



7 Risk assessment and management



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Cover photograph: Tailings Storage Facility (March 2019)

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GLOSSARY

Below are key terms that are used in this section.

Key term	Definition
As Low As Reasonably Achievable	Abbreviated to ALARA. As low as reasonably achievable, economic and social factors being taken into account.
Risk	The chance of something happening that will have an impact on objectives NOTE 1: A risk is often specified in terms of an event or circumstance and the consequences that may flow from it. NOTE 2: Risk is measured in terms of a combination of the consequences of an event and their likelihood NOTE 3: Risk can be a threat or an opportunity
Risk Analysis	Systematic process to understand the nature of and to deduce the level of risk NOTE 1: Provides the basis for risk evaluation and decisions about risk treatment.
Risk Assessment	The overall process of Risk Identification, Risk Analysis and Risk Evaluation and shall be retained in accordance with procedure.
Risk Control	The process of elimination or minimisation of risks.
Risk Evaluation	The process used to determine risk management priorities by comparing the level of risk against predetermined standards, target risk levels or other criteria
Risk Management Process	The systematic application of management policies, procedures and practices to the tasks of establishing the context, identifying, analysing, assessing, controlling and monitoring risk
Risk Priority Class	One of four categories where a hazard can be located on the ERA Ranger Risk Matrix – from CRITICAL to HIGH to MODERATE to LOW
Risk Ranking	The level of risk allocated to a non-conformance if a corrective or preventative action is not carried out. The 5 x 5 Consequence/Probability model.
Risk Register	A register of risk information and controls kept at ERA, categorized into functional areas



ABBREVIATIONS & ACRONYMS

Below are abbreviations and acronyms that are used in this section.

Abbreviation/ Acronym	Description
1G project	1 Gigalitre project
AAPA	Aboriginal Areas Protection Authority
ALARA	As Low As Reasonably Achievable
ARR	Alligator Rivers Region
ARRAC	Alligator Rivers Region Advisory Committee
ARRTC	Alligator Rivers Region Technical Committee
ASS	Acid Sulfate Soils
BC	Brine Concentrator
BMM	Bulk Material Movement
CCTV	Closed Circuit Television
CIP	Closure Implementation Plan
CLM	Contaminated Land Management
CPT	Cone Penetration Testing
DEM	Digital Elevation Model
EOI	Expression of Interest
ER	Environmental Requirements
ERA	Energy Resources of Australia Ltd
ERISS	Environmental Research Institute of the Supervising Scientist
FIFO	Fly In Fly Out
FS	Feasibility Study
GAC	Gundjeihmi Aboriginal Corporation
GIS	Geographic Information System
HDS	High Density Sludge
H&S	Health and Safety
HSE	Health, Safety and Environment
HSEC	Health, Safety, Environment and Communities
ITWC	Interim Tailings, Water and Closure
KNPS	Kakadu Native Plants
LAA	Land Application Area

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Abbreviation/ Acronym	Description
LEM	Landform Evolution Model
MBL	Mine Bore L
MCP	Mine Closure Plan
MOL	Maximum Operating Level
MTC	Minesite Technical Committee
NP	National Park
OBS	Osmoflow Brine Squeezer
OHS	Occupational Health and Safety
OMM	Operations Maintenance Manual
OPSIM	Operation Simulation Modelling
P50, P70, P90	50th percentile, 70th percentile, 90th percentile
PCBs	Polychlorinated Biphenyl
PFS	Prefeasibility Study
QA	Quality Assessment
RBS	Risk Breakdown Structure
RCCF	Ranger Closure Consultative Forum
RP2	Retention Pond 2 – also denotes other retention ponds used on site – e.g. RP1, RP3, RP6
RPA	Ranger Project Area
RSA Archer	Risk Management Tool
RSO	Radiation Safety Officer
TARP	Trigger Action Response Plan
SIA	Social Impact Statement
SSB	Supervising Scientist Branch
TDS	Total Dissolved Solids
TO	Traditional Owner
TSF	Tailings Storage Facility
TSS	Total Suspended Solids
UNSCEAR	United Nations Scientific Committee on the Effects of Atomic Radiation



7 RISK ASSESSMENT AND MANAGEMENT

Risk assessment and management is a central element of the Energy Resources of Australia Ltd (ERA) business framework and is undertaken in accordance with the internal Hazard Identification and Risk Management Standard (ERA 2018) and ERA Closure Risk Management Plan (CDM.03-0000-MR-PLN-00001). The Ranger Mine Closure Risk Management Plan applies a holistic suite of risk management techniques across all risk areas including strategic, technical, commercial, safety and environmental and establishes a framework for:

- Risk identification,
- Risk evaluation, and
- Risk treatment (actions).

The objectives of risk management are to improve execution and reduce risk exposure. To achieve these objectives, ERA has implemented a transparent, proactive, structured and consistent process that provides a clear indication of the most significant risks and mitigating actions.

ERA also engages in a consultative process with key stakeholders to ensure there is transparency and that due consideration is given to the identification of closure threats and control measures. Successful management of risks requires the implementation of a clear risk management strategy supported by adequate resources and a strong risk-aware culture. The Ranger Mine closure risk management strategy emphasises the development of purpose-specific, risk-based plans at various stages within the major project delivery functions, all within the context of a risk-based project plan that is integrated with and supported by the Health and Safety Quality and Environmental systems. This involves maintaining an up to date risk register that is regularly consulted and reviewed.

To support risk management during closure execution, specific risk management accountabilities and responsibilities are assigned to relevant project and support personnel. Additionally, the closure management team is responsible for ensuring that the management plans are implemented and resources are made available when required.

Since 2008, ERA has held regular risk assessment workshops to identify key risks relating to the closure of the Ranger Mine. A workshop was held in August 2016 to identify specific closure environmental risks in relation to Best Practicable Technology assessments. This was followed by a number of assessments undertaken as part of the Ranger closure feasibility study during 2018, with the outcomes presented in the 2018 Mine Closure Plan. In 2019, following the completion of another closure risk review and release of the 2018 Mine Closure Plan, the risk register was updated to incorporate the comments received from stakeholders. The closure risk register continues to be regularly reviewed and updated.

An overview of the risk management standards and requirements is included in Section 7.1. The following sections describe the key standards and requirements, outcomes of previous risk based assessments relevant to closure, the risk assessment process and the outcomes of the 2020 risk review. The updated closure risk assessment is provided in Appendix 7.1.



7.1 Standards and requirements

ERA developed the Hazard Identification and Risk Management Standard (ERA 2018) to ensure that all hazards, aspects and opportunities for a particular project are identified and all impacts to the business, people, property, assets and the environment are assessed, with strategies developed to manage these risks. This standard is integrated within element three of the ERA Health, Safety and Environmental Management System, which has been certified to meet the requirements of the AS/NZ ISO14001:2015 and ²AS4801 national standards. The basic AS/NZS ISO 31000 process as detailed in Figure 7-1 below will be the procedural framework for management of risks on the Ranger Closure.

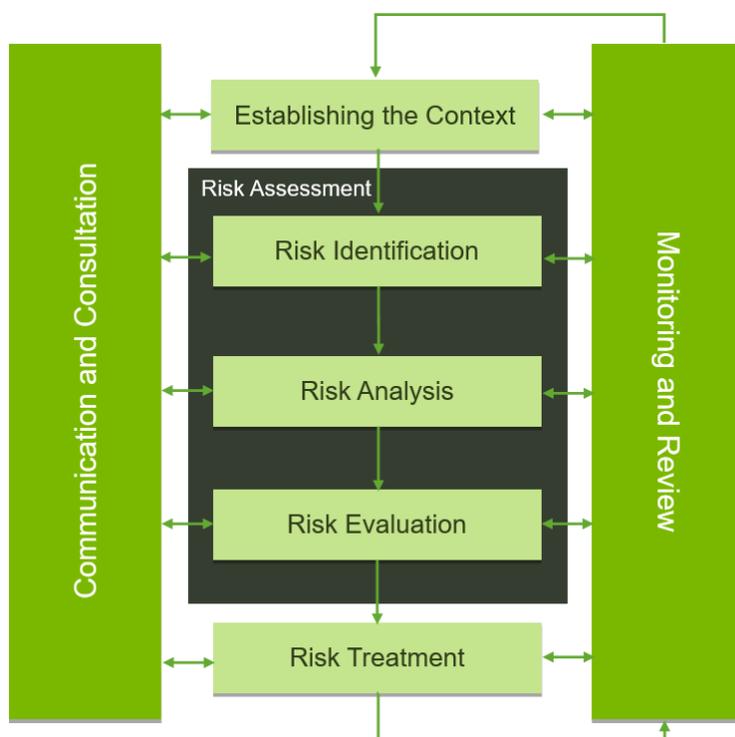


Figure 7-1: - ISO 31000 Risk Management Process

The risk identification and assessment process generates a comprehensive list of risks (threats and opportunities) that have the potential to prevent, degrade, delay or enhance the Project goals and objectives.

Potential events are clearly defined to identify the nature, likelihood, magnitude and severity of impacts.

² AS4801 has been superseded by ISO 45001. ERA will move to ISO 45001 in 2021

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Each event will be analysed to identify plausible causes and establish causal pathways. Causes and hazards associated with the risk are assessed singularly and cumulatively. Preventative and mitigating controls are identified directly related to the causal pathways and the application of the Hierarchy of Controls considered for each control identified. This management process is consistent with the following national and corporate management standards:

- AS/NZS ISO 14001 Environmental management systems – specification with guidance for use
- AS4801² Occupational health and safety (OHS) management systems – specification with guidance for use
- AS ISO 31000:2018 Risk Management– Principles and guidelines
- Environmental risk management – Principles and processes (HB 203:2012)
- Rio Tinto Risk policy and standard
- Rio Tinto Health, Safety and Environment (HSE) management system – Element 3 hazard identification and risk assessment
- Rio Tinto HSE performance standards.

In addition, ERA is required to comply with the Commonwealth Environmental Requirements (ERs), set out in the Ranger Authorisation 0108-18, to minimise risk through the implementation of effective controls that enable:

- the protection of attributes for which the Kakadu National Park (NP) was inscribed on the World Heritage list
- protection of ecosystem health of wetlands listed under Ramsar Convention on Wetlands
- protection of health of the members of the regional community, and
- maintenance of the nature and biological diversity of aquatic and terrestrial ecosystems of the Alligator Rivers Region, including ecological processes.

7.2 Previous closure risk assessments

ERA has used the risk assessment process to identify all potential environmental closure risks through several risk assessments completed to date.

The outcome of past and recent risk assessments and modelling studies (solute transport, tailings consolidation etc.) inform the assessment, along with sources, pathways and receptors as discussed previously with stakeholders (Bartolo et al. 2013).



A review of the respective risk assessments was completed in 2019 with an objective of incorporating relevant risks from these earlier registers into an updated register to reflect the current status of the Ranger Mine closure strategy. The following risk assessments were reviewed:

- Pit 1 Interim Tailings, Water and Closure (ITWC) Prefeasibility study (PFS) risk register, 2008: The purpose of this risk analysis was to identify and evaluate threats and opportunities associated with the options considered for Pit 1 closure to PFS level. The output of this risk analysis helped determine the appropriate closure method to be advanced to feasibility level.
- ITWC PFS risk register, 2011: The purpose of this risk analysis was to identify and evaluate threats and opportunities associated with all aspects of closure across a 14-year schedule (2012 to 2026) and 10,000-year tailings containment period.
- Tailings transfer risk register, 2012: The purpose of this risk analysis was to identify and evaluate threats and opportunities associated with elements of the tailings transfer process from the TSF to Pit 3, including dredging, Pit 3 pumping system, power requirements and procurement.
- PFS brine injection prefeasibility operational risk register, 2012: The purpose of this risk analysis was to identify and evaluate the risks associated with the brine injection aspect of the Ranger Mine closure project.
- Feasibility study (FS) tailings and brine management closure risk register, 2013: The purpose of this risk analysis was to identify and evaluate the risks associated with the tailings and brine management aspect of the Ranger Mine closure project. Elements assessed during this risk assessment included brine injection, tailings transfer and implications for both Pit 3 and the tailings dam during the activity, dredging, Pit 3 pumping system and operational readiness.
- Ranger Mine Pit 1 closure risk environmental register, 2016: The purpose of this risk analysis was to identify and evaluate the consequences and significance of the opportunities and threats on the surrounding environment, associated with the closure of Pit 1, and the final average tailings deposition in the pit to a level of 7 mRL. This risk analysis takes controls into consideration.
- Ranger MCP risk assessment, 2016: this risk assessment was presented in the 2018 MCP and at the time incorporated all other risk assessments undertaken over the life of the Ranger Mine at the time. As part of the scoping, the BPT options were considered in the risk assessment in addition to incorporating previous risk assessment outcomes.
- Ranger Closure Feasibility Study 2018: This risk assessment rolled all previous closure risk assessments up into a single register that is now hosted on the Rio Tinto risk platform "Archer". This risk register is actively reviewed and managed as part of the Ranger Closure Project. The risks presented in this MCP are the health, safety, environmental and community risks extracted from this register.
- Ranger Closure Risk Review, 2019: This risk review was completed to address the comments received on the risk identified and included within the 2018 MCP.

