Government of Western Australia
Department of Water and Environmental Regulation

Decision Report

Application for Works Approval

Part V Division 3 of the *Environmental Protection Act 1986*

Works Approval Number	W6862/2023/1
Applicant	Evolution Mining (Mungari) Pty Ltd
ACN	002 124 745
File number	DER2023/000674
Premises	Mungari Gold Operations Kundana Road, Kalgoorlie WA 6430 Legal description Part of mining tenements: L15/228, L15/246, L15/387, M15/688, M15/829, M15/830, M15/1287, M15/1407, M15/1741 and M15/1827 As defined by the coordinates in Schedule 2 of the works approval
Date of report	23 April 2024
Decision	Works approval granted

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1. Decision summary

This decision report documents the assessment of potential risks to the environment and public health from emissions and discharges during the construction and operation of the premises. As a result of this assessment, works approval W6862/2023/1 has been granted.

2. Scope of assessment

2.1 Regulatory framework

In completing the assessment documented in this decision report, the Department of Water and Environmental Regulation (the department; DWER) has considered and given due regard to its regulatory framework and relevant policy documents which are available at https://dwer.wa.gov.au/regulatory-documents.

2.2 Application summary and overview of premises

On 12 October 2023, Evolution Mining (Mungari) Pty Ltd (the applicant) applied for a works approval to the department under section 54 of the *Environmental Protection Act 1986* (EP Act). The premises is approximately 20 km north of Coolgardie and currently operates under Licence L7750/2001/10, which authorises operations under categories 5, 6, 12 and 89. The premises has an above-ground tailings storage facility (TSF) comprised of four cells, with tailings currently discharging to TSF Cells 3 and 4.

The works approval relates to proposed construction works to convert Cutters Ridge Pit into an in-pit tailings storage facility (CRIPTSF) for the deposition of tailings. The disposal of tailings is authorised under category 5 and the assessed production / design capacity under Schedule 1 of the *Environmental Protection Regulations 1987* (EP Regulations) which are defined in works approval W6862/2023/1. The infrastructure and equipment relating to the premises category and any associated activities which the department has considered in line with *Guideline: Risk Assessments* (DWER 2020) are outlined in works approval W6862/2023/1.

2.2.1 Construction

The proposed CRIPTSF is located on mining tenement M15/1827. The CRIPTSF is approximately 6 km west of the Mungari processing plant and consists of two existing pits that have ceased mining operations; the Stage 2 (Main) Pit and a smaller Stage 3 (Satellite) Pit. Figure 1 displays pit characteristics.

Construction includes a water reclamation decant water system at the CRIPTSF including a pontoon mounted pump. No underdrainage system is proposed due to the relatively short operational life and increased potential for blockage. A monitoring network of six groundwater bores are proposed around the CRIPTSF to monitor both the shallow and deep aquifers (further information in section 3.3.5).

Pit / Facility	Indicative Pit Geometry	Pit Surface Area (ha)	Approx. Max. Tailings Depth (m)	Indicative Tailings Storage Volume (Mm^3)*	Indicative Tailings Storage Capacity (Mt)*	Indicative Life of operations (years)*
Cutters Ridge (Main S2 Pit)	Width 300 m; Length 550 m Orientation: north-south Min. pit rim: RL 355 m (east) Max. pit rim: RL 369 m (south) Max. Depth 125 m (north) to 152 m (south)	13.8	139	5.51	7.17	3.4
Cutters Ridge (Satellite S3 Pit)	Width 200 m; and Length 260 m Orientated north-south Min. pit rim: RL 354 m (east) Max. pit rim: RL 362 m (north-west) Max. Depth 70 m	4.5	62	0.78	1.01	0.5
Total		18.3	–	6.29	8.18	3.9

Note: *Storage volume was based on the tailings deposition modelling using single point discharge(s) with an assumed tailings beach slope of 1:120 (V:H). Storage capacity and life were conservatively calculated based on the adopted tailings dry density of 1.3 t/m^3 and tailings production of 2.1 Mtpa which is half the production of the expanded Mungari Mill (50% tailings to IPTSFs and 50% to TSFs).

Figure 1: CRIPTSF and physical characteristics[5]

The applicant is also proposing the construction of a pipeline bunding corridor (tailings and return water pipelines) connecting the CRIPTSF to the Mungari processing plant. This pipeline will be constructed alongside the existing haul road routed through existing approved disturbance area and will join a tailings distribution pipeline extending around the perimeter of the pit crest. An estimated 20 km of pipeline of both steel or HDPE pipe will be required. Pipeline bunding corridors and access tracks associated with the CRIPTSF will have a nominal width of 15 m (comprising a 5 m wide pipeline bunding corridor and an access track of up to 10 m wide). Containment bunds along both sides of the pipeline corridor will have a minimum height of 0.5 m. Minor clearing is required to facilitate the construction of the corridors around each pit.

2.2.2 Time limited operations

This current application proposes time limited operations (TLO) relating to 50% of tailings generated at the Mungari processing plant (fed with ore from White Foil and Frog's Leg pits). Tailings will be pumped using the proposed tailings pipeline to the CRIPTSF. Expected storage capacity of 6,130,000m^3 lasting 4.2 years (comprised of Stage 2 pit with 3.7 years and Stage 3 pit with 0.5 years). The remaining 50% will be discharged to the existing storage at TSF 3 and TSF 4 approved under L7750/2001/10.

For most of the operations (initial stage), tailings will be deposited from a single discharge point at one end of each Stage 2 and Stage 3 pit. At the discharge point/spigot location, the tailings delivery pipeline extends a minimum distance of 5m over the pit rim, from where the tailings is deposited into the facility.

The supernatant pond will be progressively developed and located at the opposite pit side, where a pontoon-mounted pump will be deployed and moved up the pit access ramp (when the tailings and the water level rise) to recover water from the facility and return it to the processing plant for re-use. During the last few months of operations (final stage), tailings will be deposited into each pit from up to three discharge points.

