conserve the variety and integrity of distinctive physical landforms so that environmental values are protected.	No visible landforms will be constructed or modified.	Following the cessation of mining in 2003, much of the site was rehabilitated / revegetated, including the WRDs and TSFs. All waste rock will remain contained within Prospect Pit or returned underground. The portal to access the underground mine is located within the existing Prospect Pit. Following closure the void will be left to refill with water, returning the pit to pre-mining pit lake conditions. All surface infrastructure associated with the underground mine will be decommissioned, removed and the areas rehabilitated. The Proponent has provided a commitment that rehabilitation will achieve a stable and functioning landform, consistent with the surrounding landscape.
SEA		
The Proposal does not occur near or within coastal waters and/or estuaries of the Northern Territory.		

AIR		
Air quality and greenhouse gases Objective: Maintain air quality and minimise emissions and their impact so that environmental values are protected.	Air quality may be reduced by dust generated through clearing of vegetation, mining activities and vehicle transportation, leading to impacts on sensitive receptors. Greenhouse gas emissions can occur from land clearing, combustion of diesel for onsite power generation and operation of mining equipment and vehicles through implementation of the Proposal.	The nearest sensitive receptors are the dwellings associated with Esmerelda Farm (about 5 km east from the underground mine). The nearest community is Pine Creek (20 km south-west). Dust from the Proposal is unlikely to impact sensitive receptors. Dust generation would be limited by the placement of tailings sub-aqueously in Crosscourse Pit and watering unsealed tracks and open areas. Given the location, small scale, underground nature and dust management measures, cumulative dust impacts are not anticipated to be significant. The Proposal would source power from the existing mains 66 kV power supply via additional internal power infrastructure, increasing capacity from 9 MW to 12 MW. Monthly power usage is estimated to be about 750 to 1000 MWh. A standard vehicle and machinery fleet would operate to support the transport of personnel and to undertake mining operations. Diesel fuel consumption is estimated to be about 50 000 L per month. All plant and equipment will be regularly inspected and maintained to minimise exhaust emissions. The NT EPA calculated that the total estimate greenhouse gas emissions from the Proposal (9639 t CO₂-e.) equates to 0.06% of the total emissions produced in the NT in 2017 (DISER, 2017) and is unlikely to be significant from a national perspective.
PEOPLE AND COMMUNITIES		
Social, economic and cultural surroundings Objective: Protect the rich social, economic, cultural and heritage values of the Northern Territory.	There is potential for changes to the social, economic and cultural surroundings of Pine Creek region through implementation of the Proposal.	Mining plays a strong social and economic role in the region. In the EIS the Proponent identified the Proposal would provide about 80 new jobs during operations with a focus on training and employing locally. The region has a history of change depending on the commencement and cessation of mining interests by various operators. Cultural heritage sites across the URPA are well documented and maintained. The location of cultural heritage sites has been considered during project planning and clearing confined to previously cleared areas. The McKinlay River is less than 1 km from the Proposal, flowing during the wet season northwards to the Mary River. The Mary River is known as one of the most important recreational fishing sites in the Northern Territory (PWCNT, 2015), attracting local and visiting fishers year round. The NT EPA considers that if the McKinlay River is protected in accordance with recommendations made in this Report, there should be no flow-on impacts to the Mary River.

		Overall, the NT EPA considers that if the proposed management measures are implemented and the key environmental factors are addressed, the Proposal is unlikely to have a significant impact on social, economic and cultural surroundings.
Human health Objective: Ensure that the risks to human health are identified, understood and adequately avoided and/or mitigated.	The Proposal is within an existing mine site with no public access. The potential for impacts on human health is limited to underground mine workers.	The Proponent has experience with managing occupational health and safety risks at the nearby Cosmo Underground Mine. Further to this experience, the Proponent has identified potential impacts on occupational health and safety of workers in its Risk Management Plan, submitted to NT WorkSafe, the regulator, under the <i>Work Health and Safety (National Uniform Legislation) Act 2011</i> . The NT EPA considers that if the proposed management measures are implemented, the Proposal is unlikely to have a significant impact on human health.

Appendix 2 – Principles of Ecologically Sustainable Development

Under the *Northern Territory Environment Protection Authority Act 2012*, ecologically sustainable development (ESD) means using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quantity of life now and in the future can be increased.

In December 1992, the NT Government endorsed the 'National Strategy for Ecologically Sustainable Development' and agreed, along with all other States and Territories, to the 'Intergovernmental Agreement on the Environment' (IGAE) (DoEE, 1992).

