# Decision Report

## Application for Works Approval

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

| | |
|---|---|
| **Works Approval Number** | W6719/2022/1 |
| **Applicant** | Lakewood Mining Pty Ltd |
| **ACN** | 659 952 066 |
| **File number** | DER2022/000261 |
| **Premises** | Lakewood Gold Processing Facility<br>Legal description:<br>Mining tenements M26/242 and M26/367<br>Mount Monger Road<br>LAKEWOOD WA 6431<br>As defined by the premises map attached to the issued works approval. |
| **Date of report** | 20 January 2023 |
| **Decision** | Works approval granted |

Fiona Westcott
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**Fiona Westcott**
**SENIOR ENVIRONMENTAL OFFICER, INDUSTRY REGULATION**
**REGULATORY SERVICES**

an officer delegated under section 20 of the *Environmental Protection Act 1986* (WA)

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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 time limited operation of the premises. As a result of this assessment, works approval W6719/2022/1 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

On 14 June 2022, Lakewood Mining Pty Ltd (the applicant) submitted an application for a works approval to the department under section 54 of the *Environmental Protection Act 1986* (EP Act).

The application is to undertake construction works and time limited operation at the Lakewood Gold Processing Facility (Lakewood GPF; the premises) for the following:

- Construction of embankment raises at tailings storage facility (TSF) 1 (TSF1);
- Construction of new TSF2 and subsequent embankment raises;
- Upgrades to the Lakewood Processing Plant to increase production capacity from 900,000 tonnes per annum (tpa) to 1,200,000 tpa, including:
    - Change to carbon-in-leach (CIL) process stream flow;
    - Refurbishment of the existing Dunford regrind mill;
    - Upgrade to the Primary Grinding Mill power; and
    - Installation of a carbon regeneration kiln.
- Construction of a capture trench to collect surface water flow from the neighbouring waste rock dump operated by Kalgoorlie Consolidated Gold Mines Pty Ltd (KCGM).

The premise relates to the category and associated design capacity under Schedule 1 of the *Environmental Protection Regulations 1987* (EP Regulations), which are defined in works approval W6719/2022/1. The infrastructure and equipment relating to the premises category and any associated activities, which the department has considered in line with *Guideline: Risk Assessment* (DWER 2020b), are outlined in works approval W6719/2022/1.

## 2.3 Overview of premises

The premise is located approximately 3 km east of the City of Kalgoorlie-Boulder. The premises was initially constructed in 1989 and operated periodically to treat and store tailings using the CIL process. Since then, the premises has operated sporadically by a number of operators and underwent multiple upgrades and periods of care and maintenance.

Currently, the Lakewood GPF is the only toll treating facility in the Kalgoorlie region. No ore is mined at the premises. The premises receives gold ore from third parties for toll treatment under agreement. The premises is currently authorised to undertake Category 5 activities with a maximum design capacity of 900,000 tonnes per annum under licence L9124/2018/1. Tailings are currently stored in the existing TSF1. The site layout is shown in Figure 1.