The tailings fed to the CRIPTSF have the following properties listed in Table 1.

Table 1: Tailings properties

Parameter	Value
Total dissolved solids (TDS)	85,000 mg/L
Solids content	55%
pH	8.3 to 9.4
Deposited density	1.3 t/m^3 (dry density, conservatively adopted)
Weak Acid Dissociable Cyanide (WAD CN)	50 mg/L
Total cyanide (CN)	200mg/L

The applicant will propose to increase the Mungari processing plant's throughput capacity from 1.9 Mtpa to 4.2 Mtpa by 2025. This increase will be requested via a future licence amendment application.

3. Legislative context

3.1 Mining Act 1978

The Department of Energy, Mines, Industry Regulation and Safety (DEMIRS) approved the Mining Proposal for the CRIPTSF (REG ID 120616) on 14 December 2023 under the Mining Act 1978. The mining tenements associated with the proposal are M15/1827 and L15/387. DEMIRS conducted a geotechnical assessment review process and assigned CRIPTSF a hazard category of "Low – Category 3."

4. Risk assessment

The department assesses the risks of emissions from prescribed premises and identifies the potential source, pathway and impact to receptors in accordance with the *Guideline: Risk Assessments* (DWER 2020).

To establish a risk event there must be an emission, a receptor which may be exposed to that emission through an identified actual or likely pathway, and a potential adverse effect to the receptor from exposure to that emission.

4.1 Source-pathways and receptors

4.1.1 Emissions and controls

The key emissions and associated actual or likely pathway during premises construction and operation which have been considered in this decision report are detailed in Table 2 below. Table 2 also details the control measures the applicant has proposed to assist in controlling these emissions, where necessary.

Table 2: Proposed applicant controls

Emission	Sources	Potential pathways	Proposed controls
Construction			
Dust	Construction of tailings deposition and return pipelines	Air / windborne pathway	• Use of water cart and water sprays
Noise			• Ensure machinery operating to manufacturer's standard • Compliance with *the Environmental Protection (Noise) Regulations 1997*
Operation			
Decant water and/or tailings spill	Operation failure of decant pipeline and/or tailings delivery pipeline (spills/leaks)	Direct discharge/runoff	• Pipeline to be constructed within containment trench. • Telemetered flow meters on both the decant and tailings slurry lines • Daily inspections of pipeline integrity • Scour pits along the length of the pipeline with sufficient volume to contain 24hrs of flow • Pipeline to be double walled along sections where seasonal rainfall is possible
	Deposition of tailings at the Cutters Ridge In-Pit TSF	Seepage through base of pit	• Proposed groundwater monitoring program including groundwater monitoring bores (more detail in section 3.3) • Low permeability pit base • Daily inspection of TSF, decant system and TSF perimeter • Monitoring the water recovery and the corresponding size of the decant pond and dry beach, by quarterly drone surveys or similar
		Overtopping of pit	• Storage capacity to accomodate a 1:100-year AEP, 72-hour storm event (~0.2m) • Maintain minimum total freeboard of 0.5m (between stormwater level and minimum pit rim level) • Daily visual inspection of freeboard • Abandonment bund around the pit crest • Volume recorded regularly when actively discharging • Decant water return network

Emission	Sources	Potential pathways	Proposed controls
			• Ability to decrease deposition flowrate by increasing flowrate to TSF Cells 3 & 4.
Contaminated stormwater	Deposition of tailings at the Cutters Ridge In-Pit TSF	Stormwater runoff around CRIPTSF and overtopping	• Bunding constructed around infrastructure • Stormwater storage capacity to accommodate a 1:100-year AEP, 72-hour storm event (~0.2m) • Maintain minimum total freeboard of 0.5m (between stormwater level and minimum pit rim level) • Adequate uncleared buffer zones retained between disturbed areas and natural drainage lines.

4.1.2 Receptors

In accordance with the *Guideline: Risk Assessment* (DWER 2020), the Delegated Officer has excluded the applicant's employees, visitors, and contractors from its assessment. Protection of these parties often involves different exposure risks and prevention strategies, and is provided for under other state legislation.

Table 3 and Figure 2 below provides a summary of potential human and environmental receptors that may be impacted because of activities upon or emission and discharges from the prescribed premises *(Guideline: Environmental Siting* (DWER 2020)).

Table 3: Sensitive human and environmental receptors and distance from prescribed activity

Environmental receptors	Distance from prescribed activity
Priority flora: 1. *Allocasuarina eriochlamys* subsp. *grossa* (P3) 2. *Austrostipa blackii* (P3) 3. Calandrinia sp. Gypsum (P3) 4. *C. lefroyensis* (P1)	1-3. Recorded during Phoenix's field survey (2019) in M15/1827 4. Not believed to occur within M15/1827 [6]
Priority fauna: 22 threatened species have the potential to occur within the area including the Leipoa ocellata (Malleefowl)	Malleefowl sighted in surrounding areas, however was the only threatened species identified during Phoenix's field survey (2019) [6]
Underlying groundwater (non-potable purposes)	Groundwater chemistry in the area is reflective of regional hypersalinity, with values at the nearby MGO ranging from 150,000 mg/L to 250,000 mg/L TDS and pH levels ranging from slightly acidic to neutral. These harsh parameters result in no environmental values of the groundwater and little to no beneficial uses [6].

<table>
<tr><td></td><td>Depth to groundwater from Stage 2 and Stage 3 pit is greater than 10m.

Regional groundwater recharge occurs primarily through up-flowing hydraulic gradient from underlying aquifers, with infiltration, with minimal direct infiltration occurring via rainfall. After periods of intense rainfall, minor perched aquifers may form in the upper saprolite horizon.

Further groundwater chemical characteristics outlined in Section 3.3.</td></tr>
<tr><td>Minor surface water lines</td><td>1 km and 1.8 km south of the pit; another 1.8 km east of the proposed pipeline at Mungari Mill.

