2 Project overview
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>PROJECT OVERVIEW</td>
<td>2-1</td>
</tr>
<tr>
<td>2.1</td>
<td>History</td>
<td>2-1</td>
</tr>
<tr>
<td>2.1.1</td>
<td>Ranger Mine EIS assessment</td>
<td>2-2</td>
</tr>
<tr>
<td>2.2</td>
<td>Overview of operations</td>
<td>2-3</td>
</tr>
<tr>
<td>2.2.1</td>
<td>Mining</td>
<td>2-7</td>
</tr>
<tr>
<td>2.2.2</td>
<td>Processing</td>
<td>2-7</td>
</tr>
<tr>
<td>2.2.3</td>
<td>Ranger 3 Deeps exploration decline</td>
<td>2-8</td>
</tr>
<tr>
<td>2.2.4</td>
<td>Tailings storage</td>
<td>2-8</td>
</tr>
<tr>
<td>2.2.5</td>
<td>TSF</td>
<td>2-10</td>
</tr>
<tr>
<td>2.2.6</td>
<td>Pit 1</td>
<td>2-10</td>
</tr>
<tr>
<td>2.2.7</td>
<td>Pit 3</td>
<td>2-11</td>
</tr>
<tr>
<td>2.2.8</td>
<td>Stockpiles</td>
<td>2-12</td>
</tr>
<tr>
<td>2.2.9</td>
<td>Water management</td>
<td>2-12</td>
</tr>
<tr>
<td>2.2.9.1</td>
<td>Retention ponds</td>
<td>2-14</td>
</tr>
<tr>
<td>2.2.9.2</td>
<td>Water treatment plants</td>
<td>2-14</td>
</tr>
<tr>
<td>2.2.9.3</td>
<td>Wetland filters</td>
<td>2-14</td>
</tr>
<tr>
<td>2.2.9.4</td>
<td>Land application areas</td>
<td>2-19</td>
</tr>
<tr>
<td>2.2.9.5</td>
<td>Brine concentrator</td>
<td>2-20</td>
</tr>
<tr>
<td>2.2.9.6</td>
<td>Brine Squeezer</td>
<td>2-21</td>
</tr>
<tr>
<td>2.2.9.7</td>
<td>Site water model</td>
<td>2-21</td>
</tr>
<tr>
<td>2.2.10</td>
<td>Jabiru Airport</td>
<td>2-22</td>
</tr>
<tr>
<td>2.3</td>
<td>References</td>
<td>2-24</td>
</tr>
</tbody>
</table>

## FIGURES

- Figure 2-1: Oblique views of the Ranger Mine site (2015 top, 2019 bottom) | 2-4
- Figure 2-2: Ranger Mine site (aerial 2019) | 2-5
- Figure 2-3: Ranger Mine plant layout | 2-6
- Figure 2-4: Spatial extent of the Ranger 3 Deeps exploration decline | 2-9
- Figure 2-5: Surface water release points on the RPA (Deacon 2017) | 2-16
- Figure 2-6: General arrangement of water class catchments on the RPA (Deacon 2017) | 2-17

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Cover photograph: Pit 3 March 2019
Figure 2-7: Current Ranger Mine water circuit ................................................................. 2-18
Figure 2-8: Land Application Areas ............................................................................... 2-20
Figure 2-9: Site water model free process water inventory forecast (June 2019) ............. 2-22

TABLES

Table 2-1: Indicative ore grades and mineral type ......................................................... 2-7
Table 2-2: Water classes and their management ............................................................. 2-13
Table 2-3: LAA description of generalised water management ....................................... 2-19

PLATES

Plate 2-1: Brine Squeezer ............................................................................................. 2-15
Plate 2-2: TSF before dredging commenced ................................................................ 2-23
2 PROJECT OVERVIEW

The purpose of this section is to provide background information on the history and status of the Ranger Mine project, and the current site activities.

2.1 History

The initial discovery of the Ranger Mine deposits was made in October 1969 by an exploration joint venture between Peko-Wallsend Operations Limited (Peko) and Electrolytic Zinc Company of Australasia Ltd (EZ) through aerial radiometric survey. Further drilling confirmed the feasibility of mining two ore bodies, 'Ranger 1' and 'Ranger 3', and in June 1971, Peko and EZ established Ranger Uranium Mines Pty Ltd to manage and develop the deposits.