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- Social Risk Review, 2020: This risk review was completed to address the threats or opportunities that may result from how the business/project impacts upon and interacts with communities and stakeholders.
- Covid-19 risk review, 2020: This risk review was completed to address potential threats to mine closure as a result of Covid-19 impacts.
- Annual Ranger Closure Risk Review, 2020; this risk review was completed to challenge the risk profile and provide confidence that the most material risks to achieving the strategic objectives and targets are understood. The risk threshold is reviewed against the business's objectives and targets, the risk profile is challenged due to external or internal influences/decisions, the control effectiveness is reviewed based on assurance outcomes and implemented actions, new risks are captured and existing risks are closed or tolerated.
- Ranger Closure Quarterly Risk Review 2020: The purpose of this risk review is to ensure that the information remains current, including risk trend update, control effectiveness, overall control effectiveness, action status and overall action status.
- Multiple ad hoc reviews 2020: Determined by business need, risk owner or other with the aim to ensure that information is current and material risks are being actively managed, meaning new risks can be identified or existing risks are reviewed. Examples are; water related risks, critical path, seeds and fire.

7.3 ERA closure risk assessment methodology

The following section describes the ERA closure risk assessment process. In summary, all closure risk assessments have been facilitated by competent personnel, involved a range of technical and subject matter experts, and followed the standard process described within the ERA and Rio Tinto hazard identification and risk management standard. The key elements of this process involve:

- setting the context and scope for the assessment
- identifying key objectives and assumptions
- setting risk acceptances and thresholds
- identifying key stakeholders and participants
- generating a list of applicable risk scenarios (threats) and consequences based on potential risk exposure pathways between identified hazards (causes/triggers) and receptors (i.e. person or environment)
- identifying the existing control measures available to mitigate each threat and the control effectiveness (rating)

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- evaluating the risk likelihood and maximum reasonable consequence for each threat using the descriptors included within the Rio Tinto HSEC 5 x 5 risk determination matrix to establish an overall risk class, which can range from Class I (Low) to Critical IV (Critical)
- identifying additional control measures for significant threats rated as either Class III (High) or Class IV (Critical) to ensure the residual risk rating is as low as reasonably achievable (ALARA)
- recording outcomes within the ERA closure risk register to ensure active management is maintained during implementation
- developing action plans as required to support the implementation of effective control measure and assign accountabilities
- communicating risk information
- reviewing and updating risk, control and action status

Further detail relating to each of these elements is provided within the following sub-sections. The closure risk assessment will continue to be reviewed and updated following further internal or external workshops. Therefore, the closure risk portfolio is an evolving tool that is integrated into daily planning and operations. The outcomes of the ERA closure risk assessment will continue to be used for setting priorities and management strategies throughout the closure process.

7.3.1 Purpose and scope

The purpose of the ERA closure risk assessment is to identify threats and consequences associated with mine closure activities and evaluate the significance of the potential threats to the environment on and surrounding the RPA. The risk assessment considered the threats that may occur during the closure (decommissioning, rehabilitation, early monitoring) and monitoring and maintenance phases.

Closure commences at the scheduled completion of processing in January 2021, and will continue to 2026. Closure includes decommissioning, the general works associated with rehabilitating the site to an agreed standard of environmental protection and the re-contouring and revegetation of the final landform. The monitoring and maintenance phase is the period post-decommissioning where active works have generally ceased and the progression towards the development of a long-term viable ecosystem and meeting closure criteria has commenced. This phase may require initial management as landform settling, subsidence and erosion occur, and vegetation establishes. Passive water management techniques will be implemented where required. The relinquishment phase will occur once monitoring has demonstrated the closure criteria have been achieved and a close-out certificate has been issued. It is in this period the site will be returned to the Traditional Owners, and the site may be incorporated within Kakadu NP in the future.

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The scope of the closure risk assessment included risks associated with:

- ERA 'License to Close'
- engineering and design of mine closure
- implementation of mine closure activities
- implementation of maintenance and monitoring

The following aspects were excluded from the assessment:

- socio-economic related risks as this will form a separate assessment
- business economic and reputational risks
- closure and rehabilitation risks associated with the infrastructure immediately south of the Jabiru Airport (identified as the Jabiru field station currently and occupied by the ERISS)

7.3.2 Assumptions

The following assumptions were made in undertaking the closure risk assessment:

- technical advice, generated from both internal and external sources (e.g. contractors, consultants, associates, government agencies and research partners), was assumed to be appropriate
- all existing ERA controls will continue to be applied where applicable
- all standard ERA risk controls will be applied

7.3.3 Risk Management Tool

Mine Closure risks are managed using the RSA Archer Integrated Risk Platform. This tool provides the project and the business with a consolidated and clear view of risks, including version and history tracking and unique identification of risks and their components for future tracking purposes.

7.3.4 Risk Identification

The aim of risk identification is to generate a comprehensive list of credible risks related to mine closure based on operational and planned closure activities.

The Project Risk Management process is intended to identify and manage risks not being managed under the existing business processes of ERA, contractors, consultants or suppliers (e.g. those risks that require additional management effort outside of existing procedures). Emphasis is on the development of purpose-specific, risk-based plans at various stages within the project delivery functions.

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During management of each major deliverable, risks found to have a material impact to the project objectives (Class III and Class IV) shall be transferred to the closure project portfolio for ongoing monitoring and treatment.

7.3.5 Risk Relationships

All risks have a Risk Breakdown Structure (RBS) element selected within the risk database at the time of evaluation. The RBS element categorises the risk for all future reporting. A risk taxonomy must also be selected that allows for tracking and identification of similarly themed risks (e.g. hydrogeology, tailings transfer).

The risk breakdown structure includes:

- approvals
- studies
- tailings transfer
- Pit 3 capping
- demolition
- bulk material movement
- revegetation
- post-closure
- recruitment
- site wide
- process water capital works
- pond water treatment
- storage facilities
- Brine Concentrator operations
- HDS water treatment
- brine injection



7.3.6 Risk Evaluation

ERA has established an extensive suite of environmental management controls, processes and standards that have been implemented during operations and will remain applicable during closure. Existing controls are taken into account when determining the risk ranking, thus the “residual” rather than the “inherent” (baseline) risk is determined in the final risk ranking (as per ISO 31000).

Control effectiveness is also assessed as an indicator of successful risk mitigation and provides a prompt for additional controls to be considered.

A 5 x 5 risk matrix (Table 7-1) is used to determine the overarching risk classification for each threat. The risk classification is a function of the threat consequence and likelihood ratings determined in accordance with AS ISO 31000:2018 and ERA Standard: *HSEC Hazard Identification and Risk Management*. The overarching risk classification is determined to be either; Class I (Low), Class II (Moderate), Class III (High) or Class IV (Critical).

The risk classification identifies the level of management action that must be taken to mitigate the risk (Table 7-2). A risk that results in Class III or Class IV is considered to be a material risk that requires active management and consideration of additional control measures.

Table 7-1: Risk Class Determination

Likelihood	Consequence Severity				
	Very low	Low	Moderate	High	Very high
Almost certain	Class II	Class III	Class IV	Class IV	Class IV
Likely	Class II	Class III	Class III	Class IV	Class IV
Possible	Class I	Class II	Class III	Class IV	Class IV
Unlikely	Class I	Class I	Class II	Class III	Class IV
Rare	Class I	Class I	Class II	Class III	Class III

Table 7-2 Risk management response

Risk Class - Threats	Response
Class I	Risks that are below the risk acceptance threshold and do not require active management.
Class II	Risks that lie on the risk acceptance threshold and require active monitoring.
Class III	Risks that exceed the risk acceptance threshold and require proactive management.
Class IV	Risks that significantly exceed the risk acceptance threshold and need urgent and immediate attention.

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The risk class determination tables associated with the 5 x 5 risk matrix were referenced in order to determine a consequence and likelihood rating for each closure threat.

The consequence rating criteria (Table 7-3) provides a range of qualitative severity ratings that range from “very low” to “very high.” The consequence definitions are based on the ERA risk scheme and were customised to align with the particular environmental and cultural aspects of the Ranger Mine.

The criteria for assessing the likelihood rating (Table 7-4) are used to assign a qualitative probability of occurrence that ranges from “rare” to “almost certain.”

It is noted that some risks are considered with reference to the 10,000 year timeframe. The likelihood rankings used by ERA do not span this timeframe; however, the consequence of the risk occurring any time within the 10,000 years is assessed. Based on this, the likelihood descriptors are considered appropriate.

Table 7-3: Likelihood qualitative criteria

	Likelihood				
	Rare	Unlikely	Possible	Likely	Almost certain
Frequency interval (multiple events)	Less than once per 100 years	Once in ten to once in 100 years	Once per year to once in ten years	Twice per year to once per year	More than twice per year
Probability (single events)	<5%	5-20%	20-50%	50-75%	>75%

A control effectiveness rating is determined for each threat to evaluate whether they will sufficiently mitigate the risk (Table 7-5). If the controls for any given threat are rated as either C3 (Marginal) or C4 (Weak) then further assessment is required to determine feasible controls.



Table 7-4: Consequence qualitative criteria

	Consequence				
Consequence Type	Very Low	Low	Moderate	High	Very High
Licence to Operate / Stakeholders	2 - Informal disapproval from local stakeholders	3 - Stakeholder actions resulting in days of operational impacts	4 - Stakeholder actions resulting in weeks of operational impacts. Local reputation damage	5 - Stakeholder actions resulting in months of operational impacts. National reputation damage	6 - Stakeholder actions resulting in years of operational impacts. International reputation damage
Health & Safety	2 - Low level short term inconvenience or symptoms. Typically a first aid case	3 - Injury or illness requiring medical treatment, that does not lead to restricted duties or lost time	4 - Injury / illness with moderate damage or impairment to one or more persons	5 - Single fatality or severe permanent impairment	6 - Multiple fatalities or severe permanent impairment to multiple people
Environment	2 - Harm to the environment that is localized, and is quickly and easily rectified	3 - Harm that is localized, and is rectified or reversed within a few days to weeks	4 - Harm that is largely localized but starts to be unconfined, rectified within weeks to months	5 - Harm that is unconfined, and is rectified or reversed within months to years	6 - Widespread environmental harm that is rectified or reversed within several years to decades
Radiation (employees, contractors or public)	2 - Measurable increase in radiation dose with outcomes remaining below dose constraints.	3 - Increase in radiation dose above the dose constraints but still below international limits.	4 - Increase in radiation dose to above international limits.	5 - Radiation doses above 100 mSv to an individual and likely to significantly increase the risk of cancer to that individual.	6 - Radiation doses to multiple individuals above 100 mSv or acute radiation syndrome to an individual.



	Consequence				
Consequence Type	Very Low	Low	Moderate	High	Very High
Communities & Social Performance	2 - Short term loss of trust with communities. Damage to cultural heritage of low significance	3 - Loss of trust with communities taking weeks to resolve. Non-disruptive organised opposition	4 - Loss of trust with communities that cannot be resolved through routine procedures	5 - Widespread, sustained opposition from communities	6 - Systemic opposition from communities that impacts community trust at other Rio Tinto assets
Legal & Regulatory Compliance	2 - Non-compliance resolved via informal discussion or direct engagement	3 - Breaches resulting in formal notices or written warnings	4 - Breaches resulting in low-level fines or payments	5 - Breaches resulting in fines, settlements or payments that are material at the Site level	6 - Breaches resulting in fines, settlements or payments that are material at the Business Unit level
Closure and Legacy Management	2 - Changes to closure scope which have limited impact	3 - Changes to scope with a noticeable increase in complexity and/or degree of difficulty of closure	4 - Change to scope with a moderate increase in complexity and/or degree of difficulty of closure	5 - Changes to scope with a significant increase in complexity and/or degree of difficulty of closure	6 - Material changes to scope with a major increase in complexity and/or degree of difficulty of closure
Schedule (Time)	3-6 weeks	6 weeks - 3 months	3-6 months	6-12 months	1 - 2 years



Table 7-5 Control and Overall Control Effectiveness

Control Rank	Description	Guidance
C1	Good	Substantially effective/adequate design Controls are considered adequately designed and are operating effectively on almost all occasions
C2	Satisfactory	Mostly effective/adequate design Controls are considered adequately designed and are operating effectively on most occasions
C3	Marginal	Inadequate design/partially effective Controls are considered inadequately designed or are only operating to partial effectiveness on most occasions
C4	Weak	No controls/ineffective. There are no controls designed or the existing controls are operating ineffectively on all occasions

Further to this, the Ranger Mine Closure portfolio captures Overall Control effectiveness and Overall Action Status as an indicator of the overall health of the mine closure risk portfolio.

7.3.7 Communication and Consultation

All closure project personnel are actively encouraged to identify and discuss potential risks as a normal part of daily work, regardless of their role.

The full closure risk portfolio is available to all project personnel through the internal ERA intranet promoting project team members to actively incorporate risk management into their daily discussions and promotes continual review of risk as a part of normal project activities.

Communication is also supported by a formal project risk reporting process, as outlined in Figure 7-2 Figure 7-2 Risk Reporting Structure below.

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Figure 7-2 Risk Reporting Structure

Consultation on risk related matters occurs regularly through the following channels:

- Monthly notifications are sent to action owners on overdue actions, regular reminders are sent to risk and action owners to ensure data is complete and current.
- Fortnightly risk meetings are conducted to review report on risk movement, review overdue actions, discuss trending, capture emerging risk and highlight concerns.
- Quarterly reviews are conducted with the aim to ensure that the information remains current, including risk trend update, control effectiveness, overall control effectiveness, action status and overall action status.
- Annual reviews are conducted with the aim to challenge the risk profile and provide confidence the most material risks to achieving the strategic objectives and targets are understood. The risk threshold is reviewed against the business's objectives and targets, the risk profile is challenged due to external or internal influences/decisions, the control effectiveness is reviewed based on assurance outcomes and implemented actions, new risks are captured and existing risks are closed or tolerated.
- Ad hoc workshops are determined by business need, risk owner or other with the aim to ensure that information is current and material risks are being actively managed, meaning new risks can be identified or existing risks are reviewed.