The water catchment details for the area of interest are shown in Figure 6-4 of the supporting document. The flat terrain and presence of salt lakes impacts directly on flood runoff flows and flood levels[6].</td></tr>
<tr><td>Surface water bodies:

1. Kurrawang lake
2. Cattle swamp
3. Kopai lake
4. Other waterbodies</td><td>1. 0.57km south from the proposed pipeline & 4.4km east of the pit
2. 1.6km south of the proposed pipeline & 2.4km southeast of the pit
3. 1.1km northeast of the proposed pipeline at Mungari Mill
4. Displayed in Figure 2</td></tr>
<tr><td>Aboriginal sites and heritage places

<table>
<tr><th></th><th>PLACEID</th><th>NAME</th><th>TYPE</th></tr>
<tr><td>1</td><td>18384</td><td>Kopai Lakes</td><td>Stored data</td></tr>
<tr><td>2</td><td>38309</td><td>Mungari TSF</td><td>Artefacts / Scatter</td></tr>
<tr><td>3</td><td>846</td><td>PIIRA TUKURR</td><td>Mythological</td></tr>
<tr><td>4</td><td>22897</td><td>Mungari 2 (X03)</td><td>Artefacts / Scatter</td></tr>
<tr><td>5</td><td>34415</td><td>Pulyinyaminya Cave</td><td>Artefacts / Scatter, Ceremonial, Rockshelter, Named Place, Natural Feature, Plant Resource</td></tr>
<tr><td>6</td><td>22896</td><td>Mungari 1 (X02)</td><td>Artefacts / Scatter</td></tr>
<tr><td>7</td><td>846</td><td>Piira Tukurr</td><td>Mythological</td></tr>
<tr><td>8</td><td>22903</td><td>Mungari 8 (X09)</td><td>Artefacts / Scatter</td></tr>
<tr><td>9</td><td>38309</td><td>Mungeri TSF</td><td>Artefacts / Scatter</td></tr>
<tr><td>10</td><td>22900</td><td>Mungari 5 (X06)</td><td>Artefacts / Scatter</td></tr>
<tr><td>11</td><td>22899</td><td>Mungari 4 (X05)</td><td>Artefacts / Scatter</td></tr>
</table>
</td><td>1-6: located within the prescribed premises.

7-11: located within 1km buffer from the prescribed premises boundary. In particular, Piira Tukurr (7) is located 0.59km south of the proposed pipeline.

Note:

5. Pulyinyaminya Cave (5) location overlaps the pit. This Aboriginal site is listed as a restricted location. However Department of Planning, Lands and Heritage (DPLH) has informed DWER that the proposed activities intersects the public boundary of the Pulyinyaminya Cave, but not the actual boundary. DPLH has stated that the proposed works is believed to not have any impact on the Aboriginal site (see section 4 for further details).</td></tr>
</table>