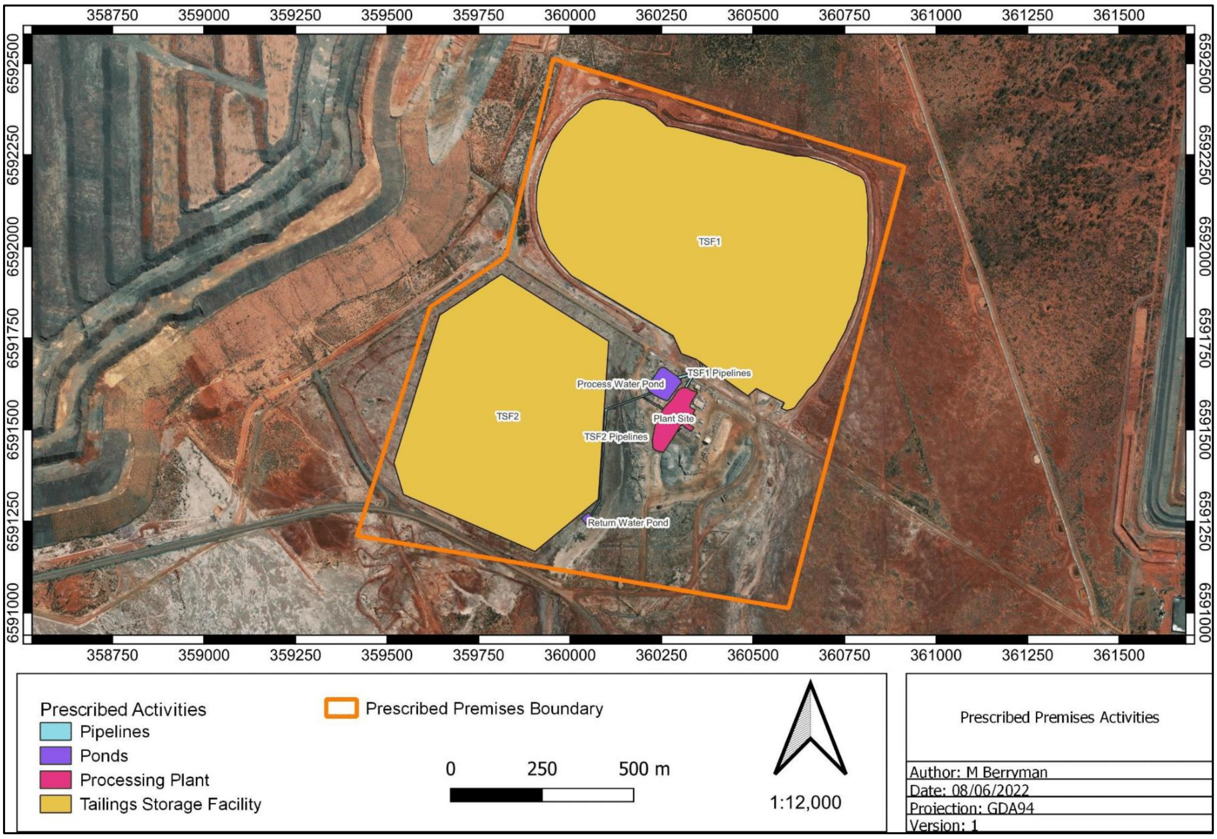



**Figure 1: Site layout and premises boundary**

## 2.4 Proposed activities

### 2.4.1 Lakewood processing plant

The applicant intends to undertake staged upgrades to the Lakewood Processing Plant to increase the target throughput of the premises to 1,200,000 tpa. To achieve this, several primary plant modifications were proposed, as shown in Figure 2 and described in Table 1.

Additional tailings produced from the increased throughput will be stored in the existing TSF1 and new TSF2. All externally sourced ore will be characterised in accordance with an Ore Acceptance Procedure prior to acceptance in the premises (TTC 2022).