The grant of a mining lease to allow development of the project was deferred whilst the new Commonwealth Government, elected in December 1972, defined and implemented a policy of public ownership of certain energy resources, including uranium. To comply with the Government’s energy resources policy, Peko, EZ and the Australian Atomic Energy Commission (AAEC), as an agent for the Government, signed the ‘Lodge Agreement’ in October 1975. Under this agreement: (i) the AAEC retained ownership of the uranium and financed 72.5 percent of the project; (ii) Peko and EZ were to fund the balance in equal shares; and (iii) the AAEC would sell the uranium for the Commonwealth Government, with Peko and EZ entitled to share in 50 percent of the net sales proceeds.

A new Commonwealth Government announced approval of the project under the repealed Commonwealth Environmental Protection (Impact of Proposal) Act 1974 (EPIP Act) in August 1977, following submission of an Environmental Impact Statement (EIS) and associated supplements under this Act. The Commonwealth Government made the decision to approve the project following the recommendations of the First and Second Reports of the Ranger Uranium Environmental Inquiry, which had been established under the EPIP Act (termed ‘the Fox Inquiry’) into the potential impacts of uranium mining in the Alligator Rivers Region (Fox et al. 1976, Hart & Jones 1984a).

At the same time, much of the Alligator Rivers Region was declared a National Park (NP) and Aboriginal people were given a major role in the Kakadu NP management. The Commonwealth Government introduced laws covering the Alligator Rivers Region (Commonwealth Environment Protection (Alligator Rivers Region) Act 1978) and established several research bodies and committees to overview the environmental regulation of mining in the region. These included the Supervising Scientist and the Environmental Research Institute of the Supervising Scientist (ERISS), the Alligator Rivers Region Advisory Committee (ARRAC) and the Alligator Rivers Region Technical Committee (ARRTC). In 1978, title to the Ranger Project Area (RPA) was granted to the Kakadu Aboriginal Land Trust, in accordance with the Commonwealth Aboriginal Land Rights (Northern Territory) Act 1976 (Aboriginal Land Rights Act) and the
Commonwealth Government entered an agreement with the Northern Land Council (NLC) to permit mining to proceed.

Construction of the Ranger Mine began in January 1979 and the mine came into full production in October 1981. During the early stages of construction, the Commonwealth Government announced its intention to divest its interest in the project. Peko subsequently established a new company, Energy Resources of Australia Ltd (ERA), to purchase the existing partners' interests. Mining of the Ranger 1 orebody (Pit 1) was completed in December 1994 and development of the adjacent Ranger 3 orebody (Pit 3) commenced in 1996. ERA sells its product to power utilities in Asia, Europe and North America under strict international and Australian Government safeguards. The company aims to maintain long-term relationships with its customers to meet their energy needs and provide a reliable supply of high quality product.

In 2008, ERA announced a significant mineral exploration target, 'Ranger 3 Deeps', of 15 to 20 million tonnes (T) with a potential for 30,000 to 40,000 T of contained uranium oxide. In 2011, ERA approved the construction of an exploration decline to conduct close spaced underground exploration drilling of Ranger 3 Deeps and works began on constructing the exploration decline in May 2012. On 16 January 2013, ERA submitted a referral and notice of intent under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) and Northern Territory Environmental Assessment Act, for the Ranger 3 Deeps underground mine (EPBC 2013/6722). Although an Environmental Impact Study (EIS) was lodged for the proposed mine in 2014 (ERA 2014b), in 2015 ERA announced that the Ranger 3 Deeps Project would not proceed to final feasibility study due to a depressed uranium market and project economics.

2.1.1 Ranger Mine EIS assessment

In February 1974, an EIS was submitted for the Ranger Mine under the repealed EPIP Act. Supplements 1 and 2 to the EIS were submitted in May 1975. As outlined above, in August 1977 a new Commonwealth Government announced approval of the project, following the assessment of the proposal via the Ranger Uranium Environmental Inquiry, or Fox Inquiry (Fox et al. 1976, 1977).