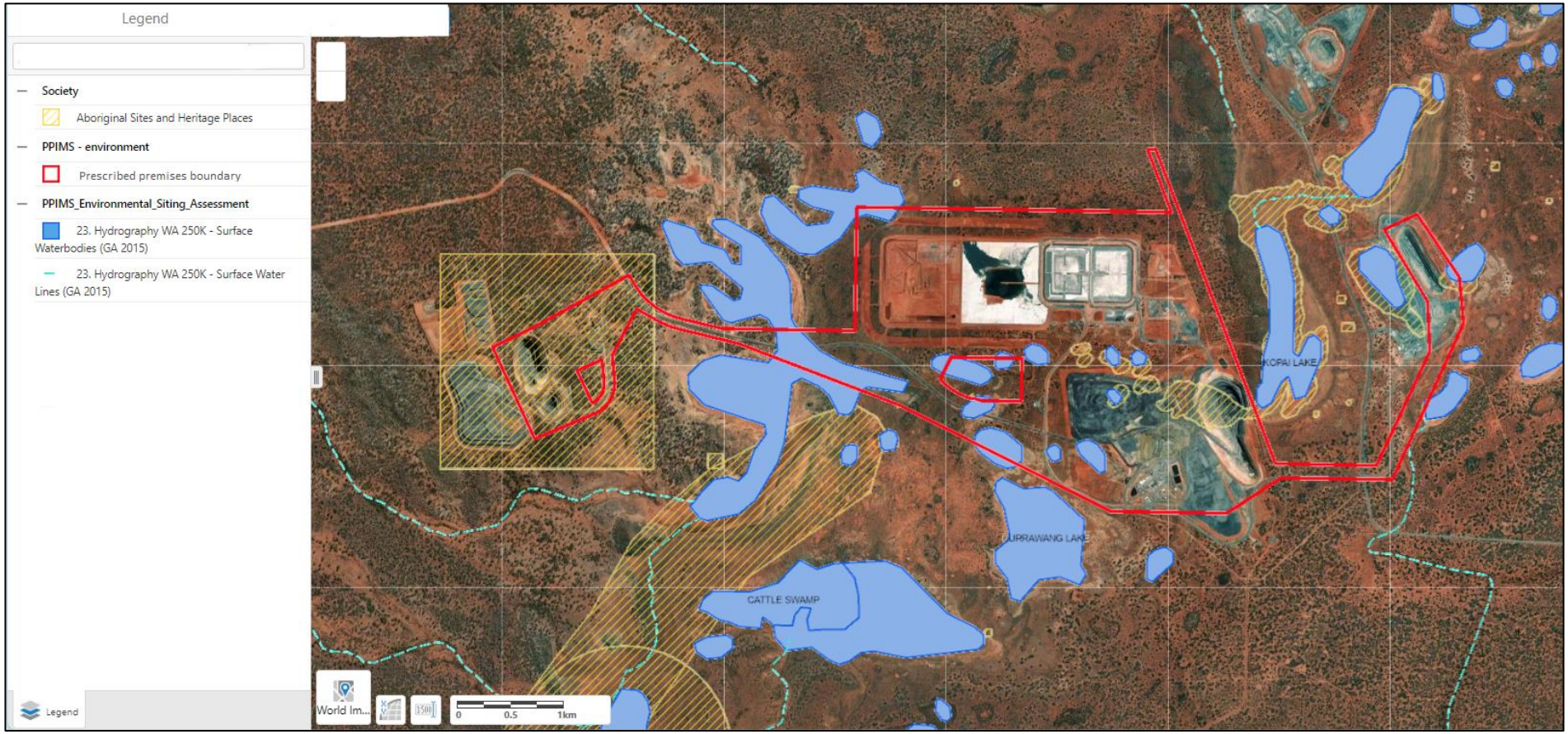

Figure 2: Distance to sensitive receptors

4.2 Risk ratings

Risk ratings have been assessed in accordance with the *Guideline: Risk Assessments* (DWER 2020) for each identified emission source and considers potential source-pathway and receptor linkages as identified in Section 4.1. Where linkages are in-complete they have not been considered further in the risk assessment.

Where the applicant has proposed mitigation measures/controls (as detailed in Section 4.1), these have been considered when determining the final risk rating. Where the delegated officer considers the applicant's proposed controls to be critical to maintaining an acceptable level of risk, these will be incorporated into the works approval as regulatory controls.

Additional regulatory controls may be imposed where the applicant's controls are not deemed sufficient. Where this is the case the need for additional controls will be documented and justified in Table 4.

Works approval W6862/2023/1 that accompanies this decision report authorises construction and time-limited operations. The conditions in the issued works approval, as outlined in Table 4 have been determined in accordance with *Guidance Statement: Setting Conditions* (DER 2015).

A licence is required following the time-limited operational phase authorised under the works approval to authorise emissions associated with the ongoing operation of the premises i.e. category 5 activities. A risk assessment for the operational phase has been included in this decision report, however licence conditions will not be finalised until the department assesses the licence application.

Table 4: Risk assessment of potential emissions and discharges from the premises during construction and operation

Risk events					Risk rating [1] C = consequence L = likelihood	Applicant controls sufficient?	Conditions [2] of works approval	Justification for additional regulatory controls
Sources / activities	**Potential emission**	**Potential pathways and impact**	**Receptors**	**Applicant controls**				
Construction								
Construction of pipeline	Dust	Air/windborne pathway causing impacts to health and amenity	Aboriginal heritage sites Priority flora	Refer to Section 3.1	C = Slight L = Unlikely **Low Risk**	Y	Condition 1 – Infrastructure construction requirements	N/A
	Noise		Threatened fauna	Refer to Section 3.1	C = Slight L = Unlikely **Low Risk**	Y	Condition 1 – Infrastructure construction requirements	N/A
Operation (TLO)								
Operation failure of decant pipeline and/or tailings delivery pipeline (spills/leaks)	Decant water and/or tailings	Direct discharge/runoff causing contamination/erosion	Surface water bodies and lines Native vegetation, including priority flora	Refer to Section 3.1	C = Moderate L = Unlikely **Medium Risk**	Y	Condition 1 – pipeline construction – containment trench, telemetered flow meters, double-walled sections, scour sumps and containment trench to contain 24hrs of flow. Condition 8 – Pipeline TLO – maintained within containment trench to contain 24hrs of flow Condition 9 – pipelines daily inspection	N/A
Deposition of tailings at the Cutters Ridge In-Pit TSF	Decant water and/or tailings	Seepage through base of pit causing groundwater mounding and adverse impacts to groundwater dependent vegetation	Groundwater Native vegetation including priority flora	Refer to Section 3.1	C = Moderate L = Unlikely **Medium Risk**	Y	Condition 2, 10 – groundwater monitoring bores constructed to monitor seepage and groundwater quality	See detailed risk assessment in section 4.3.
	Decant water	Overtopping of pit and stormwater runoff,	Surface water bodies and lines	Refer to	C = Moderate	Y	Condition 8 – Minimum freeboard requirement.	N/A. Licence to include daily

Risk events					Risk rating [1] C = consequence L = likelihood	Applicant controls sufficient?	Conditions [2] of works approval	Justification for additional regulatory controls
Sources / activities	**Potential emission**	**Potential pathways and impact**	**Receptors**	**Applicant controls**				
	and/or tailings	causing contamination/erosion	Aboriginal heritage sites Priority flora	Section 3.1	L = Unlikely **Medium Risk**			inspection of freeboard, however not possible to breach freeboard during TLO.

Note 1: Consequence ratings, likelihood ratings and risk descriptions are detailed in the *Guideline: Risk Assessments* (DWER 2020).

Note 2: Proposed applicant controls are depicted by standard text. **Bold and underline text** depicts additional regulatory controls imposed by department.

4.3 Detailed risk assessment for seepage from CRIPTSF

4.3.1 Summary of risk event

There is potential for tailings seepage from the in-pit CRIPTSF to cause contamination of soil and groundwater and harm to native vegetation.

4.3.2 Characterisation of emission and potential impact

Chemical characteristics of tailings

The most significant environmental hazard that would be associated with tailings disposal to the proposed in-pit TSF, is the extremely high salinity of the pore-water and of the natural groundwater. This high water-salinity would have the potential to cause the death of nearby vegetation if significant groundwater mounding were to take place near the facility.

In addition, chemical analyses that have been provided by the applicant have indicated that the tailings pore-water would also contain some other chemical constituents of environmental concern, including elevated concentrations of selenium and arsenic.

Geochemical test-work was undertaken on samples of tailings materials that would be discharged to the CRIPTSF. These tailings samples were taken from the Mungari processing plant which was fed with ore from White Foil and Frog's Leg pits (blend called operating sample). The Department's internal technical contaminated site's experts reviewed the test-work and concluded that the type of testing conducted was suitable for assessing the environmental risk associated with discharge of tailings above the water table.