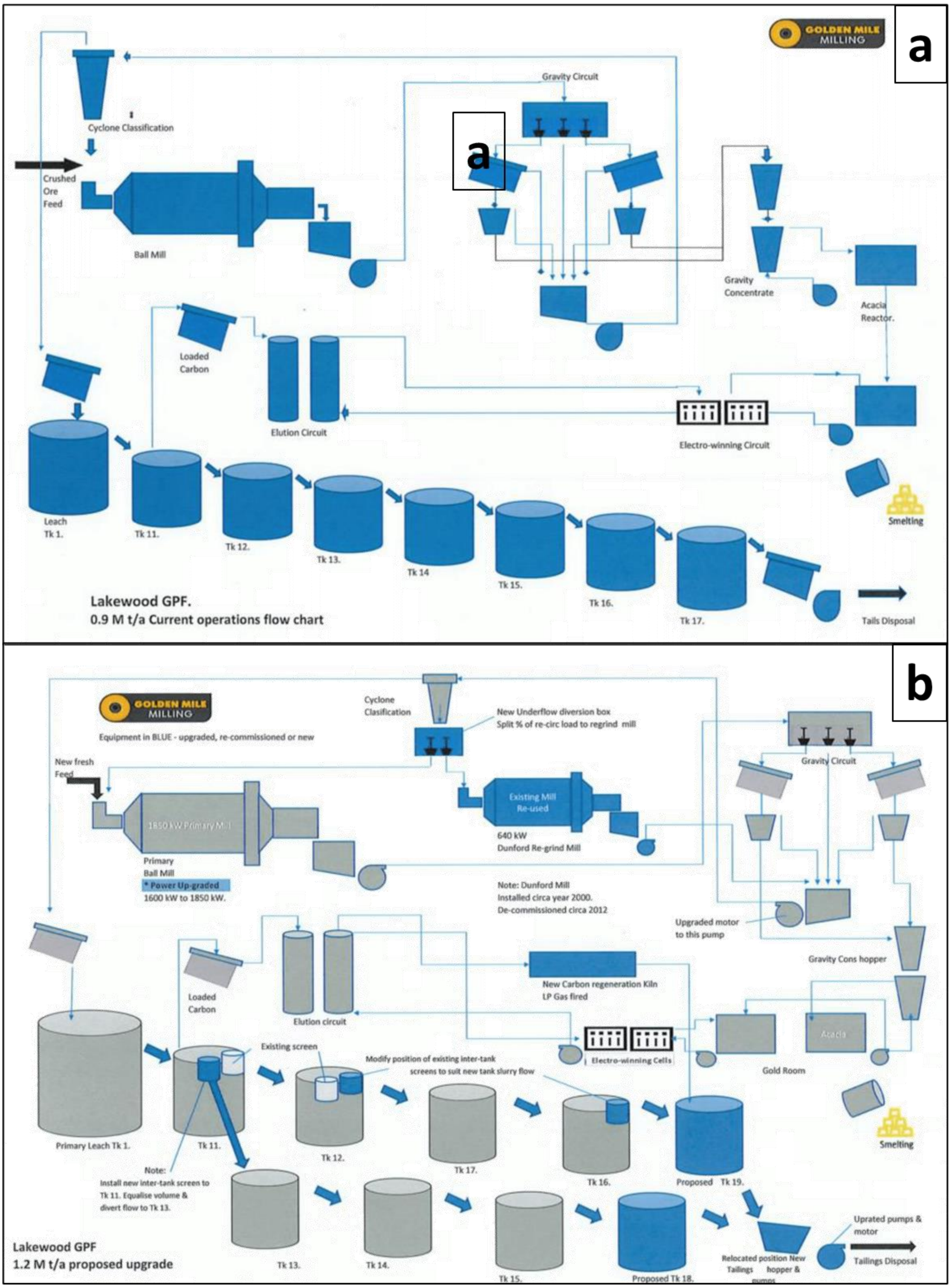



**Figure 2: (a) Current and (b) proposed process flow at Lakewood Processing Plant**

**Table 1: Summary of proposed changes at Lakewood Processing Plant**

| Sequence of works | Infrastructure / equipment | Description |
|---|---|---|
| 1 | Carbon-in-leach circuit | Proposed to construct two additional 300 $m^3$ adsorption tanks, resulting in the leaching circuit comprising of ten tanks, including one 1,500 $m^3$ primary leach tank, followed by nine adsorption tanks (Figure 2).<br><br>The CIL circuit will also be altered such that slurry flow will be split into two streams after the primary leach tank and first adsorption tank (Figure 2). |
| 2 | Dunford regrind mill | The existing Dunford Mill (utilised by previous occupier) will be recommissioned and integrated as a regrind mill.<br><br>A measured portion of the grinding re-circulating load will be split off and directed to the Dunford regrind mill for further grinding, allowing additional "new" mill feed to be introduced into the Primary Grinding Mill at the front of the circuit (Figure 2). |
| 3 | Primary grinding mill | Currently, the primary grinding mill is rated to 1,600 kW. The applicant proposed to upgrade the motor power rating to 1,850 kW. The upgrade will optimise the mill power and increase grinding media to approximately 33% to 35% of volume capacity. |
| 4 | Carbon regeneration kiln | The applicant proposed to install an Ansac Rotary-style gas-fired kiln to reactivate the barren carbon on premises for re-use in the leaching circuit.<br><br>The applicant currently employs an offsite vendor to reactivate carbon used for elution. |

### 2.4.2 TSF1

The existing TSF1 is located approximately 200 m north of the processing plant, with an embankment footprint area of 49 ha within mining tenement M26/242.

TSF1 was initially constructed in 1989, along with the processing plant, as part of the Fimtails Tailings Retreatment Project. The TSF1 embankments were constructed using upstream construction method and comprised of only one cell (i.e. the Central cell). Between 2009 to 2011, two additional cells were constructed to abut the Central Cell, namely the Eastern Cell and Western Cell. In 2018, the Eastern Cell and Central Cell were combined to form one single larger Eastern Cell. As such, TSF1 currently comprises two cells: Western Cell and (the larger) Eastern Cell.

TSF1 cells are authorised by Mining Proposal Reg ID 19291 to reach a maximum embankment crest height of RL349.0 m (Stage 8). Currently, both cells have been raised to Stage 6, which ranges from RL343.5 m (Western Cell) to RL345.0 m (Eastern Cell). Construction of embankment raises will continue, alternating between cells (Table 2). The department notes that the applicant does not currently hold a valid Part V instrument authorising the construction of Stage 7 and 8 embankment raises; only approval under the *Mining Act 1978* was evident at the time of assessment. Construction of these embankment raises at TSF1 were previously authorised under works approval W4561/2001/1 but have expired on 13 September 2019.

As part of this works approval, the applicant intends to further raise the perimeter embankments to a maximum height of RL353.5 m. Given the schedule of proposed works (Table 2), only the construction works for Stage 9 embankment raise to RL351.0 m would occur within the next five years (i.e., the duration of works approval W6719/2022/1). As such, only works up to Stage 9 embankment raise of TSF1 will be authorised under this works approval. The Stage 10 embankment raise will need to be reassessed under a separate works approval application in the future.

**Table 2: TSF construction and operational schedule**

| Deposition sequence | Active TSF | Embankment height (mRL) | Storage capacity (Mt) | Intended commencement date | | Operational duration (months) |
|---|---|---|---|---|---|---|
| | | | | Construction | Operation[1] | |
| 1 | TSF 2 (Stage 1) | 334.0 | 2.02 | April 2023 | April 2024 | 20.2 |
| 2 | TSF1 E Cell (Stage 9) | 351.0 | 0.50 | September 2025 | December 2025 | 5.0 |
| 3 | TSF 2 (Stage 2) | 336.5 | 0.89 | February 2026 | May 2026 | 8.9 |
| 4 | TSF1 W Cell (Stage 9) | 351.0 | 0.33 | November 2026 | February 2027 | 4.0[2] |
| 5 | TSF 2 (Stage 3) | 339.0 | 0.85 | March 2027 | June 2027 | 8.5 |
| 6 | TSF1 E Cell (Stage 10) | 353.5 | 0.59 | November 2027 | February 2028 | 5.9 |
| 7 | TSF 2 (Stage 4) | 341.5 | 0.77 | May 2028 | August 2028 | 7.7 |
| 8 | TSF1 W Cell (Stage 10) | 353.5 | 0.40 | January 2029 | April 2029 | 4.0 |
| 9 | TSF 2 (Stage 5) | 344.0 | 0.73 | May 2029 | August 2029 | 7.3 |

Note 1: Based on plant throughput of 900,000 tpa during TSF1 Stage 6 to Stage 8 embankment operations, and a plant throughput of up to 1,200,000 tpa during Stage 9 and Stage 10 embankment operations.

Note 2: Plant throughput will be capped at 1,000,000 tpa to control the rate of rise of TSF2 Stage 3 embankment operation.