The draft EIS and supplements described all components of the proposed Ranger Mine, including but not limited to:

- geographic location of the proposed Ranger Mine, uranium ore deposits and estimated U₃O₈ content
- conformance with standard open cut mining practices proposed for ore extraction
- intended milling and processing method

---

3 The Nuclear Non-Proliferation Treaty, the Convention on the Physical Protection of Nuclear Material and Australia’s other various bilateral cooperation agreements.
• water treatment and management, including descriptions of, for example, Retention Ponds 1 & 2 and water release strategies during operations
• the proposed tailings dam, known as the Tailings Storage Facility (TSF), construction and operation, including future wall lifts, intended to ensure there was always an adequate height of embankment above the water surface in the TSF
• management of potential radiation, air and water pollutants, and
• proposed rehabilitation and the continuing protection of the surrounding region.

The proposed Ranger Mine, as defined in the draft EIS, was fully assessed as part of the Fox Inquiry. The Fox Inquiry made several recommendations including conditions specific to rehabilitation and closure. Further detail is presented in Section 3.

2.2 Overview of operations

Sections 2.2.1 to 2.2.8 provide an overview of the components of the mining and processing operations at the Ranger Mine (Figure 2-1), including the associated key activities and infrastructure.

Section 2.2.9 summarises the site wide water management system.

Discussion on the closure of Jabiru East area and the Jabiru Airport are not included within the Mine Closure Plan (MCP).

Conventional open cut mining of uranium ore ceased in November 2012. The processing of stockpiled ore continues through the Ranger Mine processing plant, where uranium is leached from the ore using sulfuric acid. The uranium is then purified, concentrated, precipitated, calcined (dried), placed into drums and exported. Components of the mining and processing operations in the context of closure domains are shown in Figure 2-2 and Figure 2-3 and include:
• processing area including a power station (which also provides power to the town of Jabiru), administration and maintenance facilities
• a TSF (historically referred to as the 'tailings dam')
• two mined-out pits – Pit 1 and Pit 3
• ore and waste rock stockpiles
• several water retention ponds, water storage structures and constructed wetland filters
• water treatment plants
• irrigation areas for the disposal of managed release water
• an access road and service tracks
• Ranger 3 Deeps exploration decline (Section 2.2.3), and
• Jabiru Airport, Jabiru East and associated infrastructure (Section 2.2.10).

These components are described in the following sections.
Figure 2-1: Oblique views of the Ranger Mine site (2015 top, 2019 bottom)
Figure 2-3: Ranger Mine plant layout
2.2.1 Mining

Mining activity at the Ranger Mine involved a conventional open cut process, which commences with drilling and blasting. Pit 1 was mined out in 1994 and mining in Pit 3 ceased in November 2012. Prior to the completion of mining in the pits, mined material was categorised by a discriminator, which measured the gamma emissions of each load to calculate uranium grade for either stockpiling or immediate processing according to the grade of the ore (percent uranium oxide) (Table 2-1). Low-grade ore will be returned as backfill to the mined-out pits and covered by non-mineralised rock to create the final landform.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Grade (% U$_3$O$_8$)</th>
<th>Material type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>&lt;0.02</td>
<td>&lt;0.02</td>
</tr>
<tr>
<td>2</td>
<td>0.02-0.05</td>
<td>0.02-0.08</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>0.05-0.10</td>
<td>0.08-0.12</td>
</tr>
<tr>
<td>4</td>
<td>0.10-0.20</td>
<td>0.12-0.20</td>
</tr>
<tr>
<td>5</td>
<td>0.20-0.35</td>
<td>0.20-0.35</td>
</tr>
<tr>
<td>6</td>
<td>0.35-0.50</td>
<td>0.35-0.50</td>
</tr>
<tr>
<td>7</td>
<td>&gt;0.50</td>
<td>&gt;0.50</td>
</tr>
</tbody>
</table>

2.2.2 Processing

The major ore processing stages are described below:

- uranium ore is crushed and ground, then the fine ore is mixed with water to produce a slurry.
- the ore slurry is pumped to leaching vessels where, over a period of 24 hours, more than 90 percent of the uranium in the ore is dissolved using sulfuric acid and pyrulosite (an oxidant).
- the uranium in solution is then separated from the depleted ore in a seven-stage washing circuit.
- after separation, the acidity of the depleted ore (tailings) is partially neutralised with lime before being pumped to the TSF, whilst the leach solution is clarified and filtered.
- the uranium is extracted from the leach solution and concentrated, and then pumped to precipitation tanks.
• A bright yellow uranium compound (ammonium diuranate), commonly referred to as 'yellowcake' is precipitated using ammonia.