- A monthly summary of material risk is provided in the Closure Steering Committee for further monitoring and action as necessary.
- A monthly reporting on the overall status and health of the risk register.
- Bi-annual risk portfolio health checks are undertaken i.e. missing fields, querying data and providing overall summary.

7.4 Current risk profile

Figure 7-3 below shows the open 2019 risk class distribution against the open 2020 risk class distribution. There are 46 open risks as of June 2020 with three Class IV (Critical) risks, an increase of 2, seventeen Class III (High) risks, an increase of 3 and a reduction of 6 class II risks and no change to class I risks.

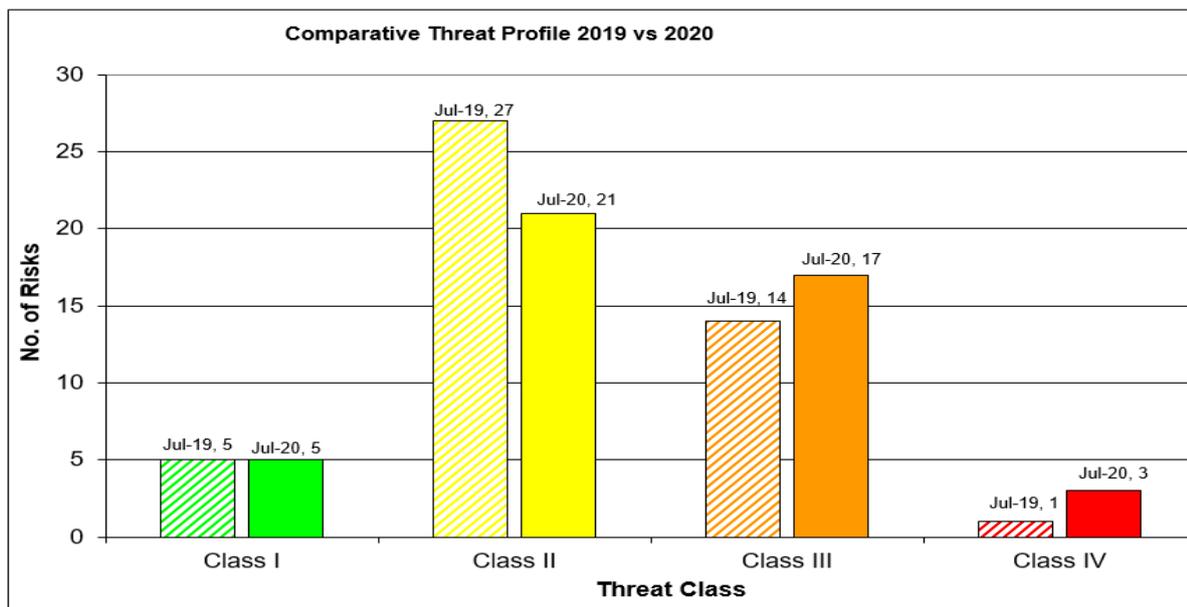


Figure 7-3 2019 risk profile vs 2020 open risk profile

7.4.1 Closure Class IV risks

A total of three Class IV (Critical) risks were identified following the review of the closure risk register in June 2020. The threats assigned this risk classification included:

- Failure to contain and/or eradicate Spigelia weed from the operations area causing infestation in Kakadu NP.
- Rainfall is greater than planned in the Water Model (P50) increasing the process water inventory requiring management, leading to later completion of process water treatment than planned
- Unable to inject brine into the underfill



The causes, impacts, existing controls, evaluation rationale and planned actions for each of the threats above are detailed within Appendix 7.1 and 7.2.

The Class IV risk detailed in the 2019 MCP, insufficient volume or quality of viable seed stock available for whole of site revegetation, was actively managed throughout 2019 and 2020 and has been re-evaluated to a Class III risk. Some of the actions completed during the past 12 months include the upgrade of the Ranger Nursery with increased security and fire protection, the evaluation of viability of historical seed, development of a seed tracking metric and the commencement of routine seed collection on the RPA. The current open actions for this risk are detailed within Appendix 7.1.

7.4.2 Closure Class III risks

A total of seventeen Class III (High) risks were identified following the review of the closure risk register in June 2020. The threats assigned with this risk classification included:

- Ranger Mine impacts the local economics
- contaminated material leaves site during closure activities
- inaccuracies or simplifications in the water model, excluding rainfall and water treatment rates (managed in other risks), lead to inadequate water treatment tactics (critical path)
- insufficient volume or quality of viable seed stock available for whole of site revegetation
- large scale fire or natural disaster (e.g. cyclone) destroys immature vegetation
- low plant survival rates in the field during establishment and vegetation decline after/at establishment
- planned active process water treatment tactics (i.e. plant capacity) do not meet the assumed productivities modelled for site inventory reduction (critical path)
- process water exceeds MOL in Pit 3
- site condition at 8 Jan 2026 does not meet Stakeholder expectations
- solute transport outcomes do not match modelled behaviour, breaching closure criteria
- tailings exceeds MOL in Pit 3
- Tailings Storage Facility wall breached during deconstruction works while still in use
- increased TSS in process water feed to Brine Concentrator
- removal of remnant tailings takes longer than planned
- groundwater drawn into underdrain during operation of pumps



- subaqueously installed geotextile fails to meet design requirements for geotechnical strength
- brine storage assumptions do not meet the storage requirements for site salt inventory

The causes, impacts, existing controls, evaluation rationale and planned actions for each of the threats above are detailed within Appendix 7.1 and 7.2.

Figure 7-4 provides a snapshot overview of how the overall control effectiveness and the overall action status is managed through the RSA Archer Integrated Risk Platform in ERA. The overview indicates the health of the individual risks, actions and provides detail on the current trends.



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Figure 7-4 Overall risk portfolio

Risk Record	Current Risk Class	Risk Matrix	Risk Matrix Values	Maximum Reasonable Consequence	Overall Control Effectiveness	Overall Action Status	Current Risk Trend
Failure to contain and/or eradicate Spigelia weed from the operations area causing infestation in Kakadu National Park [597589]			107 - Threat-High-Possible	Environment,	Satisfactory	Resourced and On Track	Stable
Unable to inject brine into underfill. [504876]			104 - Threat-Very High-Possible	Total Cost of Closure, Schedule Time,	Marginal	Resourced and On Track	Increasing
Rainfall is greater than planned in the Water Model (P50) increasing the process water inventory to manage/treat leading to later completion of process water treatment than planned. [504166]			107 - Threat-High-Possible	Schedule Time,	Good	Resourced and On Track	Increasing
Increased TSS in process water feed to Brine Concentrator [691266]			117 - Threat-High-Unlikely	Schedule Time,	Satisfactory	Resourced and On Track	Stable



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7.5 References

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APPENDIX 7.1 RANGER CLOSURE RISK ASSESSMENT

Risk ID	Risk Title	Causes	Consequences	Controls	Evaluation Rationale	Recent Developments	Trend	Date	Control Effectiveness	Risk Management Class	Manageability	Actions	Risk Status
503350	Airport is unable to be retained and handed over to stakeholders	Lack of agreement between government and stakeholders on a future state and funding arrangement for airport.	Inability to maintain FIFO arrangement to end of Closure activities.	Involvement in Jabiru Stakeholder Planning Group. [503351]	Agreement likely due to the essential services provided by the airport, and the active participation within the Jabiru Stakeholder Planning.				Unrated	I		Handover of airport to new operator [503353]	Open
504214	Brine storage assumptions do not meet the storage requirements for site salt inventory.	<p>Errors in modelling of underfill void space.</p> <p>Lack of quality assurance (injection well permeability test not undertaken).</p> <p>Lack of quality assurance during underfill backfill activities (increased laterite material, increased compaction).</p> <p>Brine concentration too low.</p> <p>Errors in site salt balance (additional salt mobilised due to lower than modelled process water pH).</p>	<p>Increased cost from alternative salt storage system.</p> <p>Increased schedule for alternate salt storage.</p> <p>Brine reaches the underdrain - potential shutdown of brine injection.</p>	<p>Brine concentrator operational quality assurance. [504259]</p> <p>Conductivity meter on the underdrain water flow. [504264]</p> <p>Flowrate measurement. [504270]</p> <p>HDS plant incorporated into water model. [504252]</p> <p>Manual water sampling. [504268]</p> <p>Underfill engineered with a 20% contingency (based on 100% of process water treated via BC). [504236]</p> <p>Underfill volume review of as-built undertaken (Mark Coghill Nov. 2016) and determined contingency of 20%. [504242]</p> <p>Water model contains assured salt balance module. [504247]</p>	<p>High level of confidence in brine storage space available.</p> <p>Contingency plans being finalised.</p>	07/07/20 Annual risk workshop determined new action and no change to risk. EOI out for the development of an alternative brine disposal option	Stable	14/07/2020	Satisfactory	III		<p>Contingency plan for brine injection system development [706768]</p> <p>Develop alternative contingency options for incremental storage of salt. [504326]</p> <p>Develop an action plan (Decision Tree) for response to brine break through into underdrain. [504328]</p> <p>Issue Expression of interest for the development of an alternative brine disposal option [726641]</p> <p>Re-instate brine injection and monitor/assess effectiveness. [726535]</p>	Open



Risk ID	Risk Title	Causes	Consequences	Controls	Evaluation Rationale	Recent Developments	Trend	Date	Control Effectiveness	Risk Management Class	Manageability	Actions	Risk Status
505289	Cannot achieve revegetation planting rates	<p>Insufficient rest provisions in schedule.</p> <p>Dehydration.</p> <p>Assumed cycle times are optimistic.</p> <p>No cool rooms available.</p> <p>Little precedent for proposed process - semi-mechanised, waste rock.</p> <p>Cultural requirements for random planting pattern.</p> <p>Workforce not acclimatised to local conditions.</p> <p>Commercial payment structure.</p> <p>Workforce unfit for work - medical conditions, etc.</p> <p>Unknown medical conditions.</p> <p>Larger plants from nursery than planned.</p>	<p>Schedule delay.</p> <p>Additional cost for larger crews/additional resources to maintain schedule.</p> <p>H&S incident.</p> <p>Poor quality planting leading to higher mortality.</p>	Existing H&S processes and procedures. [505290]	Lower productivity leads to increased resources to meet schedule. Increases revegetation costs by 25%.	07/07/20 Annual workshop determined no change.	Stable	21/07/2020	Unrated	II		<p>Assess mechanically-assisted planting methods. [505294]</p> <p>Completion of the revegetation handover checklist [600371]</p> <p>Conduct heat-stress analysis of planting activities to inform thermal stress and hydration management plan. [505293]</p> <p>Incorporate stage 13 results into revegetation plan [600376]</p> <p>Utilise learnings from Pit 1 revegetation program to confirm assumed planting rates and update revegetation plan. [505292]</p>	Open
505219	Cannot achieve the desired tailings surface for post-deposition activities in Pit 3	<p>Uneven deposition of tailings.</p> <p>Excessive segregation.</p> <p>Uneven consolidation.</p>	<p>Delay in Pit 3 capping works.</p> <p>Difficulty collecting process water expressed from tailings (impacts dewatering).</p> <p>Extended consolidation.</p> <p>Failure of geotextile material (tearing).</p> <p>Eruptions of tailings through capping.</p>	<p>Consolidation modelling. [505220]</p> <p>Ongoing monitoring and modelling of tailings during deposition phase. [602110]</p> <p>Pit 3 capping methodologies. [505222]</p> <p>Pit 3 wicking design complete. [505223]</p> <p>Tailings Deposition Plan [505221]</p> <p>Pit 3 decant engineering design incorporating outcomes from tailings deposition plan and consolidation model. [505230]</p>	Final engineering to be completed. Potential for several additional decant wells. Additional 3-month schedule delay. Potential to affect geotextiles, design and installation.	07/07/20 Annual risk workshop determined re-evaluation to class II.	Stable	14/07/2020	Marginal	II	Extremely difficult to manage (M3)	<p>Confirm final deposition plan and tailings surface - Document required tailings capping method. [505232]</p> <p>Develop plan for re-profiling of tailings to occur in parallel with TSF cleaning. [505233]</p> <p>Incorporate engineering review immediately post tailings deposition into the CIP and schedule (CPT, wicking design etc). [505231]</p> <p>Update consolidation model based on latest Pit 3 Fugro survey and CPT testing. [505228]</p>	Open