#### 2.4.2.1 Embankment raise

The eastern and western cell of TSF1 will be raised by two metres, from RL349.0 m to RL351.0 m, using an upstream construction method. Dry compacted tailings sourced from TSF1 will be utilised as construction material, with the downstream batters capped with a 500 mm-thick layer of competent waste rock as erosion control. The embankment has design slopes of 1V:275H downstream and 1V:2H upstream.

The embankment crest will have a 2% crossfall towards the upstream side and nominal 0.5 m-high windrows at both downstream and upstream edges. Due to the crossfall sloping inwards towards the storage, there will be regular 'drainage' gaps (predominantly at tailings discharge points) in the inner windrow to allow for the drainage of rainfall runoff from the crest. The perimeter embankment crest will be sheeted with a nominal 100 mm-thick layer of wearing course material.

#### 2.4.2.2 Decant system

The existing supernatant pond will be maintained around the central decant structure within each cell. Based on the embankment stability, freeboard and water balance assessments, the recommended supernatant pond characteristics for both TSF1 western and eastern cells were determined to be:

- Average area of normal supernatant pond is 43,240 $m^2$ (Eastern Cell) and 24,600 $m^2$ (Western Cell);
- Average 'equivalent radius' of the normal supernatant pond is 120 m (Eastern Cell) and 90 m (Western Cell); and
- Minimum distance from the normal supernatant pond to the perimeter embankment is 105 m (Eastern Cell) and 90 m (Western Cell).

Water in the supernatant pond will be removed via a dedicated submersible pump installed in the decant tower. The return water is pumped back to the Process Water Pond for reuse in the Lakewood processing plant.

The decant tower is accessed through an accessway, which will be raised by centreline construction method, constructed using traffic-compacted dried tailings. The decant accessway has nominal 7 m-wide design crest sheeted with a nominal 100 mm-thick layer, nominal 0.5 m-high windrows on both crest edges and slopes of 1V:1.5H on both sides.

The decant tower has a nominal 10 m-wide design crest with slotted pre-cast concrete well liners stacked vertically and surrounded by clean filter rockfill.

#### 2.4.2.3 Seepage control infrastructure

TSF1 was designed with an underdrainage system to reduce the phreatic surface and seepage potential through the embankment foundations. The system comprises underdrains for the full internal perimeter of the upstream embankment toe of the Western and Eastern Cell and along the Central Cell embankment toe (i.e., now part of Eastern Cell). The underdrains are aggregate and slotted pipework wrapped in geotextile and stabilised with selected waste rock. The seepage intercepted drains into a dedicated collection sump located on the south-eastern side of the Eastern Cell, which is then pumped back to the Process Water Pond for reuse in the processing circuit.

A seepage recovery trench is also present around the perimeter of TSF1. The trench is lined with geotextile and has a slotted drainage pipe at the base. The trench drains into two recovery sumps comprising slotted concrete well liners, located on the southern side of TSF1. The sumps are equipped with pumps that transports the collected seepage to the Process Water Pond for reuse.

In 2019, ten monitoring bores surrounding TSF1 were converted to seepage recovery bores. The bores were installed in 2019 in response to concerns relating to the detection of weak acid dissociable cyanide (WAD CN) in groundwater and mounding of the water table around TSF1. Recovered water is pumped to the Process Water Pond for reuse in the Lakewood processing plant.

No changes or additional seepage control measures were proposed for the Stage 9 embankment raises.