• In the final stage of the process, the yellowcake is heated to 800 °C to produce the final product – uranium oxide, which is a dark green powder.

• The product is packed into 200 litre (L) steel drums. These are sealed and transported by road, using an accredited transport company, to a secure holding facility and then exported by ship.

2.2.3 Ranger 3 Deeps exploration decline
ERA constructed an exploration decline at Ranger Mine from near the south-eastern rim of Pit 3, from early May 2012 to December 2014 (Figure 2-4). This enabled an underground exploration and infill drilling program to increase orebody knowledge and provide geological, hydrogeological, geotechnical and radiological data.

The decline extends 2,700 m in length and 450 m below the ground surface, above and parallel to the target mineralised zone. The decline was intended to provide access to the mineral resource and subsequent underground mine known as 'Ranger 3 Deeps'. The Ranger 3 Deeps exploration decline project has been completed and has been decommissioned (Section 11).

2.2.4 Tailings storage
The TSF, Pit 1 and Pit 3 have been approved for the storage of tailings and process water in accordance with relevant conditions prescribed in the Ranger Authorisation (Section 3). Tailings are deposited to achieve the maximum practicable density, and both subaqueous (below surface) and subaerial (in air) deposition methods have been used.
Figure 2-4: Spatial extent of the Ranger 3 Deeps exploration decline
2.2.5 TSF

The TSF is an above ground facility designed to store mill tailings, raised to approximately pH 4, and process water (Figure 2-2). The free process water inventory held in the TSF is progressively reduced through passive evaporation and water treatment via the brine concentrator (BC). A dyke (‘turkey nest’) structure with walls constructed using appropriate soil and rock materials is present adjacent to the TSF. The eastern, southern and western walls of the TSF run along ridges approximating catchment divides which separate Coonjimba Creek from adjacent surface water catchments, including Gulungul Creek to the west and the Djalkmarra and Georgetown catchments to the east. The TSF embankments have been constructed in seven stages between 1979 and November 2012 to the current clay core elevation of +60.5 m RL.

Performance of the TSF is monitored and inspected annually by independent engineers in accordance with the Ranger Authorisation. It is operated in accordance with the requirements of the Australian National Committee on Large Dams and International Commission of Large Dams guidelines for TSF design, construction and operation (ANCOLD 2019). The data is reported to the regulators to confirm that the structure continues to perform according to its design and operational criteria. The TSF is also operated in accordance with the Rio Tinto Standard D5: Management of Tailings and Water Facilities (Rio Tinto 2015), which covers all development phases from planning, design through construction, operation, closure and post-closure where applicable.

Current dredging activities associated with tailings transfer to Pit 3 and estimated volumes are detailed below in Section 2.2.7.

ERA will seek decommissioning of the TSF via a standalone application to the Minesite Technical Committee (MTC), scheduled for submission by November 2021 (Section 11, Appendix 11.4).

2.2.6 Pit 1

Approximately 18 million T of ore was mined from Pit 1 between May 1980 and December 1994. Once the pit was mined out, tailings deposition into the pit commenced in 1996, to an average height of +12 m RL, until deposition ceased in November 2008.

The proposed method and level of unconsolidated tailings deposition in Pit 1 was described in two Applications to the MTC submitted in 1995 and 2005, respectively (ERA 2014a). The first Application proposed the deposition of neutralised tailings to 0 m RL; the second Application proposed tailings deposition to +12 m RL. Both applications received ministerial approval and were the precursor to the bulk backfill activities currently underway.

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4 Reference Level abbreviated to RL. Denotes a specific elevation relative to mean sea level and is regularly used to identify the height or depth of plan or mine infrastructure – e.g. the height of the TSF, depth of Pit 3.
Between 1996 and November 2008, ERA deposited approximately 19.9 million m³ of tailings into the pit. Pit 1 then functioned as a process water storage facility until 2012. Since then, various works have been undertaken to expedite pit tailings consolidation and facilitate bulk backfilling and landform development. The two latter activities commenced after ERA received Northern Territory (NT) and Commonwealth regulatory approval (via the MTC) for a predicted final average tailings consolidation level in the pit of approximately +7 m RL in March and April 2017, respectively (Figure 2-2).