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Risk ID	Risk Title	Causes	Consequences	Controls	Evaluation Rationale	Recent Developments	Trend	Date	Control Effectiveness	Risk Management Class	Manageability	Actions	Risk Status
504047	Closure of Ranger Mine impacts on local economics	Removal of subsidies. Removal of services. Cessation of royalties. Lack of consultation. Lack of understanding of timeline of closure. Lack of understanding of impact on population of Ranger closure. No future plan for the region by government.	Businesses become unviable. Social dislocation. Loss of leasehold to operate business. GAC reduced income.	Engagement with stakeholders on future state. [504049] Public updates through Town Hall meetings and local media. Closure schedule developed. [504050] SIA (social impact assessment) [504048] Continue local employment programs to build a future employable workforce. [504058] Support Commonwealth and NTG enquiries into local economic impact and opportunities through involvement in Jabiru Steering Committee. [504053]	It is possible that this will occur, but ERA is working closely with the community to ensure the transition is transparent. Increasingly Jabiru master plan vision may not happen in the time frame, no alternate economic model, this may add pressure to fund employment, housing rental etc.	07/07/20 Annual workshop determined that this risk is re-evaluated to class III due to the possibility of the Jabiru master plan taking longer to put in place, no alternate economic model, this may add pressure to fund employment, housing rental etc.	Increasing	21/07/2020	Unrated	III		Communicate ERA's plan for Jabiru exit (timing) when appropriate. [504056] Complete SIA refresh in particular the economic assessment portion. [504052] Develop sustainable programs, practices and support business development to align with Jabiru future. [504057] Provide relevant information to royalty recipients in half yearly update to support financial planning. [504054]	Open
505352	Contaminated material leaves site during closure activities.	Equipment and tooling is not appropriately decontaminated and taken off site by contractors. Inadequate checks undertaken. Poor communications with contractors. New contractors not familiar with processes. Not continuing induction processes.	Breach of Licence. Prosecution. Impact on community health. Impact to reputation.	Changes to controlled areas summarised in CIP. [505359] Contractor induction process. [505356] ERA Radiation Management Plan. [505353] Gated security. [505355] Physical radiation induction checklist. [505357] Random testing by RSO's. [505358] RSO's within org structure. [505354] Closure Implementation Plan [505361]	This may possible even with controls in place, moderate reputational impact (limited to NT based on last incident).	07/07/20 Annual workshop increased likelihood to possible as the risk is possible even with controls in place.	Increasing	21/07/2020	Unrated	III		Develop plan for controlled area's - include in CIP [505363] Ensure inductions and on-boarding materials make expectations clear to employees and contractors. [728994] Review existing radiation procedures during shutdown - include in CIP [505364] Review security and RSO resources [505365]	Open

Risk ID	Risk Title	Causes	Consequences	Controls	Evaluation Rationale	Recent Developments	Trend	Date	Control Effectiveness	Risk Management Class	Manageability	Actions	Risk Status
505863	Damage occurs to cultural heritage site during rehabilitation works	<p>Vehicle movement in restricted areas.</p> <p>Non-conformance with the land disturbance permit process.</p> <p>Breach to the cultural heritage management system.</p> <p>Not all sites identified.</p> <p>Indirect impact from closure activities e.g. water run-off, erosion, sedimentation, changes to landforms.</p> <p>Not meeting agreed mitigation measures.</p> <p>Increased dust from closure activities.</p>	<p>Breach of NT Heritage Act and Sacred Sites Act.</p> <p>Reputation impacted.</p> <p>Cost of remediation.</p> <p>Fines.</p> <p>Civil/criminal action.</p> <p>Loss of trust.</p>	<p>AAPA certificate. [505865]</p> <p>Access restricted to sites through signage and / or fencing. Cultural Heritage Management Plan for closure includes mitigation measures, incident process and additional security of sensitive sites. [505868]</p> <p>Cultural Heritage Management system including general induction and heritage induction. [505864]</p> <p>Database of cultural heritage sites. [505867]</p> <p>Land Disturbance Permit system. [505866]</p> <p>Maintain multiple ERA representatives with relationships to specific stakeholders i.e. GAC [696045]</p>	Cultural heritage GIS complete. All sites identified.	07/07/20 Annual workshop. Cultural heritage GIS complete. All sites identified. Unlikely to occur. Risk re-evaluated to class II.	Stable	15/07/2020	Satisfactory	II	Easily managed by entity (M1)	<p>Build cultural heritage capacity with Djurrubu Rangers [616907]</p> <p>Cultural heritage management plan to be developed including mitigation measures [505872]</p> <p>Incident process captured in cultural heritage management plan [505874]</p> <p>Review the need for new AAPA certificate for rehabilitation. [505875]</p> <p>Review the roles required to have a cultural heritage induction. [505877]</p>	Open
506028	Direct and indirect impact to cultural heritage sites during post closure - especially if signage/demarcation is decommissioned.	<p>Inappropriate access on RPA by contractors</p> <p>Remediation works carried out without consideration of cultural heritage (process not followed)</p>	<p>Breach of NT Heritage Act and Sacred Sites Act.</p> <p>Reputation impacted.</p> <p>Cost of remediation.</p> <p>Fines.</p> <p>Civil/criminal action.</p> <p>Loss of trust.</p>	<p>AAPA certificate [506030]</p> <p>Land disturbance process [506031]</p>	Unlikely probability as management plans effective in preventing such a risk during operations, and will continue during closure works	07/07/20 Annual workshop determined no change to this risk.	Stable	21/07/2020	Unrated	II		<p>Identify protection measures to remain in place based on post-rehab monitoring plan [506034]</p> <p>Investigate AAPA certificate schedule (including what point it is no longer needed based on risk) [506033]</p> <p>Review land disturbance permit process for post-closure and rehab suitability [506035]</p>	Open
694586	Disposal location for contaminated material not available following backfill of Pit 3.	<p>Pit 3 no longer available for disposal of contaminated material (water treatment plants, HME, construction facilities).</p> <p>Inability to agree upon location with stakeholders.</p> <p>Water treatment infrastructure is required post backfill of Pit 3.</p>	<p>Schedule overrun.</p> <p>Cost overruns.</p> <p>Potential offsite disposal (higher cost).</p>	<p>Closure schedule. [507994]</p> <p>Decontaminate and transport materials off-site. [694589]</p> <p>RP2 planned for Phase 2 demolition material. [694588]</p>	Opened for MCP, but is well managed now RP2 will be used for disposal	07/07/20 Annual workshop determined risk to be trending down as RP2 is the alternative disposal location when approval comes through.	Decreasing	22/07/2020	Unrated	I	Easily managed by entity (M1)		Open



Risk ID	Risk Title	Causes	Consequences	Controls	Evaluation Rationale	Recent Developments	Trend	Date	Control Effectiveness	Risk Management Class	Manageability	Actions	Risk Status
694650	Elevated levels of contaminants (metals) in bush tucker.	Bioaccumulation of contaminants from surface water/sediments, and/or soils. Localised areas of higher uptake coinciding with higher harvesting rates.	Non-compliance with ER 3.1. Increased uptake of metals.	ARRTC process and key knowledge needs developed. [500616] Bush food consumption restrictions to particular areas of the RPA may apply post closure. [694655] Closure criteria working group [507828] Site specific research undertaken against identified knowledge gaps. [499956] Stakeholder communication strategy and management e.g. traditional owners, MTC, ARRAC, ARRTC, technical working groups, community engagement. [693662] Stakeholder engagement. [518282]	Likelihood based on bio-accumulation potential in aquatic organisms on site. Small contribution of bush tucker from RPA to overall diet. Communication to address community concerns.	07/07/20 Annual workshop determined no change to this risk.	Stable	21/07/2020	Unrated	II	Extremely difficult to manage (M3)		Open
500751	ERA is not meeting community expectations for local employment	Number of total jobs available are reduced through closure. Some jobs require specialised skillsets. Lack of engagement with local community	Reduced economic and social benefit to community. Not being able to meet agreed ERA local employment targets; loss of reputation predominantly with federal government	Engagement with local community to identify opportunities under each work package. Potential for business to be formed and/or opportunity for existing businesses to grow. [602093] FS Closure Implementation Plan identifies packages of work suitable for local employment. [500753] Requirements defined under mining agreement. [500754]	Very low local employment during closure due to skills gap, unavailability of local labour, or poor planning.	07/07/20 Annual workshop determined no change to this risk.	Stable	21/07/2020	Unrated	II		Identify challenges/barriers for employment of local residents [500771] Include communication requirements into Community and Stakeholder Engagement Plan. [500774] Link with other local stakeholders to address work readiness e.g. A&OD, GAG, LLN. [500773] Revise local employment targets/strategy for closure [500763]	Open



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Risk ID	Risk Title	Causes	Consequences	Controls	Evaluation Rationale	Recent Developments	Trend	Date	Control Effectiveness	Risk Management Class	Manageability	Actions	Risk Status
693671	Erosion and gully formation across landform surface exposes contained tailings.	<p>Rainfall is greater than anticipated (e.g. Climate Change scenarios)</p> <p>Failure of proposed erosion controls.</p> <p>Erosion rates do not match modelled.</p> <p>Final landform not constructed to design.</p>	<p>Non-compliance with ER 2.1, ER 5 and ER 11.3(i).</p> <p>Potentially increases solute transport on/off site.</p> <p>Potentially increases radiation dose to members of the public.</p> <p>Limits access by traditional owners to post decommissioning site.</p>	<p>Design of Pit backfill has tailings low in the Pit with thick waste rock cap. [693681]</p> <p>Erosion structures are incorporated into landform design - e.g. ripping and armouring where required. [693677]</p> <p>Establishment of vegetative surfaces to reduce erosion. [693676]</p> <p>Implementation of a QA program for landform construction and erosion controls. [693679]</p> <p>Iterative/adaptive landform design based on landform stability modelling. [693675]</p> <p>Landform designed with drainage channels diverted away from in Pit tailings. [693683]</p> <p>Ongoing maintenance of erosion structures and mitigation of gully formation, post decommissioning. [693678]</p>	Rare likelihood due to existing controls being extensive.	07/07/20 Annual workshop determined no change to this risk.	Stable	21/07/2020	Unrated	II	Some difficulty in managing (M2)		Open



Risk ID	Risk Title	Causes	Consequences	Controls	Evaluation Rationale	Recent Developments	Trend	Date	Control Effectiveness	Risk Management Class	Manageability	Actions	Risk Status
504475	Excessive erosion impacts landform stability and revegetation success.	Final landform not matched to rainfall characteristics. Insufficient sedimentation control. Insufficient erosion control. Tailings not fully consolidated. Rainfall is greater than anticipated (e.g. Climate Change scenarios). Revegetation insufficient or ineffective in minimizing erosion.	Revegetation requires ongoing management. Extensive cracking and subsidence occurs over the landform leading to an increased maintenance regime. Stability issues occur along the developing gullies causing excessive erosion. Tailings or Low 2 material becomes exposed.	Access tracks will be designed to minimise erosion and/or not cause erosion [602120] Contour ripping in high erosion areas. [602119] Controls on Material Movement to ensure built landform matches design. [504478] Final designed landform does not contain slopes > 4%. [504480] Flood study used to design erosion controls. [504482] Landform Evolution Model (LEM) model has informed both landform design, erosion controls and sediment traps. [504476] LEM has climate change scenarios and a synthetic rainfall data set for 10,000 years. [504477] Revegetation strategy tailored to landform elements (e.g. slopes, gullies, etc.). [602118] Updated consolidated model with Pit 1 validation from monitoring data and CPT testing. Ongoing updates. [504481] Validation of consolidation models. [504479] Ongoing updates to consolidation model. [504496]	Ongoing rectification works during post-closure - earthworks and revegetation. No impact to closure schedule as in post-closure	07/07/20 Annual workshop determined LEM modelling from our RT expert shows results better than SSB model.	Decreasing	21/07/2020	Unrated	II		Complete landform flood study. [504485] Completion of the revegetation handover checklist [600371] Finalise ripping plan. [504494] Incorporate stage 13 results into revegetation plan [600376] Investigate interim sediment and erosion controls and provide sequencing plan [600381] Outcomes from flood study to inform drainage channels and sedimentation design. [504488] Provide DEM to SSB to run LEM modelling (assurance). [504490]	Open
505366	Exposure of people to radioactive materials during demolition and decommissioning.	Dust hang-up in Mill. Calcliner residual material. SX tanks residual material. Poor decommissioning and cleaning post Mill closure. Incorrect demolition methodology. Lack of radiation support. Removal of density gauges.	Workers exposed have negative health impacts. Breaches of Licence conditions. Reputational impact. Schedule impact pending investigation.	Controlled areas. [505372]. Decommissioning and demolition plan. [505374]. Established standards of protection from radiation. (e.g. radiation protection system, PPE) [505367]. Inductions and training. [505373]. Medicals and monitoring. [505371] Membership of professional networks. [505370] Org structure currently includes RSO roles. [505368] Significant corporate knowledge and experience [505369] Closure Implementation Plan [767664]	New activities during decommissioning, only administrative controls therefore likelihood greater than Rare.	07/07/20 Annual workshop determined no change.	Stable	21/07/2020	Unrated	II		Develop detailed de-commissioning and decontamination plan for Milling area. [505411] Upload historic radiation records into national database. [505426]	Open