Results of sampling are displayed in Table 5. The tailings water samples are hypersaline with Total Dissolved Solids (TDS) of 183,231 – 200,320 mg/L, and slightly alkaline with pH values of 7.1 and 7.4. This is comparable to the hyper-saline groundwater in the area ranging from 150,000 mg/L to 250,000 mg/L TDS and pH levels ranging from slightly acidic to neutral. Some elements in the tailings were found to have higher concentrations in the supernatant water when compared to groundwater, in particular selenium and arsenic. The elevated concentrations of selenium that were measured in samples of tailings pore-water (up to 780 µg/L) and arsenic (up to 240 µg/L) are of particular concern. These higher concentrations have the potential to negatively impact native vegetation plant health surrounding the CRIPTSF and contaminate groundwater.

Although testing has not been conducted for the potential release of metals and metalloids from tailings deposited below the water table (after TSF mine closure), the applicant sought expert review. Expert review expects that the contrasting permeability of the tailings-bed and adjoining bulk-aquifer will negate the possibility of a groundwater-throughflow system occurring and the tailings bed becoming submerged in the local groundwater. Additionally, geochemical conditions will not support the reductive dissolution conditions to exist and hence there will be little to no release of metals and metalloids to the groundwater [7].

Table 5: Supernatant comparison to local groundwater

Parameter	Reference Value (mg/L)	Assay Results (mg/L)		
		Frog's Leg	White Foil	Operating Sample
pH	6.97	7.40	7.10	7.40
TDS	192650	183231*	192022*	200320*
Aluminum	0.19	1	1	0.1
Antimony	N/D	0.044	0.008	0.018
Arsenic	0.025	0.24	0.21	0.03
Barium	N/D	0.11	0.17	0.28
Boron	N/D	1	1	0.1
Cadmium	0.006	0.002	0.002	0.0023
Calcium	826	845	892	2225
Chloride	99500	93881	93354	104949
Chromium (total)	0.02	1	1	0.1
Cobalt	0.02	0.08	0.03	0.203
Copper	0.035	1	1	0.15
Cyanide-Total	N/D	0.75	1.6	3
Cyanide-Free	N/D	N/D	N/D	<0.1
Cyanide-WAD	N/D	0.5	1	0.6
Fluoride	N/D	0.1	0.1	0.6
Iron	1.61	1	1	0.1
Lead	0.05	0.06	0.05	0.005
Magnesium	8300	7684	7770	4173
Manganese	0.97	3	4	9.3
Mercury	N/D	0.01	0.01	0.001
Molybdenum	N/D	0.04	0.03	0.050
Nickel	0.01	1	1	0.55
Phosphorus	N/D	10	10	1.5
Selenium	0.02	0.78	0.76	0.014
Silver	N/D	0.001	0.004	0.0072
Sodium	56400	49275	49955	61765
Sulphate	17200	16179	15722	5328
Tin	N/D	0.01	0.01	0.005
Uranium	N/D	0.002	0.005	0.0013
Vanadium	N/D	1	1	0.15
Zinc	0.17	1	1	0.1

Note:
Elements highlighted in orange indicate that the laboratory limit of detection exceeds the average groundwater monitoring concentration, and elements highlighted in red indicate that an element exceeds the average groundwater monitoring concentration.
N/D = Not determined. * indicated converted from mg/kg to mg/L based on supernatant SG of 1.2.

Physical characteristics of tailings

The applicant provided historical and recent findings of the tailings' physical properties. The recent tailings sample was found to be finer than the historical sample with a fines content (passing 75 µm) of 92 to 94.4%, and a clay content (passing 2 µm) of 8.8 to 11.2%. It is classified

as low plasticity clayey silt-like material. The undrained and drained settling and air-drying laboratory testing indicated that the tailings could achieve a dry density of 1.3 t/m3 during operations, and final settled dry density of between about 1.6 and 1.7 t/m3 post operations.

Water balance

The most effective way of minimising risks to vegetation is to minimise seepage and keep the water table as deep as possible during tailings disposal into the proposed TSF. In-pit TSFs generally do not initially leak due to the effects of evaporation from the mine void (a terminal groundwater sink). However, they will start to leak when sufficient material is deposited in the mine void to reduce the effects of evaporation. Seepage rates from TSFs are usually estimated using from water balance assessments.

The applicant was requested to resubmit a water balance with more accurate pan-factors for evaporation for hypersaline water with a TDS of 200,000mg/L (0.4 for decant pond area and 0.2 for beach areas on the TSF). The water balance is configured where the rate of water return for the decant system ensures the total inflows matched the total outflows, meaning there would be no surplus or deficit. The water balance summary can be seen in figures Table 6 and Table 7. The proposed water recovery system is designed to remove 85% of the slurry water for use in the Mungari plant.

The revised water balance indicated that seepage losses would be small, based on the pit wall and pit floor permeability of 5.0×10^{-8} m/sec/m^2. Tailings testing (Extended Hight Consolidation Test) achieved a permeability (k) of 9.6×10^{-11} m/sec under loading of 1600 kPa which demonstrates that tailings will effectively form a ‘relatively impermeable plug’ within the pit. Additionally, actual flows into the pit were less than anticipated, meaning the ground is ‘tighter’ than assumed during earlier dewatering studies and therefore the potential losses to seepage are likely to be ‘negligible’[8].