For information on Pit 1 tailings consolidation and solute egress modelling, refer to Section 7.

### 2.2.7 Pit 3

Approval to backfill Pit 3 was obtained in June 2007, from the NT Minister for an Application submitted in November 2006 (Puhalovich et al. 2006). The Application sought approval to backfill Pit 3 “… to an average interim fill level of ~RL-20m during the period from 2009 until 2014 …” Due to a pit expansion in 2007, and later (e.g. Shell 50) further advice to the MTC indicated that the pit tailings would likely be significantly lower.

The 2006 Application was followed up with a "notification" submitted in August 2014, on the "Assessment of Potential Environmental Impacts from an 'Interim' Final Tailings Level of RL-20 m in Pit 3" (ERA 2014a). The predicted modelling was based on "… the designated maximum tailings (RL-20 m) and maximum brine (RL-118 m) levels within Pit 3 as a constant level over the full 10,000 year assessment period. In the case of the Pit 3 tailings level this is a very conservative assumption as the expected average tailings level in 2026, after consolidation, is expected to be RL-30.2 m."

The initial backfill of Pit 3 to construct the in-pit drainage and extraction pumping system was successfully completed in August 2014 with 33.7 million T of waste rock placed into the pit (ERA 1984b) (Figure 2-1). The in-pit drainage and extraction pumping system installed in Pit 3 at the end of 2014 enables the removal of water associated with the tailings slurry mixture and water within the backfilled rock. This water returns to the TSF, where it is then returned to the site processing area and treated by the BC.

The transfer of tailings from the mill to Pit 3 began in early 2015 and will cease when processing stops. Dredging and tailings transfer from the TSF commenced in December 2015 and is expected to be completed in 2020.

The combined tailings from the mill and TSF will fill the Pit 3 void from a starting elevation of approximately -100 m RL to approximately -15 m RL by the end of the deposition phase in 2020. Approximately 23 million m³ of tailings stored in the TSF will be transferred to Pit 3 during 2016 to 2020. The dredge can pump approximately 3.5 ML of tailings slurry per hour from the TSF to Pit 3. Further information on the dredging program is provided in Section 11.

ERA will seek approval for the whole of Pit 3 closure via a standalone application to the MTC, scheduled for submission in October 2020 (Section 11, Appendix 11.4).
2.2.8 Stockpiles

Several stockpiles comprising of ore grade material and waste are situated within the vicinity of the mine pits and the TSF. Approximately 21 million T of ore will be processed from these stockpiles, whilst about 252 million T of waste exist within the stockpiles, which will be used for backfilling of pits and shaping of the final landform for closure.

Throughout the mine life, the stockpiles have been segregated according to both grade and material type. Three main material types are used: primary, weathered and laterite. Primary material consists of unweathered host rock, which consists mainly of altered quartz-feldspar schists and to a lesser extent, cherts and carbonaceous materials. Weathered material consists of friable rock (usually quartz-feldspar schist) with altered mineral assemblages but generally still low in clay content. Laterite is a near-surface, highly weathered and sometimes reconsolidated material that is generally high in iron and aluminium clays and other gangue minerals that have made it difficult to process conventionally. Early in the mine life, improved processing performance led to the combination of the weathered with the primary material being fed to the processing plant. In more recent years a separate laterite processing circuit was developed that allowed this material to also have uranium recovered.

2.2.9 Water management

Water management is the most significant environmental and operational aspect of the Ranger Mine and is an integral part of the ERA Health, Safety and Environment Management System. It encompasses all aspects of water capture, storage, supply, distribution, use and disposal. Water is managed according to the Ranger Water Management Plan, which describes the method used to control water on site (ERA 2019). The management plan, which fulfils the requirements of the Ranger Authorisation (0108-18) and is approved annually by regulators, outlines the approach ERA takes to:

- protect both the wider environment and Magela Creek from the impacts of mining and processing operations
- meet all current statutory requirements
- manage water inventories and discharge mechanisms based on water quality according to the whole of mine approach rather than the source of the water
- strategically manage process and pond water inventories in accordance with current closure planning and strategies.