#### 2.4.2.5 Monitoring infrastructure

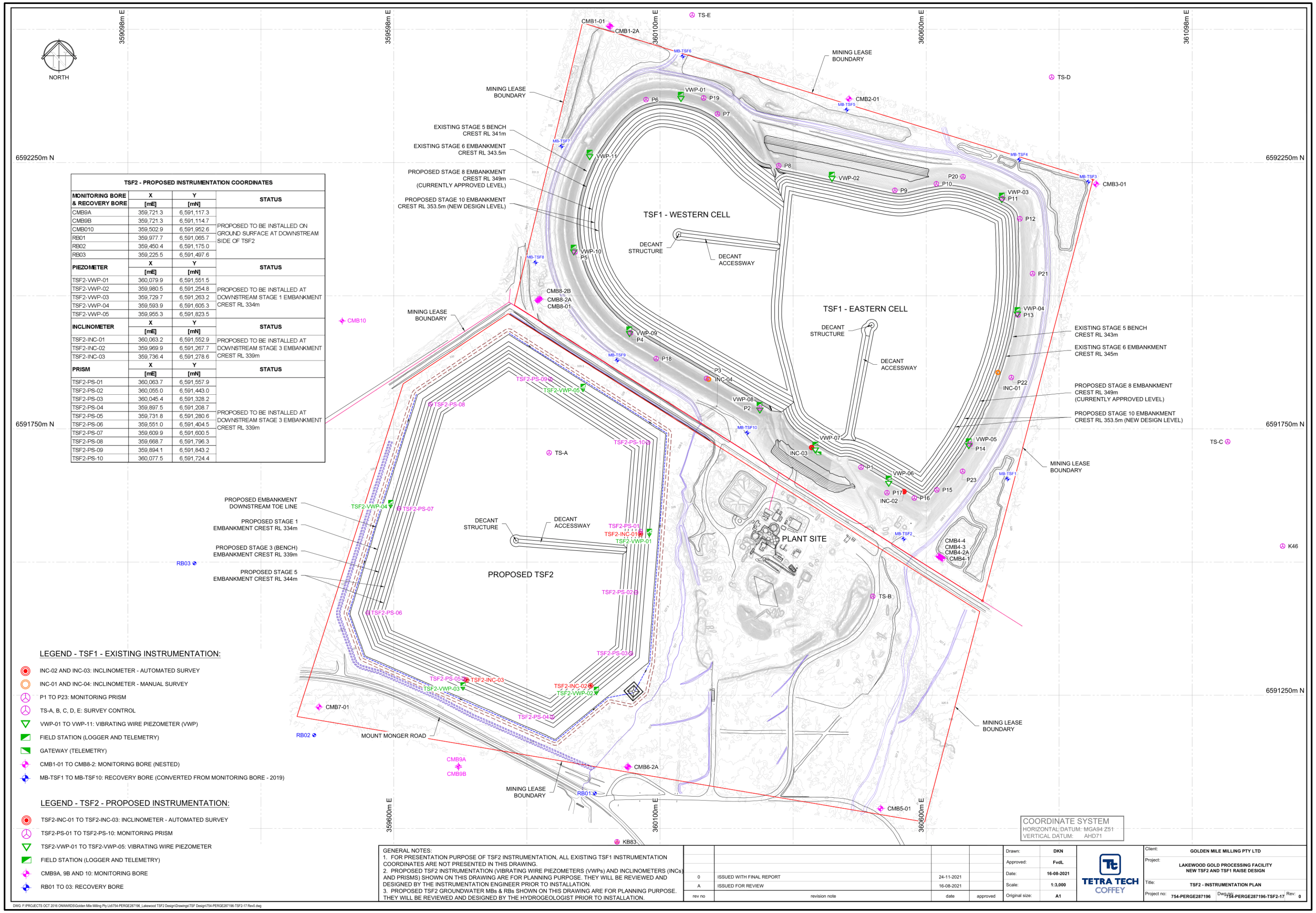
Current monitoring infrastructure at TSF1 comprises the following:

- Six vibrating wire piezometers (VWPs) and five VWPs at the Eastern and Western Cells, respectively. Each VWP was installed in a vertical borehole drilled from the downstream Stage 5 embankment crest at approximately RL343 m (Eastern Cell) and RL340 m

(Western Cell), with sensor located nominally 0.5 m above the natural ground foundation surface level and near the upstream toe of the Stage 1 embankment. Each VWP is connected to a data logger that takes hourly readings and telemetered to a monitoring data management system. The recommended VWP monitoring frequency is monthly.

- Three vertical borehole inclinometers (INCs) and one INC at the Eastern and Western Cells, respectively. The INCs are located along the southern and south-east side of TSF1 to monitor lateral displacement of the critical embankments. Two of the Eastern Cell INCs are automated, with hourly survey readings recorded and telemetered to a monitoring data management system. The remaining two INCs are manually surveyed at least once per quarter.
- Twenty-three survey prisms are located around TSF1 to monitor precise 3D surface displacement of the embankments. Each prism is surveyed monthly.
- Fifteen nested groundwater monitoring bores in eight locations surrounding TSF1 and the southern boundary of the premises.

The locations of these monitoring infrastructure are shown in Figure 3. The applicant has determined that the existing monitoring system is adequate for the proposed continued raising of TSF1 embankments, up to Stage 10 (i.e., RL353.5 m).




| TSF2 - PROPOSED INSTRUMENTATION COORDINATES | | | |
|---|---|---|---|
| MONITORING BORE & RECOVERY BORE | X [mE] | Y [mN] | STATUS |
| CMB9A | 359,721.3 | 6,591,117.3 | PROPOSED TO BE INSTALLED ON GROUND SURFACE AT DOWNSTREAM SIDE OF TSF2 |
| CMB9B | 359,721.3 | 6,591,114.7 | |
| CMB010 | 359,502.9 | 6,591,952.6 | |
| RB01 | 359,977.7 | 6,591,065.7 | |
| RB02 | 359,450.4 | 6,591,175.0 | |
| RB03 | 359,225.5 | 6,591,497.6 | |
| PIEZOMETER | X [mE] | Y [mN] | STATUS |
| TSF2-VWP-01 | 360,079.9 | 6,591,551.5 | PROPOSED TO BE INSTALLED AT DOWNSTREAM STAGE 1 EMBANKMENT CREST RL 334m |
| TSF2-VWP-02 | 359,980.5 | 6,591,254.8 | |
| TSF2-VWP-03 | 359,729.7 | 6,591,263.2 | |
| TSF2-VWP-04 | 359,593.9 | 6,591,605.3 | |
| TSF2-VWP-05 | 359,955.3 | 6,591,823.5 | |
| INCLINOMETER | X [mE] | Y [mN] | STATUS |
| TSF2-INC-01 | 360,063.2 | 6,591,552.9 | PROPOSED TO BE INSTALLED AT DOWNSTREAM STAGE 3 EMBANKMENT CREST RL 339m |
| TSF2-INC-02 | 359,969.9 | 6,591,267.7 | |
| TSF2-INC-03 | 359,736.4 | 6,591,278.6 | |
| PRISM | X [mE] | Y [mN] | STATUS |
| TSF2-PS-01 | 360,063.7 | 6,591,557.9 | PROPOSED TO BE INSTALLED AT DOWNSTREAM STAGE 3 EMBANKMENT CREST RL 339m |
| TSF2-PS-02 | 360,055.0 | 6,591,443.0 | |
| TSF2-PS-03 | 360,045.4 | 6,591,328.2 | |
| TSF2-PS-04 | 359,897.5 | 6,591,208.7 | |
| TSF2-PS-05 | 359,731.8 | 6,591,280.6 | |
| TSF2-PS-06 | 359,551.0 | 6,591,404.5 | |
| TSF2-PS-07 | 359,609.9 | 6,591,600.5 | |
| TSF2-PS-08 | 359,668.7 | 6,591,796.3 | |
| TSF2-PS-09 | 359,894.1 | 6,591,843.2 | |
| TSF2-PS-10 | 360,077.5 | 6,591,724.4 | |