Table 6: S2 pit water balance[8]

Inflows (m^3)	S2 Stage 1 (RL 325 m)		S2 Stage 2 (RL 340 m)		S2 Stage 3 (RL 355 m)	
Annual Average Rainfall Runoff (m^3)	19,740	1%	12,062	1%	3,651	0%
Water in Tailings Slurry (m^3)	1,890,000	99%	1,890,000	99%	1,890,000	100%
Total Inflows (m^3)	1,909,740	100%	1,902,062	100%	1,893,651	100%
Outflows (m^3)	**S2 Stage 1 (RL 325 m)**		**S2 Stage 2 (RL 340 m)**		**S2 Stage 3 (RL 355 m)**	
Decant Pond as a % of total surface area at nominated RL	70%		30%		5%	
Wet beachs as a % of the total surface area at nominated RL	5%		5%		5%	
Annual Average Evaporation Loss from Decant Pond (m^3) with evaporation pan coefficient of 0.4	46,925	2%	29,317	2%	6,568	0%
Annual Average Evaporation Loss (m^3) from tailings area transpiring with evaporation pan coefficient of 0.2	1,676	0.1%	2,443	0.1%	3,284	0.2%
Seepage Loss (m^3)	10	0.001%	15	0.001%	21	0.001%
Retention (Residual Moisture - m^3) assumes tailings profile fully saturated	737,100	39%	585,900	31%	472,500	25%
Water recovery with designed pumping capacity not less than 85% of slurry water(m^3)	1,124,029	59%	1,284,387	68%	1,411,278	75%
Total Outflows (m^3)	1,909,740	100%	1,902,062	100%	1,893,651	100%
Potential water recovery as a % of water in tailings slurry	**59%**		**68%**		**75%**	

Table 7: S3 pit water balance[8]

Inflows (m^3)	S3 Stage 1 (RL 340 m)		S3 Stage 2 (RL 345 m)		S3 Stage 3 (RL 350 m)	
Annual Average Rainfall Runoff (m^3)	6,240	0.3%	5,320	0.3%	3,190	0.2%
Water in Tailings Slurry (m^3)	1,890,000	99.7%	1,890,000	99.7%	1,890,000	99.8%
Total Inflows (m^3)	1,896,240	100%	1,895,320	100%	1,893,190	100%
Outflows (m^3)	**S3 Stage 1 (RL 340 m)**		**S3 Stage 2 (RL 345 m)**		**S3 Stage 3 (RL 350 m)**	
Decant Pond as a % of total surface area at nominated RL	70%		30%		5%	
Wet beachs as a % of the total surface area at nominated RL	5%		5%		5%	
Annual Average Evaporation Loss from Decant Pond (m^3) with evaporation pan coefficient of 0.4	15,803	0.83%	7,876	0.42%	1,738	0.09%
Annual Average Evaporation Loss (m^3) from tailings area transpiring with evaporation pan coefficient of 0.2	564	0.03%	656	0.03%	869	0.05%
Seepage Loss (m^3)	2	0.0001%	2	0.0001%	3	0.000%
Retention (Residual Moisture - m^3) assumes tailings profile fully saturated	737,100	38.87%	585,900	30.91%	472,500	24.96%
Water recovery with designed pumping capacity not less than 85% of slurry water(m^3)	1,142,771	60.27%	1,300,886	68.64%	1,418,079	74.90%
Total Outflows (m^3)	1,896,240	100%	1,895,320	100%	1,893,190	100%
Potential water recovery as a % of water in tailings slurry	**60%**		**69%**		**75%**	

4.3.3 Assessment Criteria

The department has considered the chemical characteristics of tailings against the local groundwater and the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZG 2018). Salinity, selenium and arsenic are of particular concern due to elevated concentrations measured in tailings. The natural groundwater in the vicinity of the mine is hypersaline and considered to have no beneficial use other than limited use in mining and processing.

4.3.4 Works approval holder controls

Section 4.1.1 outlines the works approval holder's proposed controls. The applicant has proposed six monitoring bores to be constructed around the two mine voids contained within the TSF (**Error! Reference source not found.**). Internal technical advice has advised that the spatial distribution of these bores is appropriate to monitor standing water levels and water quality.

The applicant has also proposed monitoring the water recovery and the corresponding size of the decant pond and dry beach, by quarterly drone surveys or similar to measure the performance of water management at the CRIPTSF.