Water at the Ranger Mine is categorised into different classes according to its source and composition. Each class of water is managed in a specific way, in accordance with the Ranger Water Management System (Table 2-2).
Table 2-2: Water classes and their management

<table>
<thead>
<tr>
<th>Water class</th>
<th>Description and treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Process water</strong></td>
<td>The most impacted water class on site. Currently stored in the TSF and Pit 3. The process water inventory is derived predominantly from water that has passed through or encountered the uranium extraction circuit, and rainfall from designated process water catchments.</td>
</tr>
<tr>
<td><strong>Pond water</strong></td>
<td>Water of a quality that requires active management. Derived from rainfall that falls on the active Minesite catchments. The main storage facilities for pond water include Retention Pond 2 (RP2), RP3 and RP6.</td>
</tr>
<tr>
<td><strong>Release water</strong></td>
<td>Release water is derived from incident rainfall that falls on catchments within the mine footprint and is of a high enough quality that it is possible to leave on the site as storm water runoff. Specific streams are routed through passive treatment systems or staging points for management and release (Figure 2-5).</td>
</tr>
<tr>
<td><strong>Potable water</strong></td>
<td>Potable water is sourced from the Brockman Borefield located in the south-east of the RPA. A second production borefield (Magela Borefield) was established to the north of Jabiru East, primarily as a source of supply for Jabiru East and the Ranger Mine village. Grey water (e.g. from showers and toilets) is treated on site and pumped into septic tanks and then to leach drains.</td>
</tr>
</tbody>
</table>
| **Treated water** | Treated water is water that has passed through one of the three water treatment plants or through the BC. Treated water is divided into the following categories:  
  - Water treatment plant permeate: Water that has been treated to remove a significant amount of its dissolved solids to allow it to be released.  
  - Water treatment plant brines: Water that contains the remaining dissolved solids removed from the pond water. Brines are typically discharged to the process water inventory. However, brines may be discharged to the pond water inventory based on operational requirements.  
  - BC distillate: Purified water that is produced by the BC. Treated distillate is subject to release criteria.  
  - BC brines: Residue water after the distillate has been extracted.  
  - Osmoflow Brine Squeezer (OBS) permeate: water derived from further reverse osmosis treatment of water treatment plant brines by the Brine Squeezer. Water quality is equivalent to water treatment plant permeate.  
  - OBS brines: residue water that contain the remaining dissolved solids removed from the treatment of pond water brines. Typically, discharged to the process water inventory or alternatively to pond water inventory based on operational requirements. |

Source: Deacon 2017
The Ranger Mine footprint is divided into catchment areas (Figure 2-5) which generate surface runoff and/or seepage as a result of incident rainfall. Each catchment may comprise of several elements such as retention ponds, sumps, collection basins and groundwater interception ponds. The water circuit for the Ranger Mine, including the five water classes, the different treatments and water management features are shown in Figure 2-7. A description of the individual water management elements is provided in the following sections.

2.2.9.1 Retention ponds

Four retention ponds are used at the Ranger Mine to provide sediment control, and dilution and storage of pond and managed release waters:

- RP1 (MOL = 390 ML) comprises an earthen embankment that dams Coonjimba Creek, and receives release quality water for discharge into Coonjimba Billabong (both passively and actively) or for active discharge into Magela Creek (Figure 2-2).
- RP2 (MOL = 1,150 ML) comprises an earthen wall impoundment in the former Djalkmarra Creek catchment (now subsumed by Pit 3). RP2 is the primary storage of pond water with distribution networks to the water treatment elements (Figure 2-2, 42).
- RP3 (MOL = 61 ML) is an earthen impoundment within RP2. Water from RP3 is transferred to RP2 via a spillway and pumped for use in the lime mill (Figure 2-2, 43).
- RP6 (MOL = 976 ML) is a turkey-nested, double-lined pond that receives water from RP2 transfers and rainfall (Figure 2-2, 56).

2.2.9.2 Water treatment plants

Ranger Mine operates three water treatment plants to treat excess pond water to a level suitable for release to the environment (Figure 2-2). All water treatment plants are currently configured to treat only pond water to a required standard for release or disposal via land application. The treatment process of pre-filtration followed by reverse osmosis results in four distinct streams that may be directed to specific destinations: permeate, backwash from pre-filtration, chemical clean water and brine.