The NT EPA uses the four principles contained in the IGAE to demonstrate that it has considered ESD in its assessment of the Proposal and in its fulfilment of its objectives under the NT EPA Act 2012.

ESD Guiding principle	NT EPA assessment
The precautionary principle <i>Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.</i> <i>In application of this precautionary principle, decisions should be guided by:</i> a) <i>careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and</i> b) <i>an assessment of the risk-weighted consequences of various options.</i>	In considering this principle, the NT EPA notes that terrestrial environmental quality, hydrological processes, inland water environmental quality and aquatic ecosystems could be significantly impacted by the Proposal. The assessment of these impacts is provided in this Report. The NT EPA notes that the Proponent has identified measures to avoid or minimise significant impacts. The EPA has considered these measures during its assessment. The Proponent's investigations, and proposed characterisation and/or monitoring programs for all Proposal phases, leave some residual uncertainty relating to the environmental outcomes of the Proposal. This includes uncertainty about the residual impacts to the ghost bat. The NT EPA has made recommendations for addressing these uncertainties and for further work to determine closure options for the URPA that would avoid ongoing and future significant risks to the environment. From its assessment of the Proposal, the NT EPA concludes that if its recommendations are implemented and managed as approval conditions of the Proposal, significant or unacceptable environmental impacts and risks are likely to be avoided.
The principle of intergenerational equity <i>The present generation should ensure that the health, diversity and productivity of the environment is maintained and enhanced for the benefit of future generations.</i>	The NT EPA notes that the Proponent has taken measures to avoid and minimise impacts of the Proposal on the environment. Additionally, the NT EPA has made recommendations to manage impacts to the key environmental factors identified during the course of this assessment. In particular, the NT EPA has recommended environmental protection outcomes for primary management considerations. These include protection of the ghost bat in the region, and protection of the McKinlay River at all-times from mine related impacts, including impacts arising from Crosscourse Pit.

ESD Guiding principle	NT EPA assessment
	From its assessment of this Proposal, the NT EPA has concluded that provided its recommendations are imposed as conditions on the implementation of the Proposal, environmental values will be protected and that the health, diversity and productivity of the environment will be maintained for the benefit of future generations.
The principle of the conservation of biological diversity and ecological integrity <i>Conservation of biological diversity and ecological integrity should be a fundamental consideration.</i>	In considering this principle, the NT EPA notes that the Proposal will result in impacts and risks to four key environmental factors that relate to the conservation of biological diversity and ecological integrity. The Proposal has the potential to significantly impact terrestrial fauna through impacts to the local ghost bat colony (about 50 individuals) through noise and vibration and loss of local roosting habitat. There is uncertainty as to whether the loss of this colony and/or its roost sites have larger flow-on impacts on the viability of nearby stronghold colonies and the regional population. The Proponent has proposed substantial mitigation measures to protect this species. As the outcomes of these mitigation measures are uncertain, the Proponent has also proposed offsets, including research that would inform future conservation of the species, for the case that it is determined that the Proposal would have a significant residual impact on ghost bats. The Proposal also has the potential to significantly impact all three of its environmental objectives relating to water, which could affect the ecological integrity of aquatic ecosystems. The NT EPA has made recommendations for achieving an environmental protection outcome for the health of the McKinlay River downstream of the Proposal area. With the implementation of relevant management plans and recommendations identified above, the NT EPA considers that the Proposal could be conducted in such a manner that its objective for the key environmental factors is likely to be met.
Principles relating to improved valuation, pricing and incentive mechanisms a) <i>environmental factors should be included in the valuation of assets and services.</i> b) <i>the polluter pays principles – those who generate pollution and waste should bear the cost of containment, avoidance and abatement.</i>	In considering this principle, the NT EPA acknowledges that the Proponent would take responsibility for preventing, managing and mitigating any adverse environmental impacts during all stages of the Proposal. The NT EPA notes that this responsibility includes: (a) valuing the Proposal's water resources (b) accounting for the costs of residual risks associated with ghost bat habitat and the Proposals final landforms (WRDs, TSF and pit lakes)

ESD Guiding principle	NT EPA assessment
c) <i>the users of goods and services should pay prices based on the full life-cycle costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste.</i> d) <i>environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structure, including market mechanisms, which enable those best placed to maximise benefits and/or minimize costs to develop their own solution and responses to environmental problems.</i>	(c) preventing, managing and mitigating waste and pollution, including contamination of soils, groundwater and surface waters through accidental spills, uncontrolled discharges and tailings seepage (d) ensuring rehabilitation and closure are consistent with agreed outcomes and public scrutiny (reporting) without ongoing unacceptable liability and cost to the NT.