Risk ID	Risk Title	Causes	Consequences	Controls	Evaluation Rationale	Recent Developments	Trend	Date	Control Effectiveness	Risk Management Class	Manageability	Actions	Risk Status
597589	Failure to contain and/or eradicate Spigelia weed from the operations area causing infestation in Kakadu NP	Weed has spread without ERA detection. Insufficient monitoring of area surrounding operational area. Insufficient controls in place around vehicle hygiene. Insufficient staff knowledge of weed / transmittance of weed.	Potential to impact close out certificate. Weed may be listed as a declared weed species, creating an increased obligation to manage. Impacts ERA's ability to demonstrate ability to manage rehabilitation. Loss of containment of the Spigelia weed to the operational area. Environmental and biodiversity impacts in surrounding areas. Eradication/ remediation of Spigelia detracts from other BAU tasks (i.e. other weeds).	Dedicated resources to manage treatment [616678] External Stakeholder monitoring, managing and regular consultation [616681] Monthly reporting to weeds Branch of GOVT. [597593] Operational Weed Management plan [597591] Polaris ATV used for weed management [607791] Regular monitoring and surveys of Spigelia weed [597592] Site wide weed management plan [597590] Weed specific training (excl. Spigelia) [597594]	Consequences were determined based on the nominal financial impact compared to the costlier reputational impact. More recent review completed on 22/01/2020 (SRA workshop) where likelihood of risk occurring was increased due to increased germination (in previously unknown areas) from rainfall.	07/07/20 Annual workshop. Risk is considered stable until controls are validated, embedded and working. However if spread into the creek system it will be very hard to control.	Stable	13/07/2020	Satisfactory	IV	Some difficulty in managing (M2)	AFE procure and deliver Polaris ATV [597598] Develop and implement ERA staff weed (incl. Spigelia) training [597597] Develop annual report including review of program effectiveness to inform continuous improvement. [700452] Incorporate Spigelia into current processes and documentation [597596] Procure mini iPad for Spigelia weed monitoring [700453] Update induction to include weed awareness [616684]	Open
694625	Feral animals occur at higher densities than in surrounding KNP.	Lack of management. Open disturbed area. Weed infestation.	RPA becomes a source of feral animals to KNP. Impacts natural recruitment of fauna. Impacts revegetation success. Spreads weeds. Impact to waterways (e.g. buffalo)	Active feral animal management aligned with current operational practices. [694626] Ongoing liaison with KNP regarding fire, weed and feral animal management strategies [602396]	Unlikely probability that feral numbers will be higher than surrounding as will be managed initially and then likely to be similar to surrounding populations as aim is to achieve similar environs	This risk will always be class II as it remains a risk but solid management practices are in place. Closure resources includes feral animal shooting resource.	Stable	7/04/2020	Unrated	II	Easily managed by entity (M1)		Open
506016	Final landform fails to meet biodiversity "similarity" indices.	Insufficient diversity and abundance of flora and fauna to meet defined trajectories. Changes in biodiversity survey techniques. Lack of artificial habitat to encourage fauna.	Non-compliance with ER 2.1. Requires adjustment to flora species list.		Unlikely due to the KKN's planned to address any gaps in understanding prior to finalisation of rehabilitation	Fortnightly risk meeting determined that risk was stable at this time.	Stable	8/12/2020	Unrated	II		Develop mitigation plan. [506018]	Open



Risk ID	Risk Title	Causes	Consequences	Controls	Evaluation Rationale	Recent Developments	Trend	Date	Control Effectiveness	Risk Management Class	Manageability	Actions	Risk Status
504633	Groundwater drawn into under drain during operation of pumps.	Location of the Bore. Bore not constructed to specification. Ground water seepage from additional sources.	Causes delay in schedule due to inability to inject brine and additional water treatment. Additional cost.	25 meters of grouting at the bottom of the hole. [707080] Conductivity meter on the underdrain water flow. [504634] Flowrate measurement. [504636] Location of bore in geologically-competent ground. [504637] Manual water sampling. [504635]	Failure of bore requires additional process water to be treated (100 MI x 4 years) - continue to operate under drain.	07/07/20. Annual workshop determined risk is possible for now but will soon be unlikely due to outcome of bore rehabilitation and testing of the pumps.	Decreasing	15/07/2020	Satisfactory	III		Create a plan C (contingency) [608172] Ensure fortnightly meeting covers the operational philosophy of the bore. [726832] QA on bore construction. [504639]	Open
505272	Groundwater inflows to process water are greater than expected.	1G projects fail to prevent groundwater. Interception projects. MBL bores. Validation of water model fails to identify issues	Additional process water treatment increases schedule beyond closure date - cost + legal/regulatory & reputational impacts. Increased cost from additional process water treatment through the BC. Increased cost from requirement to implement process water contingency (large scale HDS). Delay in rehabilitating the TSF/ RP6 due to need to use for process water storage for longer.	1G projects package [767670]	6 month extension for process water treatment.	07/07/20 Annual workshop considered risk stable at this time, no change.	Stable	21/07/2020	Unrated	II		Adequately resource 1G projects. [505275] Continue work to allow MBL to be reinstated. [505274]	Open



Risk ID	Risk Title	Causes	Consequences	Controls	Evaluation Rationale	Recent Developments	Trend	Date	Control Effectiveness	Risk Management Class	Manageability	Actions	Risk Status
504367	Inaccuracies or simplifications in the water model, excluding rainfall and water treatment rates (managed in other risks), leads to inadequate water treatment tactics (critical path).	Water Model does not directly duplicate real-world scenarios. Water Model assumptions are inaccurate (only includes assumptions not included in other risks). Inaccurate tailings density assumptions.	Process water inventory reduction does not meet the closure schedule. Longer than planned process water treatment increases schedule beyond closure date - cost + legal/regulatory & reputational impacts. Increased cost from additional process water treatment through the BC. Increased cost from requirement to implement process water contingency (large scale HDS). Delay in rehabilitating the TSF/RP6 due to need to use for process water storage for longer.	Annual Water Model validation (external assurance). [504369] Regular bathymetric surveys of free process water inventory used to validate model. [504368]	6 month extension for process water treatment.	07/07/20 Annual workshop. Will keep as trending until information comes back from the consolidation model work in Late July	Increasing	15/07/2020	Satisfactory	III		Complete 1G project desktop review [678240] Conduct a 1G project workshop [678243] Implement approved water model management plan [678432] Update consolidation model [682602]	Open
694628	Increased aquatic weed establishment in RPA billabongs impacts Kakadu NP	Transfer from surrounding environment, vehicles, transient fauna. Transport of weeds from surrounding Kakadu NP.	Decrease in downstream aquatic biodiversity / habitat leading to Ramsar status and aquatic biodiversity of ARR being compromised.	Early warning monitoring and subsequent adaptive management. [694635] Operational Weed Management plan [597591]	Paragrass is in the Kakadu NP - but not upstream from Ranger Mine	07/07/20 Annual workshop determined no change.	Stable	22/07/2020	Unrated	I	Some difficulty in managing (M2)		Open
691266	Increased TSS in process water feed to Brine Concentrator	High TSS due to the source of the process water (e.g. pit 3 or TSF silt carryover). Brine injection system not commencing as per schedule resulting in recirculating concentrated brine to TSF.	Impact to Brine Concentrator distillate production. Increased scaling through the Brine Concentrator. High TSS in brine could block the porous injection cavity.	BC feed can be drawn from the TSF [726836] Change in process water sampling point [726840] Silt curtain added to the pumps [706841]	Potential for schedule delay based on operation of the brine injection system.	15/05/20 Quarterly class III & IV workshop. Risk considered stable at this time. Removed control 700014.	Stable	6/01/2020	Satisfactory	III	Easily managed by entity (M1)	Commission brine injection system [700016] Ensure process water sampling point change is reflected in procedures. [726839] Ensure there is the ability to switch back to tailings dam as contingency [706852] Review additional injection wells [700018]	Open



Risk ID	Risk Title	Causes	Consequences	Controls	Evaluation Rationale	Recent Developments	Trend	Date	Control Effectiveness	Risk Management Class	Manageability	Actions	Risk Status
505249	Insufficient volume or quality of trees from nursery for revegetation.	Higher than expected mortality in the nursery due to disease, fire, theft Under skilled propagators. Lack of viable seed. Technical issues in the nursery - e.g. disease, procedures, equipment failures. Poor production rates. Poor nursery implementation planning. Low plant propagation success.	Delay to revegetation. Unable to get stakeholder acceptance. Reduced in floristic diversity and density. Delay in revegetation schedule. Revegetation does not support fauna diversity. Unable to meet cultural criteria.	20% allowance for infill. [505250]. 30% allowance for unviable seeds. [505251]. Alternative off site nursery available if required. [602401] Disease control activities in nursery. [505254] Expert propagation knowledge and implementation provided by existing contractor. [602399] Learnings from Pit 1 will be taken into remaining work - lead time for additional seeds & seedlings. [505256] Management of combustibles in nursery area. [505253] Nursery constructed on site [602400] Nursery secured. [505252] Planting and propagation trials successfully completed. [505255]	Insufficient volume leads to 6-month delay in revegetation. Stakeholder acceptance achieved through continued active management during post-closure.	07/07/20 workshop determined risk is increasing due to 1. Recent seed viability test wrote off some old seeds. 2. ERA/KNPS have limited knowledge/skill in raising tubestock in the cool weather (dry season) 3. Potentially further compressed planting towards the end of 2025. 4. Risks of major disease and failure of the irrigation system still present.	Increasing	22/07/2020	Unrated	II		Completion of the revegetation handover checklist [600371] Confirm seed collection and propagation plan has sufficient contingency. [505258] Incorporate stage 13 results into revegetation plan [600376] Investigate the use of tissue culture techniques for use at ERA. [728127] Review current nursery management controls for gaps. [505259]	Open



Risk ID	Risk Title	Causes	Consequences	Controls	Evaluation Rationale	Recent Developments	Trend	Date	Control Effectiveness	Risk Management Class	Manageability	Actions	Risk Status
504574	Insufficient volume or quality of viable seed stock available for whole of site revegetation.	<p>Changes in seasonality - e.g. dryer wet season leads to less flowering and fruiting.</p> <p>Size of areas to be revegetated concurrently, exceed stock capacity.</p> <p>Late seasonal fires impacts seed collection.</p> <p>Predation (birds).</p> <p>Local provenance area may still be too restrictive.</p> <p>Availability of contractor/labour force to meet demand.</p> <p>Limited seed harvesting capacity.</p> <p>Loss of seed (fire, theft, disease, vermin, fungus)</p> <p>Loss of license to collect seed.</p> <p>Air conditioning fails in seed store.</p> <p>Variable seed viability after collection.</p> <p>Inadequate land access.</p> <p>Inadequate resources for seed collection.</p>	<p>Reduction in floristic diversity and density.</p> <p>Delay in revegetation schedule.</p> <p>Revegetation does not support fauna diversity.</p> <p>Reputation damage.</p> <p>Unable to meet cultural criteria for a sustainable food and medicinal source.</p>	<p>95% of stems for shrubs and trees will be planted via tube-stock rather than direct seeding (significantly less seed required) [602122]</p> <p>Alternative arrangement in place with suitable third party supplier for tube-stock propagation, including support with optimizing plant germination and propagation (i.e. maximize seed value) (e.g. MOU with Greening Australia) [504582]</p> <p>Backup air-conditioning in seed storage room. [504584]</p> <p>Contractor purchased required equipment. [504577]</p> <p>Current seed collection permit with KNP. [504576]</p> <p>Dedicated equipment for collecting grass seed [557230]</p> <p>Dedicated equipment for collection of seed i.e. EWP, brush harvester. [693553]</p> <p>ERA conducts annual seed collection on the Ranger Project Area (RPA). [504585]</p> <p>Fit for purpose nursery facility. [693556]</p> <p>Fit for purpose seed storage facility including climate control, security etc. [693557]</p> <p>MTO and schedule of seed requirements complete (including by species). [504586]</p> <p>Nursery expansion including seed storage facility. [504583]</p> <p>Ongoing collection and storage of seed stock. [504575]</p> <p>Quality assurance process applied to seed management (viability testing regime). [693559]</p> <p>Revegetation Management Plan. [504587]</p> <p>Seed management database, collection schedule and metric to manage performance. [504578]</p> <p>Site environment team collecting on lease. [504581]</p> <p>Stakeholder agreed tree and shrub species list. [504580]</p> <p>Two separate seed storage locations in use [726843]</p> <p>Handover process for handover between packages (e.g. decommissioning to demolition). [505281]</p>	<p>Further contingency actions in place to reduce the likelihood of a 1 year delay to the completion to the revegetation program to achieve the desired density and floristic diversity.</p>	<p>07/07/20 Annual workshop added an action and accepted risk at current evaluation.</p>	Stable	15/07/2020	Good	III		<p>Confirm details around MOU for Greening Australia and/or gain agreement in writing. [693562]</p> <p>Develop procedures for planning and management of seed collection. [693565]</p> <p>Develop seed collection contract. [693563]</p> <p>Develop seed collection procurement strategy [726845]</p> <p>Gain agreement with traditional owners re: alternative species that are more resilient to the waste rock substrate [557231]</p> <p>Incorporate stage 13 results into revegetation plan [600376]</p> <p>Price vegetative propagation as a contingency plan [557228]</p> <p>Renew seed collection permit with KNP. [504593]</p> <p>Review seed viability (including storage, handling, duration of viability) [504599]</p> <p>Secure Contract in place with seed and plant provider. [504595]</p>	Open



Risk ID	Risk Title	Causes	Consequences	Controls	Evaluation Rationale	Recent Developments	Trend	Date	Control Effectiveness	Risk Management Class	Manageability	Actions	Risk Status
505238	Large scale fire or natural disaster (e.g. cyclone) destroys immature vegetation.	Wild fires from external sources. Wild fires from ongoing operational management practices. Lightning strikes. Inadequate weed management. Inadequate response capability. Extreme weather event - flood, wind, drought. Resilience factors are dependent on vegetation type and time (e.g. 5-15 years).	Reduction in floristic diversity and density. Re-sprouting from lignotubers post fire, delays the maturation of the final landform revegetation. Increased active management of revegetation. Low representation of fauna taxa. Increased weed densities. Increased erosion due to lower revegetation success across landform. Potential water quality impact from increased erosion. Large scale damage to new vegetation.	Deep rooting of trees [607821] Delayed introduction of high biomass grasses, reduces fire risk. [602392] Fire breaks and access tracks. [505242] Introduction of cool burns 5-10 years post planting. [602394] Irrigation strategy creates cyclone resistance (encourages deep root development). [505241] LAAs have planned annual burn if not prevented. [505244] Ongoing active management of revegetation [505243] Ongoing liaison with KNP regarding fire, weed and feral animal management strategies [602396] Restricted access to revegetation areas [607816] Revegetation strategy designed to meet closure criteria for resilience (e.g. species mix, irrigation, weed monitoring, viability/germination rate/mortality rate/large scale failure contingency) [602395] Waste rock surface has low fire risk for 5-7 years post-planting. [505240] Weed control and fire management, including buffer zones (~200m surrounding revegetation). [602393]	Evaluation based on meeting rehabilitation requirements in Jan 2026. Cyclone or bush-fire event destroys large areas of revegetated zone. Loss of nursery, seed stocks and source plants due to cyclone would take longer to re-establish even using third party suppliers.	07/07/20 Annual workshop noted risk unlikely, however still class III as there is potential for cyclone to also take out nursery, seed stocks as well as the immature vegetation and this will take longer to re-establish even through third party suppliers. Additional action applied.	Stable	15/07/2020	Satisfactory	III		Develop / Update weed management plan for post closure [607819] Develop plan to manage fire risk to exclude fire from revegetated areas for first 5 years post planting [587522] Ensure associated management plans for nursery and emergency response address contingency management for seeds managed in both locations (nursery and Inganaar building). [726898] Include this risk in state and transition model [607817] Seed Collection Plan to allow for 20% large scale failure. Monitor actual collection against plan. [505247]	Open