2.2.9.3 Wetland filters

RP1 wetland filter comprised a series of earthen embankments forming an impoundment with discrete cells arranged in series. The wetland filter has an ecosystem dominated by water lilies and native reeds (*Eleocharis* sp.). Upon entering the wetland, water flows through each of the cells under gravity over a path length of approximately 1,000 m. The last cell of the wetland filter can be equipped with a pumping station and a controlled overflow channel that spills to RP1.

The primary role of the wetland filter is to attenuate uranium from the flow stream using biogeochemical processes before the water is discharged (passive flow) to RP1, used in land application, used in operations for dust suppression or used as construction water.
RP1 wetland filter is currently removed from operational use and its operation will be assessed at a future date.

The Corridor Creek wetland filter is the only wetland filter currently in operation at the Ranger Mine (Figure 2-2, 50). This wetland filter is a combination of natural and constructed wetlands (or cells) with a surface of approximately 17 ha and a total water volume (at full capacity) of approximately 38 mega litres. Constructed in 2001 and situated at the head of the Corridor Creek Catchment, the Corridor Creek wetland filter was designed primarily to polish ammonia from treated pond water permeate and uranium from surface water runoff. The Corridor Creek wetland filter is now used to re-mineralise and remove heat from distillate. The wetland filter continues to polish ammonia from distillate (treated process water).
Figure 2-5: Surface water release points on the RPA (Deacon 2017)
Figure 2-6: General arrangement of water class catchments on the RPA (Deacon 2017)
Figure 2-7: Current Ranger Mine water circuit
2.2.9.4 Land application areas

The land application areas (LAAs) have been used at Ranger Mine since 1985 and have a total area of approximately 350 Ha. ERA defines land application as the process by which water (release water, permeate, wetland polished water) is applied to the LAAs through a network of distribution pipes and sprinkler heads, thereby maximising evapotranspiration loss whilst minimising surface pooling and seepage, and preventing surface runoff during operations. Table 2-3 provides a generalised description of each operational LAA. Figure 2-8 shows all LAAs on the RPA, noting that Magela LAA (6) was decommissioned in 2007.

Further information on the studies undertaken in the LAAs is provided in Section 7.

Table 2-3: LAA description of generalised water management

<table>
<thead>
<tr>
<th>Land area Application Area</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corridor Creek Land Application Area (CCLAA)</td>
<td>The CCLAA is comprised of a network of pipes and sprinkler heads located to the south of Pit 1. The area is approximately 135 hectares. This area receives waters from Georgetown Creek median bund leveline (GCMBL) and Georgetown Creek Brockman Road (GCBR) and is operated during daylight hours only (Figure 2-5). There are no bunding requirements during active operation of CCLAA.</td>
</tr>
<tr>
<td>Djalkmarra Land Application Area (DLAA)</td>
<td>The DLAA is comprised of a network of distribution pipes and sprinkler heads set out across a tract of sparse native woodland north of the Pit 3 access road. The area is approximately 38 hectares. This area receives permeate (via Coonjimba Billabong 2 catchment) only and is operated during daylight hours only. There are no bunding requirements during active operation of DLAA.</td>
</tr>
<tr>
<td>Jabiru East Land Application Area (JELAA)</td>
<td>The JELAA is comprised of a network of pipes and sprinkler heads that covers an area on the old Jabiru East town site. The area is approximately 52 ha. This area receives release waters from RP1 and is operated during daylight hours only. Whilst release quality water is used for irrigation on the JELAA there is no requirement for bunding.</td>
</tr>
<tr>
<td>RP1 Land Application Area (RP1LAA)</td>
<td>The RP1LAA is comprised of a network of distribution pipes and sprinkler heads set out across a tract of disturbed sparse woodland to the west of RP1. The area is approximately 43 ha. This area receives release waters from RP1 and can be operated 24 hours a day and is suitable for flood irrigation. There are no bunding requirements during active operation of RP1LAA.</td>
</tr>
<tr>
<td>RP1 Extension Land Application Area (RP1Ext LAA)</td>
<td>The RP1Ext LAA is comprised of a network of distribution pipes and sprinkler heads set out across a tract of native woodland to the west of RP1. The area is approximately 8 ha. This area receives release waters from RP1 and is operated during daylight hours only. There are no bunding requirements during active operation of RP1 Ext LAA.</td>
</tr>
</tbody>
</table>
2.2.9.5 Brine concentrator