**Figure 3: Monitoring infrastructure at TSF1 (existing) and TSF2 (proposed)**

### 2.4.3 TSF2

TSF2 is proposed to be a single-cell, paddock-type TSF, located south of and operated in conjunction with TSF1. The construction of TSF2 was previously approved under works approval W5487/2013/1, but construction was not undertaken. The works approval has since expired. The current proposed design of TSF2 has been updated in general accordance with relevant guidelines and improved compared to its 2013 iteration. Table 3 summarises the assessments undertaken for the design of TSF2. The geotechnical and safety aspect of TSF2 was assessed by the Department of Mines, Industry Regulation and Safety (DMIRS) under the *Mining Act 1978*.

**Table 3: Changes to TSF2 design assessment since 2013**

| TSF characteristics | Description |
|---|---|
| Tailings engineering properties<br>Surface soil and subsurface condition<br>Seepage and stability analysis | Properties were reviewed and verified based on additional site investigations, including cone penetration testing (CPTu) at the existing TSF1 and laboratory testing.<br>Where appropriate, more defensive measures were applied to the assessment, based on the material permeability and shear strength values informed by the additional investigations. |
| Liquefaction assessment | Previous assessment was reviewed and verified using both screening/empirical approaches and computer software packages Geologismiki CPeT-IT and CLiq for cyclic liquefaction.<br>Flow (static) liquefaction was also examined, as recommended by the ANCOLD guidelines. |
| Dam break assessment | A more comprehensive dam break assessment was conducted to confirm the population at risk (PAR) and verify the dam consequence category. |
| Hazard rating (DMIRS)<br>Dam consequence category (ANCOLD) | Classifications were reviewed and verified based on more comprehensive dam break analysis. |
| Design flood and freeboard<br>Earthquake loading (OBE and SEE)<br>Factor of safety<br>Inspection and monitoring criteria | Designs were reviewed and verified based on the updated hazard rating/ dam consequence category assessment. |
| Earthquake magnitude | Findings were reviewed and verified based on recorded earthquakes within 200 km of the premises and the probabilistic methodology adopted from *Controlling Seismic Risk* (RaSiM6 Australia 2005). |
| Seepage management design | The internal underdrainage system was reviewed and redesigned, where an extensive underdrainage system will be installed to maximise seepage return to the plant, increase tailings density and lower the phreatic surface within the embankments, improving embankment stability. |

| TSF characteristics | Description |
|---|---|
| | The external collection sump design was also altered to the earthen cut and fill sump to increase sump capacity and performance. |
| Water management | A surface water assessment at the premises was conducted for the existing site conditions in 2021 and for proposed expansion scenarios.<br>A hydrogeological assessment was conducted to ascertain the groundwater regime at the premises due to proposed TSF1 and TSF2 works. The rate of seepage from both TSF infrastructure to critical groundwater structures and ecosystems were also considered. |

#### 2.4.3.1 Starter embankment

The starter embankment (Stage 1) will be constructed to an average height of 5.5 m (i.e., RL334.0 m), utilising *in situ* clayey material borrowed from within the TSF2 footprint area. The base of the TSF2 footprint will be treated to remove loose material, increasing permeability of the TSF base and embankment compared to the shallow soil outside the TSF.

The Stage 1 embankment crest level was assessed and limited by the shallow groundwater depth and material quantity available for construction. Where feasible, the exposed surface of the borrow area within the TSF2 footprint area will be compacted to limit potential vertical seepage.

Additionally, a 4 m-wide cut-off trench will be excavated to a nominal depth of 1.5 m beneath the Stage 1 perimeter embankment, with side batter slopes of 1V:1H. The trench will then be backfilled with compacted clayey material to reduce horizontal seepage losses beyond the TSF2 footprint area.

#### 2.4.3.2 Embankment raises

The applicant proposed up to four 2.5 m embankment raises (up to Stage 5), using upstream construction method with compacted dried tailings up to a maximum height of 17 m (i.e., RL344.0 m). TSF2 (up to Stage 5) is intended to provide an estimated total storage capacity of 5.27 Mt and a storage life of 4.4 years. Based on the construction schedule (Table 2), only the starter embankment and embankment raises up to Stage 3 would be assessed and authorised under works approval W6719/2022/1.