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694659	Legacy erosion areas persist post 2026.	Inadequate controls are implemented during the mine's operational phase.	Ongoing erosion and deposition in downstream drainage lines.	<p>Erosion structures are incorporated into landform design - e.g. ripping and armouring where required. [693677]</p> <p>Establishment of vegetative surfaces to reduce erosion. [693676]</p> <p>Final designed landform does not contain slopes > 4%. [504480]</p> <p>Implementation of a QA program for landform construction and erosion controls. [693679]</p> <p>Land form erosion modelling by SSB. [504904]</p> <p>Ongoing maintenance of erosion structures and mitigation of gully formation, post decommissioning. [693678]</p>	Unlikely as legacy erosion areas will be addressed in closure activities and monitoring will determine if there are erosion issues requiring remedial earthworks.	07/07/20 Annual workshop. Risk considered stable at this time, no change.	Stable	22/07/2020	Unrated	II	Easily managed by entity (M1)		Open



Risk ID	Risk Title	Causes	Consequences	Controls	Evaluation Rationale	Recent Developments	Trend	Date	Control Effectiveness	Risk Management Class	Manageability	Actions	Risk Status
504500	Low plant survival rates in the field during establishment and vegetation decline after/at establishment.	<p>Low plant available water in waste rock substrate.</p> <p>Competition from weedy species.</p> <p>Seasonal availability of landform is not optimum for planting.</p> <p>Plant disease or poor health in nursery stock e.g. disease or root: shoot ratio.</p> <p>Lack of nutrient cycling.</p> <p>Lack of local accumulation of litters and fines (sediments).</p> <p>Fauna grazing on tube stock/seedlings.</p> <p>Elevated magnesium sulfate concentrations in groundwater.</p> <p>Inadequate irrigation.</p> <p>Note this risk does not include fire or extreme weather events - these are included in TD.01.10.</p>	<p>Reduction in floristic diversity and density.</p> <p>Delay in revegetation schedule or resources taken from primary planting to support additional infill planting requirements.</p> <p>Revegetation does not support fauna diversity.</p> <p>Unable to meet cultural criteria for a sustainable food and medicinal source.</p> <p>Increased mortality rate from 20% to 40% (60% survival).</p>	<p>Compliance with National Standard for Nursery Management [504510]</p> <p>Construction of landform using various techniques to make sure particle size distribution is to design and paddock dumping to get better compaction. [504504]</p> <p>Criteria established with stakeholders on species and seed gathering area. [504502]</p> <p>Irrigation for first 6 months post-planting. [504508]</p> <p>Plant available water modelling predictions indicate sufficient water holding capacity of waste rock to support vegetation [504503]</p> <p>Ripping of landform. [504506]</p> <p>Sub-surface compaction layers increase water holding capacity of waste rock [504513]</p> <p>Trial landforms completed to demonstrate viability of vegetation in waste rock. [504501]</p> <p>Use of biodegradable pots. [504507]</p> <p>Watering of plants (irrigation) in early stages but not long term. [504505]</p>	<p>Additional 20% of plants die.</p> <p>Sufficient seed and plant stock available to replant so only low schedule impact.</p> <p>Potential for up to \$10m additional cost.</p> <p>Revegetation plan will be updated with experience on Pit 1 in 2020 - following this it is anticipated the likelihood will be reduced.</p>	<p>07/07/20 Annual workshop determined that the risk is trending down due to the good success of the pit 1 irrigation and planting trials. However, there is still work to validate the long term survival rates and matching the reference site to correct species and terrain to reduce mortality as well as increased confidence with long term watering abilities and outcomes.</p>	Decreasing	20/07/2020	Good	III		<p>Additional planting methods (i.e. plant guards, water crystals etc.). [504520]</p> <p>Assessment of particle size distribution of waste rock to inform PAW. [504530]</p> <p>Complete study / trial on understory development on waste rock (CDU and ERA studies). [504516]</p> <p>Completion of the revegetation handover checklist [600371]</p> <p>Conduct nutrient cycling study. [504525]</p> <p>Confirm assumptions contained within Plant Available Water Study. [504517]</p> <p>Finalise Revegetation and Post-Closure Management Plans. [504524]</p> <p>Further studies as per KKN's. [504518]</p> <p>Incorporate stage 13 results into revegetation plan [600376]</p> <p>NESP study into magnesium sulfate concentration in ground water impacting vegetation. [504532]</p> <p>Review assumed mortality rates in view of use of biodegradable pots. [504519]</p> <p>Stockpile drilling to inform perched water table. [504522]</p> <p>Update revegetation plan following experience from Pit 1. [504521]</p>	Open

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694597	Major native fauna do not return to landform.	Reduction in floristic diversity and density. Fire damage to habitat. Competition from feral animals and weeds. Acutely toxic onsite waterbodies. No appropriate habitat types preventing adequate shelter food and/or breeding opportunity	Reduced representation in functional groups. Unable to meet cultural criteria for a sustainable food and medicinal source. No fertilization some animal pollinated of flora groups Lack of sustainability of established ecosystems	Creation of faunal habitats on the landform, including nesting boxes [694620] Eventual removal of site fence (physical barriers) allowing egress on to site. [694619] Implementation of rocky habitat areas. [694617] Islands of translocated leaf litters and hummus (containing invertebrates) [694618] Ongoing liaison with KNP regarding fire, weed and feral animal management strategies [602396] Onsite water quality meets international guidelines for wildlife drinking water. [694602] Operational Weed Management plan [597591] Revegetation Strategy [694601] Weed control and fire management, including buffer zones (~200m surrounding revegetation). [602393] YFM001 Fire Management Plan [694615]	Unlikely probability due to the ability of fauna to egress from adjacent NP to rehabilitation sites	07/07/20 Annual workshop determined no change.	Stable	22/07/2020	Unrated	II	Some difficulty in managing (M2)		Open
504069	No mechanism is currently available to allow access to RPA from 9th January 2026.	Section 44 agreement does not allow access to RPA beyond January 2026.	Standard of site closure cannot be maintained in early years causing legacy issues. Stakeholders seek to impose access arrangements on onerous terms.	Acknowledgement by stakeholders that certain monitoring and maintenance activities are required for a number of years post January 2026. [504071]	Long lead time until 2026 and good working relationship therefore unlikely the ability access will not be available.	07/07/20 Annual workshop determined no change.	Stable	22/07/2020	Unrated	II		Confirm terms of access arrangements. [504074] Continue engagement with DIIS regarding access arrangements for post 9 January 2026. [504073]	Open
504895	Offsite disposal of blackjack is not possible due to inability of waste contractor to gain the necessary approvals.	Contractor cannot demonstrate facility meets environmental requirements. Incident at facility causes loss of operating license.	Onsite disposal option required.	Active engagement with preferred contractor. [505235] Contractor has received state approvals. [505236]	Approvals received, risk managed. 2nd option from BPT is implemented - onsite incineration.	07/07/20 Annual workshop determined no change. Covid-19 delays have been experienced.	Increasing	22/07/2020	Unrated	I		Continue engagement with contractor until contract in place. [504898]	Open



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503403	Perception amongst local community of downstream contamination from Ranger closure impacting ability to engage in traditional activities. Includes radiation, contamination.	Poor/lack of communication with stakeholders Historical incidents and lack of trust	Traditional owners not able to collect bush foods and/or interact with country for cultural practices. Damage to relationship with key stakeholders. Loss of community trust	Actions to manage this issue included in the Communities and Stakeholder Engagement Plan. [503406] Relationship committee meeting. [503405] Water monitoring program. External Relations team is on mailing list for enviro water monitoring to proactively manage media. [503404]	There is a low risk that the TO perceptions do not match that which has been achieved in rehabilitation.	07/07/20 Annual workshop determined no change.	Stable	22/07/2020	Unrated	II		Capture details and strategy in the Communities and Stakeholder Engagement Plan [503408] Utilise interpreter during relationship committee meeting with Traditional Owners to ensure messaging on closure environmental and health risks are well understood [503409]	Open

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504648	Planned active process water treatment tactics (i.e. plant capacity) do not meet the assumed productivities modelled for site inventory reduction (critical path).	<p>BC does not achieve sustainable planned production profile.</p> <p>Two BC heat exchangers are inadequate to operate at full capacity due to higher TDS and higher brine flow rates (current design is 1 duty).</p> <p>BC upgrades not achieved or delayed (to 125%).</p> <p>Higher TDS impacts BC productivity.</p> <p>Implementation of brine squeezer delayed.</p> <p>Brine squeezer does not perform as planned.</p> <p>HDS plant (2 Ml/d) does not deliver planned treatment rates.</p> <p>Membrane process water treatment (squeezer-like) does not deliver planned treatment rates.</p>	<p>Additional process water treatment increases schedule beyond closure date - cost + legal/regulatory & reputational impacts.</p> <p>Increased cost from additional process water treatment through the BC.</p> <p>Increase cost from higher BC operating costs.</p> <p>Increased cost from requirement to implement process water contingency (large scale HDS).</p> <p>Delay in rehabilitating the TSF/RP6 due to need to use for process water storage for longer.</p>	<p>BC evaporator vessel scaling issue understood and addressed. [504649]</p> <p>BC fan upgrade study planned. [504652]</p> <p>BC operation has reached a sustained rate of 115% with no fan upgrade and is operating consistently at a higher rate than in the current water model. [504651]</p> <p>BC seed cyclones upgraded. [504650]</p> <p>Brine squeezer being implemented - schedule in Water Model. [504653]</p> <p>Flowsheet for lime dosing developed; established the technical viability of lime dosing option - to be incorporated into future studies work. [504657]</p> <p>Perform bi-annual (6 monthly) re-baselines of the water model [749042]</p> <p>Pilot work completed for HDS. Existing plant being refurbished. [504655]</p> <p>Plan for pilot work for membrane process water treatment. [504656]</p> <p>Sensitivity analysis on current water model complete. [504658]</p> <p>Appoint project manager encompassing broader risk and consequence management [608164]</p> <p>Recommission existing HDS plant. [504666]</p> <p>Reinstate brine injection operation. [504668]</p> <p>MTC approval for release of process water treated through OBS [676904]</p> <p>Define a flowsheet for lime dosing and establish the technical viability of lime dosing option to feed into FS water tactics confirmation. [504664]</p>	<p>Membrane process water treatment requires more frequent membrane changes leading to increased operating costs.</p> <p>Worst case scenario is a smaller scale evaporator to make up the shortfall. Brine squeezer confidence.</p>	<p>07/07/20 Annual workshop increased likely (class III) due to brine squeezer confidence (12 months on schedule and significant cost).</p>	Increasing	22/07/2020	Marginal	III		<p>Assess the gap in current water treatment vs. required treatment [608163]</p> <p>Analyse and evaluate full implications of TDS on higher BC treatment rates [593630]</p> <p>Communicate results of analysis to management for action [593631]</p> <p>Complete engineering works for full OBS plant trial [673822]</p> <p>Complete FS on BC fan upgrade including the requirement for a third heat exchanger (BC FS Scope). [504662]</p> <p>Complete installation of upgraded seed cyclones into BC. [504660]</p> <p>Complete OBS pre-filtration trial [672328]</p> <p>Implement brine squeezer infrastructure. [504663]</p> <p>Kick off project 1g initiative [608165]</p> <p>Perform a 6 monthly re-baseline of the water model (H2 2020) [749452]</p> <p>Sensitivity analysis on current water model. [504665]</p> <p>Staged OBS plant trial - pilot plant trail to treat process water using brine squeezer technology. [675333]</p> <p>Undertake external study on optimization of existing process water treatment infrastructure [572907]</p> <p>Undertake external test work program on membrane technology for process water treatment. [504667]</p> <p>Undertake plant based trial of pre-filtration and brine squeezer treatment of process water [572906]</p>	Open