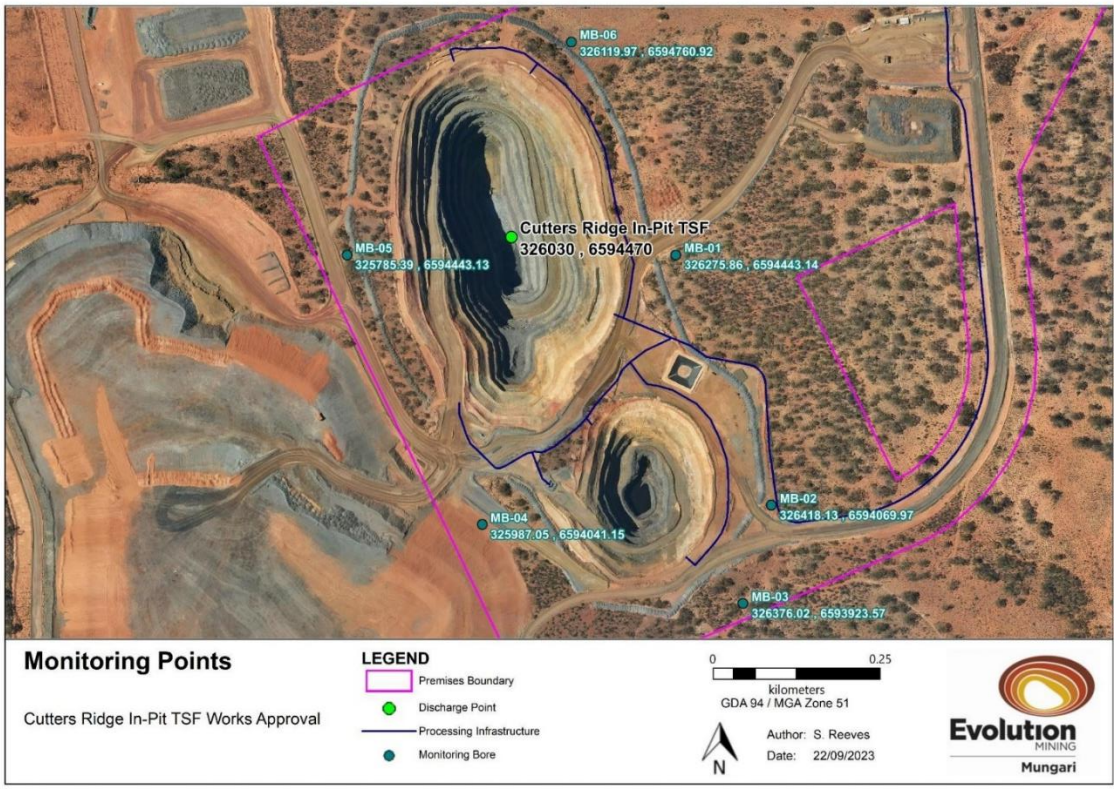

Figure 3: Location of monitoring bores

4.3.5 Risk assessment and rating

The water balance provided indicates deposited tailings are unlikely to cause excessive seepage through the pit walls and pit floor due to wall and floor permeability rates, evaporation rates, sufficient in-situ dry density and by achieving total water recovery. Water recovery infrastructure (piping and pumping) has been designed to return up 85% of total water discharged into these facilities for reuse in the Mungari Plant. However, ultimately the performance of the decant recovery system and water balance will be monitored during the operation of the TSF, primarily through ongoing groundwater monitoring.

Should seepage occur, there is the potential for impacts to vegetation if groundwater mounding was to occur, creating a potential pathway via root uptake. The elevated concentrations of selenium that were measured in samples of tailings pore-water (up to 780 µg/L) are of particular concern, because:

- These concentrations are at least a factor of ten higher than levels recommended by the Australian and New Zealand national water quality guidelines to protect plant health and to limit the risk of biomagnification of selenium in terrestrial food-webs; and
- Under some geochemical conditions, this contaminant can be transferred from a shallow water table into soil ecosystems by volatilisation (Ashworth and Shaw, 2006) without these ecosystems having direct contact with hypersaline groundwater. That is, there would possibly be an exposure pathway near the proposed in-pit TSF that would enable selenium to be transferred from hypersaline groundwater into local food webs on a long-term basis without killing vegetation.

There is currently insufficient information available to establish site-specific trigger values for selenium in groundwater that would protect vegetation and soil ecosystems from the effects of such a soil volatilisation pathway. Consequently, the Delegated Officer considers that the most

effective way of minimising these risks would be to keep the water table as deep as possible during tailings disposal into the proposed TSF. The proposed 6 metre depth limit for the water table near the TSF is considered sufficient to manage this risk and eliminate a pathway created by potential groundwater mounding and root uptake. However, this limit is redundant under time-limited operations given it is unlikely significant mounding will occur. Rather, this limit is to be applied to long-term operations should a licence under Part V of the EP Act be granted.

Concentrations of arsenic in the tailings pore-water were also elevated (up to 240 µg/L) and would be at levels of environmental concern in a freshwater environment. However, due to the lack of groundwater-dependent environmental receptors near the proposed in-pit TSF and the absence of a volatilisation pathway that could transfer this metalloid into nearby soil ecosystems, these elevated arsenic levels are not considered to be of particular environmental concern if leached into hypersaline groundwater near the TSF.

There would also be a significant risk that arsenic could be leached at higher concentrations from tailings deposited in the lower part of the pit after mine closure. This is because of the partial reductive dissolution of iron oxide minerals in tailings particles that could take place beneath the water table when the water table has rebounded with the cessation of mine dewatering. This could increase the rate at which arsenic is released from tailings into groundwater. Therefore, the applicant is expected to instigate a management response if a consistent upward trend of arsenic concentrations in groundwater were to be detected in monitoring bores near the facility.

Considering these factors, the proposed controls and separation distance to receptors, the department has determined that the consequence rating for seepage impacting vegetation is *moderate* and likelihood is *unlikely*, resulting in a *medium risk* rating. The Delegated Officer has specified works approval conditions as outlined in Table 4, including the construction of groundwater bores around the CRIPTSF and monitoring of groundwater depth and quality. No additional regulatory controls were considered necessary to mitigate the risk to an acceptable level. As noted above, the Delegated Officer recommends a 6 mbgl limit on standing groundwater levels in monitored groundwater bores be applied to a licence should one be granted for the premises, to protect vegetation from potential mounding.

5. Consultation

Table 8: Consultation

Consultation method	Comments received	Department response
Application advertised on the department's website on 15/12/2023.	None received	N/A
Local Government Authority – Shire of Coolgardie advised of proposal on 19/12/2023.	None received	N/A
Department of Energy, Mines, Industry Regulation and Safety (DEMIRS) advised of proposal on 19/12/2023.	DEMIRS approved the Mining Proposal for the Cutter's ridge in-pit TSF on 14/12/2023. DEMIRS conducted a geotechnical assessment review process and	DWER notes that a Mining Proposal has been approved for the proposed activities and will consider existing tenement conditions in setting works approval conditions.

	assigned the in-pit TSF a hazard category of “Low – Category 3”. A summary of conditions to the tenement M15/1827 on the Mining Proposal include: 1. Routine checking of the TSF by site personnel during periods of deposition to ensure the facility is functioning as per the design intent. 2. An engineering or geotechnical specialist shall audit and review the active TSF on a triennial basis. 3. Upon decommissioning of the TSF and prior to rehabilitation, a further review report by a geotechnical or engineering specialist shall be submitted to DEMIRS.	
Department of Planning, Lands and Heritage (DPLH) advised of proposal on 19/12/2023.	Comments received 05/01/2024: 1. The proposed clearance and infrastructure area intersects with the public boundary (but not actual boundary) of Aboriginal Lodged Place ID 34415 (Pulyinyaminya Cave). DPLH stated the proposed works would not have any impact on ID 34415 (Pulyinyaminya Cave) and therefore no approvals under the Aboriginal Heritage Act 1972 (AHA) would be required. 2. Limited Aboriginal heritage surveys have been conducted over the entirety of the proposed pipeline and therefore the applicant should be made aware of their obligations under the AHA should previously unreported Aboriginal heritage come to light. 3. Notes that the applicant has entered into a Native Title Agreement with Maduwongga Native Title Group and Marlinyu Ghoorlie Native Title Group.	1. DWER notes that the Pulyinyaminya Cave site will not be impacted. 2. DWER has included DPLH’s comment in this decision report to highlight the applicant’s obligations. 3. N/A.