Both the starter embankment and upstream embankment raises will comprise a minimum 6 m-wide crest and ‘core’ zone of compacted fill materials (i.e., borrowed clayey fill for Stage 1 and dried tailings for subsequent raises), capped with a nominal 500 mm-thick layer of imported mine waste rock. The embankments have design slopes of 1V:2.75H downstream and 1V:2H upstream.

The embankment crest will have a 2% crossfall towards the upstream side and nominal 0.5 m-high windrows at both downstream and upstream edges. Due to the crossfall sloping inwards towards the storage, there will be regular ‘drainage’ gaps (predominantly at tailings discharge points) in the inner windrow to allow for the drainage of rainfall runoff from the crest. The perimeter embankment crest will be sheeted with a nominal 100 mm-thick layer of wearing course material.

#### 2.4.3.3 Decant system

Tailings deposition will be undertaken such that the supernatant pond is maintained around the central decant structure. Based on the embankment stability, freeboard and water balance assessments, the recommended supernatant pond characteristics for TSF2 were determined to be:

- Average area of normal supernatant pond is 49,960 $m^2$;
- Average 'equivalent radius' of the normal supernatant pond is 130 m; and
- Minimum distance from the normal supernatant pond to the perimeter embankment is 120 m.

The central decant tower will be equipped with a dedicated submersible pump to return water to the Process Water Pond for reuse in processing. The decant structure will have a nominal 10 m-wide design crest, with standard slotted precast concrete well liners stacked vertically and surrounded by clean filter rockfill.

The decant tower is accessed through an accessway, which will be constructed and raised by centreline construction method using compacted dried tailings. The design specifications of the decant accessway is similar to those detailed for the TSF1 Stage 9 embankment raise (refer to Section 2.4.2.2).

#### 2.4.3.4 Seepage control infrastructure

The TSF2 design will incorporate an extensive underdrainage system to maximise seepage capture and reuse. Underdrainage pipework will comprise slotted panel drainpipes Megaflo 450 and 150, spaced at nominal 50 m intervals, surrounded by filter materials and geofabrics and installed on the prepared basin surface. Intercepted seepage will drain by gravity and discharge through solid outfall pipes to the Return Water Pond for reuse.

Based on seepage assessments, the internal underdrainage system is expected to recover an estimated 45 $m^3$/day of seepage, noting model limitations.

The TSF2 design also incorporates seepage recovery trenches along the downstream toe of the facility. The trenches will be excavated to a nominal depth of 1.2 m to 1.5 m and comprise slotted pipes (Draincoil DN100), geofabrics at all trench interfaces, and backfilled with filter rock. The Draincoil piping will flow by gravity and discharge through solid outfall pipes to the Return Water Pond for reuse.

Further, the applicant has proposed to install three provisional seepage recovery bores south of TSF2 as a precaution (Figure 3). Seepage recovered from these bores will be sent to either the Process Water Pond or Return Water Pond, depending on flow rates determined once the bores have been installed and are operational.

#### 2.4.3.5 Monitoring infrastructure

The proposed monitoring infrastructure at TSF2 comprises the following:

- Five VWPs, each equipped with a wireless datalogger. Each VWP is proposed to be installed in a vertical borehole drilled from the downstream Stage 1 embankment crest (i.e., RL334 m) with sensor being located nominally 0.5 m above the natural ground foundation surface level and near the downstream toe of the Stage 1 embankment. Additional VWPs may be required and installed during the Stage 3 embankment raise, depending on the actual operating conditions.
- Three automated INCs installed along the south-east side of TSF2 during the Stage 3 embankment raise (i.e., RL339 m) based on an expected tailings run-out flow distance in the order of 130 m to 290 m could reach and impact the premises if an embankment breach occurred throughout the entire Stage 3 embankment. Each INC is proposed to be installed in a vertical borehole drilled from the downstream Stage 3 embankment crest and extended nominally 3 m into the natural foundation ground.
- Ten survey prisms installed around TSF2 and surveyed monthly.
- Three groundwater monitoring bores installed in two locations, where the nested pair will be screened within the rock aquifer and within the shallow sediment aquifer. The monitoring parameters for TSF2 monitoring bores is proposed to be the same as the

TSF1 bores.

All proposed monitoring infrastructure are shown in Figure 3 and are expected to have the same specifications as those installed at TSF1.

**2.4.3.6 Tailings and return water pipeline**

Pipelines will be installed to transfer tailings slurry from the Lakewood processing plant to both TSFs and return water from the Return Water Ponds (fed by underdrainage, seepage recovery trenches and recovery bores) to the processing plant for reuse. The tailings pipeline will be nominally a 200 mm-diameter high density polyethylene (HDPE) pipeline, while the return water pipeline will be a 160 mm-diameter HDPE pipeline. Both pipelines will be equipped with telemetry systems and pressure sensors to allow for the detection of leaks and failures, as well as automatic cut-outs in the event of a pipe failure. The pipelines will be installed within earthen bunded corridors with scour pits or sumps along the length to ensure leaks and spills are contained within the bunded areas.

### 2.4.4 Time limited operation of TSF1 and TSF2

When operating under normal conditions, tailings will be discharged subaerially and cyclically from the full circumference of the TSF1 and TSF2 perimeter embankments, such that the tailings are deposited in thin discrete layers at low velocity from several spigot points. The discharge points will be regularly circulated to ensure the even development of sloped tailings beaches and the time between successive depositions in an area (i.e., drying time) is maximised. Such practices would promote the drainage of water towards the supernatant pond and maximise tailings consolidation. Over time, the development of a slope tailings beach will result in a depressed cone, with the supernatant pond located within the depression.