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691265	Potential for limited pond water storage availability (2024/2025)	Pit 3 removal for RP2 spillage. Above average rainfall recorded. High volume/storage in RP2 and RP6. Limited capacity to treat pond water for release.	Site inundation/localized flooding. Potential unauthorized release of water off-site. Limited environmental damage and significant reputational damage. Delay in closure activities due to flooding of these areas.	Continuous monitoring of pond water level and volumes [700068] OPSIM Water Balance [597533] Ranger Water Management Plan [700052] TARP for Pond Water Storage Levels [700061]	The evaluation relates specifically to off-site discharge. Inundation restricted to on-site only will have schedule and operational implications. ERA is currently not authorized to discharge pond water off-site under the current Ranger Authorization without approval from the Regulator. ERA have applied for authorization for pond water discharge off-site on limited occasions throughout ~40 years (LOM).	07/07/20 Annual workshop determined no change.	Stable	22/07/2020	Unrated	II	Some difficulty in managing (M2)	Complete validation of the OPSIM water balance forecast [700074] Revise the TARP018 Pond water storage level above capacity [700073] Revision and approval of the 2024/2025 Ranger Water Management Plan [700072]	Open
504641	Process water exceeds MOL in Pit 3.	Very high rainfall event. Additional tailings/material transferred from TSF to Pit 3. Additional tailings from mill. Notching of TSF reduces volume that can be stored in TSF.	Overflow of Pit 3. Requirement to store water in TSF stops dredging operations.	MOL proposed to stakeholders based on surrounding head data to ensure Pit 3 remains a sink. [504642] Ongoing survey of the TSF floor. [504645] Regular bathymetric surveys to determine process water inventory. [504644] Tailings quantities well understood - production data and Fugro survey. [504643]	Schedule delay on cleaning TSF due to water remaining in TSF. Overtopping pit is 1:1000 year flood event.	07/07/20 Annual workshop determined no change.	Stable	20/07/2020	Satisfactory	III		Gain approval for final Pit 3 MOL. [504647] Presentation on risk detail; causes, consequences, controls and actions to be provide to management [616899]	Open



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505984	Radiation doses from the final landform exceed dose constraint.	Mineralised material left on surface (gamma, dust and radon). Exposed tailings. Solutes expressed to surface water and mobilised. Elevated levels of contaminant (metals) in bush tucker.	Non-compliance with ER 5.	Access restrictions to particular areas of the RPA may apply post closure to keep doses below dose constraint. [505988] Active water management strategy and inventory control. Air quality assessment completed. [505993] Air quality assessment completed [604171] Data from trial landform studies has informed the landform design and LEM. [505992] Dust control during decommissioning. [505986] Engineering dose constraint of 300 µSv per year will be applied. [505989] Final landform thickness reduces the likelihood of exposing tailings and radon emanation from tailings. [505987] Iterative landform design informed by LEM. [505991] Material movement planning and stockpile resource model to identify location of 1s and 2s rock. [505985] Storm water and erosion control, design and management structures. [505990]		07/07/20 Annual workshop determined no change.	Stable	22/07/2020	Unrated	II		Air quality assessment to be completed. [505997] Complete bush tucker monitoring and assessment. [505999] Complete surface water model [505995] Identify options for restrictions on land use post-closure. [505998] Radiological dose assessment to model the predicted annual doses to be completed. [505996]	Open
506000	Radiation doses to the public exceed annual dosage limits.	Mineralised material left on surface (gamma, dust and radon). Exposed tailings - see risk TD08-01. Solutes expressed to surface water and mobilised. Elevated levels of contaminants (metals) in bush tucker.	Non-compliance with ER 5. Increased dose to public.	Access restrictions to particular areas of the RPA may apply post closure to keep doses below dose constraint. [506004] Active water management strategy and inventory control. [506008] Data from trial landform studies has informed the landform design and LEM. [506007] Dust control during decommissioning. [506002] Final landform thickness reduces the likelihood of exposing tailings and radon emanation from tailings. [506003] Iterative landform design informed by LEM. [506006] Material movement planning and stockpile resource model to identify location of 1s and 2s rock. [506001] Storm water and erosion control, design and management structures. [506005]	Would require restrictions on use - these would be minimised.	07/07/20 Annual workshop determined no change.	Stable	22/07/2020	Unrated	II		Air quality assessment to be completed. [506013] Complete bush tucker monitoring and assessment. [505999] Complete surface water model [506011] Identify options for restrictions on land use post-closure. [506014] Radiological dose assessment to model the predicted annual doses to be completed. [505996]	Open

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504166	Rainfall is greater than planned in the Water Model (P50) increasing the process water inventory to manage/treat leading to later completion of process water treatment than planned.	Rainfall exceeds the P50 as modelled. Extreme "one off" rainfall event (particularly later in the closure schedule).	Additional process water treatment increases schedule beyond closure date - cost + legal/regulatory & reputational impacts. Increased cost from additional process water treatment through the BC. Increased cost from requirement to implement process water contingency (large scale HDS). Delay in rehabilitating the TSF/RP6 due to need to use for process water storage for longer. High water inventory in 2020-21 prevents TSF being cleaned as process water cannot all fit in Pit 3.	Additional 6 months of BC operation available over and above current model (reduces size of HDS plant required). [504172] BC production currently higher than planned in model (Sept 2018). [504173] Contingency plan for higher-than-planned rainfall (large scale HDS plant) - note this contingency plan is only available up to 2023 (end of Phase 1 demolition). [504170] Industry established tool used (water model) with model assured. [504167] Process water volume tracked against water model prediction [602101] Regular Water Model update. [504171] Scenario of extreme weather event late in the closure schedule assessed during feasibility study and included in water management plans. [504174] Water inventory sensitivity to rainfall is well understood via model based on significant data base (>100 years of data). [504168] Water Model uses significant historical data records from local monitoring location. [504169] FS scope - Develop contingency plan for extreme weather event later in Closure schedule. (Run alternative scenarios of rainfall). [504180] MTC approval for release of process water treated through OBS [676904] Develop contingency plans for higher rainfall events [593627] Complete OBS pre-filtration trial [672328] Conduct a 1G project workshop [678243]	Higher than planned rainfall (P70) early in the project schedule (prior to 2022-23 wet season) results in implementation of HDS contingency at approx. 2 Ml/d. Rationale includes effect of updated BC productivities (Sept 2018) and additional 6 months of BC operation at end of schedule.	Fortnightly meeting determined risk to be stable pending thorough review of actions.	Stable	8/12/2020	Good	IV		Assess the viability of using the Pit 3 bulk backfill waste rock void as a process water storage and include into decant well design (based on Pit 1 learnings) [693029] Complete 1G project desktop review [678240] Complete a concept level study to determine a suitable location and design for RP7, including in TSF options [693027] Complete engineering works for full OBS plant trial [673822] Review and update process water inventory reduction contingency plans for the P70 and P90 cases based on the latest forecast [693026] Staged OBS plant trial - pilot plant trail to treat process water using brine squeezer technology. [675333]	Open



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Risk ID	Risk Title	Causes	Consequences	Controls	Evaluation Rationale	Recent Developments	Trend	Date	Control Effectiveness	Risk Management Class	Manageability	Actions	Risk Status
505207	Removal of remnant tailings takes longer than planned (this is on critical path).	<p>TSF amphibious excavator doesn't meet planned production rates.</p> <p>Floor cleaning methodology flawed.</p> <p>TSF floor more uneven the expected.</p> <p>Stakeholder acceptance of "clean" different to ERA definition.</p> <p>Cannot achieve water drawdown rates in TSF.</p> <p>Foreign objects in TSF floor.</p>	<p>Additional Costs.</p> <p>Delay to dredging.</p> <p>Delay to Pit 3 works.</p>	<p>Additional land based excavators utilised [607323]</p> <p>Composite floor developed. [505208]</p> <p>High-level methodology developed. [505209]</p> <p>Magnetic survey of foreign objects. [505213]</p> <p>Procuring amphibious excavator for wall cleaning. [505212]</p> <p>FS Scope - complete QRA on TSF cleaning activities. [505216]</p> <p>FS Scope - Finalise engineering solution including integration with dredging and wall cleaning activities. [505215]</p>	<p>Additional 6 months required for removal of remnant tailings.</p>	<p>07/07/20 Annual workshop determined risk to be increasing due to compressed schedule / wicking approvals causing potential impact to overall schedule of over 6 months.</p>	Increasing	20/07/2020	Satisfactory	III		<p>Finalise detailed floor cleaning plan with input from ERA Operations. [682598]</p> <p>Finalise detailed wall cleaning plan with input from ERA Operations. [505218]</p>	Open

Risk ID	Risk Title	Causes	Consequences	Controls	Evaluation Rationale	Recent Developments	Trend	Date	Control Effectiveness	Risk Management Class	Manageability	Actions	Risk Status
500614	Site condition at 8 Jan 2026 does not meet Stakeholder expectations	<p>Previous commitments made are not embedded within scope.</p> <p>Insufficient stakeholder engagement or consultation.</p> <p>Insufficient scientific basis to support closure criteria.</p> <p>Inconsistent expectations from different stakeholders</p> <p>Misalignment SSB closure elements viewed as not meeting "Best Practicable Technology" (BPT)</p> <p>Poor environment performance onsite</p> <p>Closure Studies and the outcomes presented in reports, undertaken by relevant experts are complex and difficult to communicate to stakeholders.</p> <p>Significant changes to pre-communicated/approved closure strategy</p> <p>The community may be concerned about what infrastructure is retained or lost as a result of the closure</p> <p>Community expectations for the retained infrastructure are different to that remaining.</p> <p>Misunderstanding of the Authorisation by the community.</p> <p>RPA perceived to be contaminated.</p> <p>Perception of ERA failing to comply with UN conventions, for instance those relating to Tradition Owners/ World Heritage Sites.</p> <p>Broad definition in the legislation interpreted differently by authorities.</p> <p>Landform may block the view of Mt Brockman.</p>	<p>Traditional owners do not return to country.</p> <p>Landform does not meet the values (e.g. land uses) that are expected from the Traditional Owners.</p> <p>Community dissatisfied with final land-form.</p> <p>Inability to obtain final closeout.</p> <p>Regulator agrees with stakeholders causing additional unplanned scope and cost to meet uncertain or changing closure criteria.</p> <p>Additional scope added late in schedule leads to inability to meet closure schedule milestones.</p> <p>Extended care and maintenance phase (possibly in perpetuity).</p> <p>Inability to gain closure certificate and relinquish RPA.</p> <p>May result in prosecution action from not adhering to requirements of Authorisation.</p> <p>Increased liability post-2026.</p> <p>ERA is not be released from the legal responsibilities.</p>	<p>Site specific recognised scientific research undertaken against identified knowledge gaps. [500615]</p> <p>3D printed physical model of final landform used to demonstrate final landform topography. [693665]</p> <p>Application of BPT processes [602095]</p> <p>ARRTC process and key knowledge needs developed. [500616]</p> <p>BPT and approvals process. [500625]</p> <p>Closure Criteria Working Group was re-engaged in 2016 and produced set of draft closure criteria. [500618]</p> <p>Closure Plan updates to incorporate stakeholder recommendations [500630]</p> <p>Communication fora (e.g. ARRTC, ARRAC, MTC, stakeholder workshops). [602096]</p> <p>Contingency's for closure included in Closure Plan. [500631]</p> <p>Continued stakeholder engagement via ongoing presentations to stakeholders through MTC and RCCF. [504195]</p> <p>Early engagement with stakeholders [602094]</p> <p>External commitments register [602097]</p> <p>FS schedule is transparent to stakeholders and provides pressure to endorse closure criteria. [500624]</p> <p>GIS study undertaken to model the potential view lines which has been approved by stakeholders. [602100]</p> <p>GIS study undertaken to model the potential view lines. [693666]</p> <p>Landform design cultural closure criteria. [693663]</p> <p>Nominated resource for stakeholder engagement in place - Chief Advisor. [500620]</p> <p>Rehabilitation Animation [608175]</p> <p>Socio-economic impact assessment [602098]</p> <p>Stakeholder communication strategy and management e.g. traditional owners, MTC, ARRAC, ARRTC, technical working groups, community engagement. [693662]</p> <p>Stakeholder engagement has occurred to understand their needs and the ability to meet these needs [602099]</p> <p>Stakeholder Engagement Plan developed. [500621]</p> <p>Tiered assessment framework. [500628]</p> <p>Trial landform established and results transparent to TO's. Jabiluka rehabilitation provides precedent. [500622]</p> <p>Update Closure Plan with updated closure criteria and submit to Minister for approval annually. [500646]</p> <p>Update SSB & stakeholders engagement plan for closure activities. [500640]</p> <p>Continue ongoing stakeholder engagement via the RCCF [500652]</p> <p>Create simulation (e.g. VR) of final closure site condition for communication to stakeholders. [500658]</p>	<p>Threat of closure criteria not being agreed prior to works being approved is covered by other risks. For example possible reinstatement of Djalkmarra billabong.</p>	<p>07/07/20 Annual workshop determined that risk ID 693660 is merged with this risk. Work completed with TO early on remains valid, no indications that this has changed. Also working on ripping plan for Pit 1 to get feedback on surface preferences.</p>	Decreasing	22/07/2020	Satisfactory	III		<p>Complete negotiation on the specific measurable requirements to be incorporated into closure criteria - target inclusion in MCP [500647]</p> <p>Stakeholder site visit on pit 1 ripping to be arranged. [728625]</p> <p>Update Contingency section in Closure Plan [500654]</p>	Open