Applicant was provided with draft documents on 05/04/2024	Applicant provided comments on 12/04/2024. Refer to Appendix 1	Refer to Appendix 1

6. Conclusion

Based on the assessment in this decision report, the delegated officer has determined that a works approval will be granted, subject to conditions commensurate with the determined controls and necessary for administration and reporting requirements.

As noted in Section 4.3.5, the Delegated Officer recommends a 6 mbgl limit on standing groundwater levels in monitored groundwater bores be applied to a licence should one be granted for the premises, to protect vegetation from potential mounding.

References

1. ANZG 2018, A*ustralian and New Zealand Guidelines for Fresh and Marine Water Quality*. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia. Available at www.waterquality.gov.au/anz-guidelines
2. Ashworth, D.J. and Shaw, G., 2006. Soil migration, plant uptake and volatilisation of radio-selenium from a contaminated water table. *Science of the Total Environment*, **370**, 506-514.
3. Department of Environment Regulation (DER) 2015, *Guidance Statement: Setting Conditions*, Perth, Western Australia.
4. Department of Water and Environmental Regulation (DWER) 2020, *Guideline: Environmental Siting*, Perth, Western Australia.
5. DWER 2020, *Guideline: Risk Assessments*, Perth, Western Australia.
6. Evolution Mining 2023, Works Approval Application – Additional Information Submitted - Cutters Ridge In-Pit TSF, Kalgoorlie, Western Australia.
7. Graeme Campbell & Associates Pty Ltd 2024, Response to Query from DWER re. Potential Release of Metal(loid)s to Groundwater via Reductive-Dissolution of Fe(III)-Oxyhydroxide Minerals Under the Suboxic Conditions of Saturated-Tailings, Bridgetown, Western Australia.
8. Tetra Tech Coffey 2023, Mungari Gold Operation – Cutters Ridge In-Pit TSF Design, Perth, Western Australia.
9. TSF Reviews Pty Ltd 2024, Cutters Ridge In-Pit Tailings Storage Facility – Mungari Operation – DWER RFI, Kalgoorlie, Western Australia.

Appendix 1: Summary of applicant's comments on risk assessment and draft conditions

Condition	Summary of applicant's comment	Department's response
1	1. Remove unnecessary wording 'Infrastructure location timeframe'	1. Removed accordingly
1 Table 1	2. 'Surface water management infrastructure' row from table 1 because the abandonment bund is already constructed and no additional surface water management is required as part of the works approval 3. Under tailings and decant return pipelines row, add 'scour pits' to be included with the pipeline corridor and for it to 'contain 24 hours of flow' rather than exact number. Change 'seasonal rainfall' to 'seasonal flooding'. Include 'containment trench' with the scour sumps to contain 24hrs of flow.	2. The department notes the abandonment bund is already installed and has removed from the works approval. The safety/flood protection bund will remain as a proposed piece of infrastructure as stormwater management. 3. Changed as per requested.
4	4. Correct reference to condition number	4. Amended accordingly.
8 Table 3	5. Include 'scour pits' with the containment trench for 24 hrs of flow	5. Amended accordingly.
9 Table 4	6. Remove embankment freeboard visual inspection as it is not possible to deposit sufficient tailings to breach the freeboard limit within 180 days of TLO. Include inspection condition on licence.	6. Removed requirement.
Schedule 3, Condition	7. Propose to have groundwater monitoring program to be in line with existing approval Mungari TSF groudnwater monitoring program in W6364/2020/1 and Licence L7750/2001/10 by: • Removing: Arsenic III and V divisions (just Arsenic), Bicarbonate alkalinity, Chromium III and VI (just Chromium), Selenium • Adding: Carbonate As identified in DWER's Decision Report, the water balance provided indicates deposited tailings are unlikely to cause excessive seepage through the pit walls and pit floor due to extremely low wall and floor permeability, high evaporation rates, sufficient in-situ dry density and by achieving maximum water recovery. Observed groundwater flow inflow during mining operations was negligible, further supporting the hydrogeological model. Additionally, geochemical conditions do not support the reductive dissolution conditions to exist and hence there will be little to no release of metals and metalloids to the groundwater.	7. The department agrees that the key control to mitigate potential impacts to vegetation is the standing water level limit which will be applied to a licence, should one be granted for the premises. However, to ensure sufficient baseline information is collected and in consideration of the elevated selenium levels detected in tailings pore water, the Delegated Officer has determined to keep selenium in the list of groundwater monitoring parameters. Arsenic forms III and V and chromium III and VI have been removed from their descriptions, however Bicarbonate alkalinity will remain. Carbonate is to be added to the analytical suite.. 8. Changed as per requested.

Condition	Summary of applicant's comment	Department's response
	The CRIPSTF is unlikely to have any adverse impacts on the respective aquifers, the environment, groundwater dependent ecosystems (GDEs) or other groundwater users. There are no other groundwater users within 10 km of the Project. The hydrogeological nature of the region indicates that it is unlikely that tailings deposition will have any impact on any other users in the region. Furthermore, given the saline nature of the groundwater, it is unlikely that there are any GDEs in the Cutters Ridge Project area. Local vegetation sources water from rainfall and the soil moisture in the unsaturated zone above the saline water table and will not be impacted by any changes to the groundwater quality. It is understood that a SWL limit will be applied to full time operations upon granting of a Licence amendment. The proposed SWL limit for the monitoring bores near the TSF will eliminate the pathway for potential groundwater mounding to impact vegetation via root uptake. 8. Change the frequency of parameters monitored from 'each annual period' to "a single sampling event prior to the deposition of tailings into the CRIPTSF, then once during time limited operations."	