The BC was commissioned in September 2013 to produce 1.83 GL per annum of clean distilled water (distillate) by using thermal energy to evaporate water sourced from the process water inventory (Figure 2-2). Distillate from the BC is discharged through the Corridor Creek wetland filter prior to release to Magela Creek, with brine currently transferred direct to the TSF. In 2015, ERA completed the installation of five injection bores from the surface of Pit 3 to the underfill. The purpose of the injection system is to pump brine from the BC directly into the underfill layer at the base of the pit for final storage.
2.2.9.6  Brine Squeezer

Commissioning of the Brine Squeezer began in June 2019 and is expected to be fully operational by the 2019/2020 wet season. Treatment of pond water through the water treatment plants (WTP) generates brines that are added to the process water inventory. This results in 200 to 1,000 ML/year of additional process water to be treated by the BC. However, the WTP brines are less concentrated than process water (less than 25 percent brine of process water concentration), and treatment via the Brine Squeezer is more cost effective than treating WTP brines alone. Additional processing of WTP brines will reduce the volume added to process water, reducing the total inventory to be treated by the BC, and reducing overall risks to the closure schedule and costs associated with water treatment. More detail on the Brine Squeezer is included in Section 9.2.3.

2.2.9.7  Site water model

Water management and closure planning at the Ranger Mine has been supported since 2006 by a dynamic water and solute balance model. The model is implemented using OPSIM, an operational simulation package for the modelling of water resource systems (OPSIM Pty Ltd 2017).

The model considers the characteristics, connectivity and operational rules associated with the material elements of the process and pond water circuits at the Ranger Mine, and the planned changes to the nature of those elements through to 2026, as described in Section 11. Elements included are the process and pond water catchments and storages, the water treatment plants, the mill, the BC and planned additional water treatment facilities. The model also contains approximations for the release water catchments and storages, and the facilities and rules for managed release to the environment.

The most recent validation and calibration was completed in June 2019 by an external contractor, no major changes that pertain to water management were found. The understanding of the site’s water systems, as captured in the model, is routinely tested by an annual validation and calibration process that has been conducted since the model was first introduced. This validation and calibration process take advantage of the extensive array of water related measurements at the RPA to reconcile model predictions against actual observations and provides updates to the model which addresses any identified variations.

The forecasting approach used applies multiple sequential periods of historical daily rainfall data to the model, using the multiple periods of historical rainfall as an estimate of the possible variation in future rainfall. Model results are collected for each period, simulated, and statistically analysed to provide confidence traces for each variable of interest.

The historical rainfall data for the forecast has been sourced from a point interrogation (‘data drill’) at a geographic point corresponding to Jabiru Airport, of a climate database prepared by the Science Delivery Division of the Queensland Government Department of Science, Information, Technology and Innovation (Jeffrey et al. 2001). The current rainfall data set in use commences on 1 January 1889 and runs through to 30 June 2016.
Typically, median forecasts are used for planning over closure timeframes, with higher confidence forecasts (generally corresponding to higher rainfall) used for contingency and capacity planning.

The model's median forecast for the inventory of process water in the TSF and Pit 3 over time, is presented in Figure 2-9.

![Figure 2-9: Site water model free process water inventory forecast (June 2019)](image)

Revisions continue to be made to the water model in response to updated quarterly measurements of site process water inventory, changes in closure plan tactics and recommendations arising from the annual model validation and calibration process.

### 2.2.10 Jabiru Airport

Jabiru Airport is located within the RPA and caters for light aircraft such as those providing tourist flights, location community charters, medical services and fly in/fly out services from Darwin. It, and much of the Jabiru East portion of the RPA lease, are not considered within this MCP as these assets are very likely to continue beyond the execution of the Mine Closure Plan and be operated by parties other than ERA.
Infrastructure located within the Jabiru East area not to be considered within the MCP consists of:

- Jabiru Airport runway and airport infrastructure
- ERISS buildings
- External services (Telstra).

The Commonwealth Government is responsible for the removal and remediation of the Jabiru field station (ERISS buildings) occupied by the Supervising Scientist Branch (SSB). The core yard is included within the closure implementations strategy (Section 11).

Plate 2-2: TSF before dredging commenced
2.3 References