Risk ID	Risk Title	Causes	Consequences	Controls	Evaluation Rationale	Recent Developments	Trend	Date	Control Effectiveness	Risk Management Class	Manageability	Actions	Risk Status
504602	Solute transport outcomes do not match modelled behaviour breaching closure criteria.	Higher than estimated solute load from interred tailings in Pit 1 and Pit 3. Higher than estimated solute load from Brine injection into Pit 3 underfill. Higher than estimated solute load from Pit 1 and Pit 3 backfill methodology. TSF deconstruction plan (leaving contaminated material and plume in situ). Higher than estimated solute load from final land form. Tailings consolidation modelling underestimates pore water expressed. Failure of decant structures to remove expressed pore water. Incorrect assumptions of hydraulic properties. Incorrect HLUs. Incorrect assumptions of source concentrations. Higher than estimated solute load from leaving Mill plume and other contaminants in situ. Mineralised material left out of Pit 3. Seepage rates from pit tailings/waste rock are higher than predicted. Active water treatment ceases too early. Volumes of process water and pit tailings flux are not recovered and treated, as predicted. Poor quality water shedding from waste rock is released offsite. Uncontrolled erosion on the final landform (e.g. gullyng). Water management structures undersized and/or unable to cope with extreme events. Poor quality water from legacy contaminated sites (LAA/contaminated sediments) enters offsite waterbodies at greater than predicted quantities/qualities. Exposed ASS releases contaminants to water column.	Downstream environmental impact. Additional scope and cost required to address solute transfer. Ongoing long term water treatment required. Prosecution due to lack of Compliance. Reputation impacts. Impact to cultural heritage sites. Non-compliance with ER 3.1 & 11.3 (ii) (e.g. KNP values are compromised; Ramsar status is compromised, aquatic biodiversity of ARR is compromised). Water quality closure criteria isn't met. Potential toxicity to downstream aquatic biota. Bioaccumulation in bush tucker rendering it unfit for consumption. Sediments and/or solutes entering offsite environment at greater than closure criteria. Billabong sedimentation. Ecosystem damage. Closure criteria not met; no lease relinquishment. Levels of contamination in offsite drinking water exceed health guidelines. Elevated levels of contaminants (metals) in bush tucker.	Baseline groundwater concentrations determined. [504612] Calibrating all the bores over 35 years. [504610] Characterisation of LAA and billabong sediments (partially complete). [504627] Contingency Plan for excessive solute transfer developed (i.e. interception trenches). [504605] Existing solute management experience. [504604] Historic and ongoing studies into erosion. [504625] Landform flood study informs sedimentation controls design. [504613] Monitoring of bores and review and validation of Intera model. [504607] Peer review of Intera Study. [504606] Post-closure Management Plan. [504628] Ranger Conceptual Model (RCM) and solute transport modelling completed. [504623] Sensitivity analysis. [504608] Solute transport and balance study ongoing by stakeholder recognised experts (Intera). [504603] TSF solute transfer study completed by Intera. [504626] Update of conceptual model to include all geological knowledge. [504609] Updated geochemical model and drilling of stockpiles to improve understanding of source concentration. [504611] Surface Water Model. [504616] Landform Flood Study to inform sedimentation control design. [504615] Validation of ground water model through monitored real data. [504618]	Low probability due to inherent conservatism in the model. Water quality in Magela creek causes environmental harm and reputation impact on national level; recovery period 1 year plus.	07/07/20 Annual workshop determined Risk ID 504622 Class II Solutes and sediments from surface runoff from final rehabilitated site enters off-site water bodies at greater than closure criteria. (surface water) merged with this risk.	Increasing	20/07/2020	Satisfactory	III		Challenge ERISS diet assumptions and concentration factors for manganese and prompt expert opinion [707693] Complete Ground Water and Surface Water interaction study [504617] Complete update to surface water model [715083] Consider reactive transport for Manganese, Ammonia, Uranium and Radium in Solute Transport Model [707692] Engage with stakeholders regarding water studies. [504620] Investigate potential hydrodynamic surface water modelling for Gulungul and other billabongs. [707695] Review source term for magnesium, manganese, ammonia, uranium and radium [707442] Undertake bathymetry and eye-sight scanning for Gulungul and other identified billabongs. [707694]	Open



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Risk ID	Risk Title	Causes	Consequences	Controls	Evaluation Rationale	Recent Developments	Trend	Date	Control Effectiveness	Risk Management Class	Manageability	Actions	Risk Status
504464	Subaqueously installed Geotextile fails to meet design requirements for geotechnical strength.	Uneven tailings surface. Subaqueous installation method in highly acidic water. Areas of large differential settlement, Inexperienced contractor. Poor material choice or quality. Lower density tailings than expected Utilization of inappropriate methodology/ contractor	Schedule (critical path) and cost overrun. Health and Safety impact (e.g. equipment sinking). Cannot install secondary capping. Heaving of tailings.	CPT testing at the end of tailings deposition to provide tailings properties. [504467] Engagement with vendors during FS. [504465] Similar works undertaken elsewhere (e.g. Port of Brisbane) Strength testing during construction of secondary cap. [504466]	Issues with surface of deposited tailings causes a delay in placement of the geotextile.	07/07/20 Annual workshop determined stable until EOI and further data validate methodologies.	Stable	20/07/2020	Satisfactory	III		Conduct field trial of geotextile chemical resistance. [504471] Conduct field trial of geotextile installation method at ERA. [504472] Engagement of a design consultant [608174] Peer review by geotechnical expert on geotechnical design [608173] Technical assurance of final geotech design. [504473]	Open
684886	Tailings exceeds MOL in Pit 3.	Additional tailings/material transferred from TSF to Pit 3. Additional tailings from mill. Notching of TSF reduces volume that can be stored in TSF. Sub-aerial deposition into water causes elevated tailings level (beach). Low density tailings result in elevated average tailings level.	Transport of solutes to Magela Creek through weathered zone. Requirement to store water in TSF stops dredging operations.	MOL proposed to stakeholders based on surrounding head data to ensure Pit 3 remains a sink. [504642] Ongoing survey of the TSF floor. [504645] Operations Maintenance Manual (OMM) Pit 3 [706862] Tailings quantities well understood - production data and Fugro survey. [504643]	Schedule delay. Cost to closure.	16/06/20 Fortnightly risk meeting determined risk was stable.	Stable	8/11/2020	Satisfactory	III	Extremely difficult to manage (M3)	Implement Operations Maintenance Manual (OMM) Pit 3 [706872] Presentation on risk detail; causes, consequences, controls and actions to be provide to management [616899]	Open



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Risk ID	Risk Title	Causes	Consequences	Controls	Evaluation Rationale	Recent Developments	Trend	Date	Control Effectiveness	Risk Management Class	Manageability	Actions	Risk Status
504385	Tailings Storage Facility wall breached during deconstruction works while still in use.	<p>Draw down rates within the facility cause instability and slumping of the walls.</p> <p>Wall demolition sequencing causes uncontrolled release of material.</p> <p>Seepage of water occurs through or under wall during water storage; potential for piping erosion leading to failure.</p> <p>Damage to wall rock armouring during tailings removal (dredge/machinery).</p> <p>Excessive erosion on dam walls.</p> <p>Over topping of dam leading to failure.</p>	<p>Significant compliance impact and legal prosecution.</p> <p>Reputation severely impacted.</p> <p>Clean up and remediation costs.</p> <p>Environmental impact.</p> <p>Schedule impact.</p>	<p>Additional monitoring and instrumentation for drawdown [602112]</p> <p>Advanced notice through bore monitoring. [504392]</p> <p>Compliance and auditing against compliance to RT D5 Standard. [504391]</p> <p>Dedicated dam engineer overseeing and approving all plans (Coffey). [504386]</p> <p>Downstream raise dam constructed with clay core [602113]</p> <p>Engineering supervision of construction works. [504388]</p> <p>Independent review of all engineering. [504387]</p> <p>Interception trenches installed around west wall of the TSF. [504390]</p> <p>Maintain appropriate MOL. [504395]</p> <p>Modelling to understand impact [602114]</p> <p>Process safety CCMP's include TSF failure which references drawdown rates on facility. [504389]</p> <p>Process safety controls for dredging. [504393]</p> <p>Successful completion of Eastern wall notch. [504394]</p> <p>Technical review complete for use of TSF as a water storage facility. [504396]</p>	Major compliance and reputation impact if was to occur.	07/07/20 Annual workshop determined new action and no change to risk.	Stable	20/07/2020	Satisfactory	III		<p>Add information from the finalized draw down assessment and the monitoring to the TSF OMM [707378]</p> <p>Conduct an Independent Assurance Audit on TSF deconstruction methodology (post-FS). [504398]</p> <p>Develop a TSF draw down monitoring TARP (Trigger, Action, Response Plan) [728628]</p> <p>Update process safety hazard packages for the TSF wall cleaning works. [504400]</p> <p>FS Scope - Develop model for water transfers/draw down rates. [504401]</p>	Open

Risk ID	Risk Title	Causes	Consequences	Controls	Evaluation Rationale	Recent Developments	Trend	Date	Control Effectiveness	Risk Management Class	Manageability	Actions	Risk Status
694661	Total above baseline radiation dose to plants and animals exceed UNSCEAR values.	Dust transported to local soils (terrestrial). Waste rock on final landform (terrestrial). Land application area (terrestrial). Run-off from the landform to creeks (aquatic). Controlled water releases to creeks (aquatic) during stabilisation phase. Groundwater contaminants expressed to surface water (aquatic).	Increase in radionuclide concentrations in soil affecting terrestrial biota. Increase in radionuclide concentrations in water and/or billabong sediments affecting aquatic biota.	Dust control during decommissioning. [506002] Erosion structures are incorporated into landform design - e.g. ripping and armouring where required. [693677] Establishment of vegetative surfaces to reduce erosion. [693676] Alternative/adaptive landform design based on landform stability modelling. [693675] Material movement planning and stockpile resource model to identify location of 1s and 2s rock. [506001] Storm water and erosion control, design and management structures. [506005]	Unlikely probability as existing controls effective.	07/07/20 Annual workshop determined no change.	Stable	22/07/2020	Unrated	II	Easily managed by entity (M1)		Open
504876	Unable to inject brine into underfill.	Scaling in pipelines associated with wells causes sufficient back pressure to prevent well operating (caused by scale and brine TSS). All 5 wells may block. The use of cold process water to flush blocks the pipe from scale being detached. Floating Brine injection pipeline is kinked and stops/slows flow. Blocking underfill around wellheads. Failure of underdrain bore or inability to reinstate bore. Delay in reinstatement of underdrain bore. Insufficient injection flow rate capacity. Brine does not fill void space as planned. Lack of operating data on brine injection due to underdrain not operational. Brine detected in underdrain. Insufficient brine void space	Brine recycling leads to increased TDS in process water, causing increased cost of treatment. Requirement for additional wells to be drilled. Significant additional maintenance costs. Additional cost for replacement under-drain pumping infrastructure. Significant capital cost associated with contingent brine disposal. Extended water treatment duration (with risk of additional process water from rainfall).	Ability to directional drill additional steel-cased wells with positive-displacement pumps. [504877] Assurance Plan with production metrics developed. Infrastructure built. [504878] Conductivity meter on the under-drain water flow. [602390] Data gathering plan for performance of brine injection. [504882] Full pump replacement held on-site as critical spare. [504881] Have additional pipe on-site to allow faster installation of replacement. [504880] HDS plant incorporated into water model, removes salt from circuit. [602389] Pigging strategy. [504883] Underfill engineered with a 20% contingency for brine storage (based on 100% of process water treated via BC) [602387] Underfill volume review of as-built undertaken (Mark Goghil Nov. 2016) and determined contingency of 20% [602388] Water model capable of forecasting TDS. Pigging and flushing. [504879] Develop contingency plan for blocked well head. [504886]	Current Scope includes 3 new bores. Evaluation based on potential for additional injection bores. No impact on water treatment schedule as brine recirculated. Additional work for underdrain is lower risk. Rationale does not consider alternative salt disposal. Financial risk has been assessed and schedule risk are based on alternative option being required which is unidentified at this stage.	07/07/20 Annual Risk Workshop determined that process water quality still continues to degrade while brine injection is offline. Contingency has been considered but is not a preferred option.	Increasing	14/07/2020	Marginal	IV		Confirm current pigging strategy is correct (chemistry-cold water, cold water (pipe contraction and expansion), frequency). [504891] Contingency plan for brine injection system development [706768] Engage with design vendors regarding alternative methods to directional drilling [607335] Engage with directional drilling company for scope, price and schedule for new well. [504887] Establish a data gathering plan for performance of brine injection. [504890] Issue Expression of Interest for the development of an alternative brine disposal option [726641]	Open



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Risk ID	Risk Title	Causes	Consequences	Controls	Evaluation Rationale	Recent Developments	Trend	Date	Control Effectiveness	Risk Management Class	Manageability	Actions	Risk Status
505847	Uncontrolled release of contaminated material into the onsite environment during tailings transfer to Pit 3.	<p>Failure or damage is incurred to tailings transfer pipeline.</p> <p>Poorly managed transport of hazardous substances.</p> <p>Truck deviates from planned course.</p> <p>Changing environment during closure with respect to controlled areas.</p> <p>Inadequate identification of controlled areas.</p>	<p>Release of hazardous materials on to ground causes environmental incident.</p> <p>Onsite water is contaminated</p> <p>Non-compliance with Ranger Authorisation and ERs.</p>	<p>Closure implementation plan includes expanded controlled area for all hazardous materials handling activities. [505852]</p> <p>Existing ERA procedures for contaminated material management [505851]</p> <p>Pipeline actively managed through ERA's process safety management system. [604157]</p> <p>Tailings transfer pipeline design [604154]</p>	Spillage is contained, no offsite environmental impact.	Risk discussed in a risk owner meeting held on the 06/05/20.	Stable	5/06/2020	Unrated	I		Incorporate management of controlled areas and transport of contaminated materials in the demolition and disposal work methodologies. [505855]	Open



APPENDIX 7.2 ERA CLOSURE RISK SUMMARY 2020