Both TSFs will be operated in accordance with a TSF Operations Manual (TTC 2021b), which describes the operating procedures, inspection criteria, monitoring requirements and inspection log sheets for the TSF.

### 2.4.5 Capture trench

The applicant intends to construct a capture trench along the south-western boundary of TSF1. The purpose of the trench is to collect surface water flow from a neighbouring waste rock dump managed by KCGM at the north-western boundary of TSF1. There is only a distance of approximately 115 m between the toe of TSF1 and the waste rock dump, and surface water from the waste rock dump was found to migrate onto the premises through natural drainage pathways in the form of both overland runoff and subsurface throughflow during and after rainfall events. This flow pathway may result in ground saturation and potentially a localised shallow perched water table near TSF1, posing a risk to the geotechnical stability of the TSF1 embankments and/or result in other potential environmental impacts in the longer term.

The applicant proposed to construct the capture trench, which will divert intercepted water to a soakwell. The soakwell will be equipped with a low flow pump, operating at rate of approximately 1 to 2 litres per second, on an as-needed basis. Water in the soakwell will be pumped to the Process Water Pond using existing pipework. Due to the depth of the trench, there is potential that seepage from TSF1 would also be intercepted.

## 3. 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 2020b).

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.

## 3.1 Source-pathways and receptors

### 3.1.1 Emissions and controls

The key emissions and associated actual or likely pathway during premises construction and time limited operation, which have been considered in this decision report are detailed in Table 4 below. Table 4 also details the control measures the applicant has proposed to assist in controlling these emissions, where necessary.

**Table 4: Proposed applicant controls**

| Emission | Sources | Potential pathways | Proposed controls |
|---|---|---|---|
| **Construction** | | | |
| Dust | Earthworks and construction works at TSF1 and TSF2<br>Vehicle movement | Air / windborne pathway | • Minimise exposed subsoil through progressive clearing during construction;<br>• Construction materials conditioned at borrow locations or at the TSF embankment area;<br>• Undertake regular watering using water carts across active work areas;<br>• Use defined access roads and haul routes, with speed restrictions applied; and<br>• Haul roads watered and dust suppressants, silt fences and/or windbreaks used, as required. |
| Noise | | | • Noise emissions managed in accordance with the *Mines Safety and Inspection Act 1994* and *Environmental Protection (Noise) Regulations 1997*. |
| Sediment laden stormwater | | Overland runoff | • Minimise exposed subsoil through progressive clearing during construction. |
| **Operation** | | | |
| Dust | Operation of crushing circuit and stockpile area at increased throughput | Air / windborne pathway | • Install water sprays on the crushing circuit;<br>• Conduct regular visual monitoring and implement appropriate dust controls, as required; and<br>• Undertake regular watering using water carts across active work areas. |
| | Operation of TSF1 and TSF2<br>Vehicle movement | | • Use defined access roads and haul routes, with speed restrictions applied;<br>• Rotation of spigot points around TSF to maintain damp beaches; and<br>• Complaints from stakeholders regarding dust emissions will be actioned immediately and management measures |

| Emission | Sources | Potential pathways | Proposed controls |
|---|---|---|---|
| | | | reviewed accordingly. |
| Noise | Operation of crushing circuit and stockpile area at increased throughput<br>Operation of TSF1 and TSF2<br>Vehicle movement | | • Noise emissions managed in accordance with the *Mines Safety and Inspection Act 1994* and *Environmental Protection (Noise) Regulations 1997*; and<br>• Complaints from stakeholders regarding noise emissions will be actioned immediately and management measures reviewed accordingly. |
| Sediment laden stormwater | Sediment from TSF1, TSF2, Run of Mine (ROM) pad and crushing circuit | Overland runoff | • Flood modelling undertaken to understand site drainage flow paths;<br>• Construct and maintain diversion drains around the TSFs;<br>• Ensure hydrocarbon and chemical storage are designed and constructed in accordance with Australian Standards AS1940 and AS1962;<br>• Ensure storage tanks are located within appropriately bunded facilities, whereby 110% of the largest vessel or 25% of the total volume is contained;<br>• Install sumps and pumps in the Lakewood processing plant to remove collected material (including rainwater);<br>• Lakewood processing plant routinely inspected to confirm bunding integrity and that containment volumes are not compromised;<br>• Immediately clean up any hydrocarbon or chemical spills with spill kits at key locations and site personnel trained in their use; and<br>• Ensure hydrocarbons and chemicals are licensed in accordance with the *Dangerous Goods Safety Act 2004* and that the premises holds a Dangerous Goods Site Licence at all times. |
| Hydrocarbon, chemical reagent, and contaminated stormwater | Spills and leaks from equipment or storage facility | Discharge to land | |
| Tailings, tailings slurry and supernatant water | Operation of TSF1 and TSF2 and associated containment infrastructure (Process Water Pond, Return Water Pond) | Discharge to land (embankment failure) | • Processing plant throughput managed and tailings discharge rotated between TSF1 and TSF2 to maintain acceptable rate of rise of 2.5 m per annum, based on tailings density and strength);<br>• Install and maintain monitoring infrastructure (e.g., VWPs, INCs, survey prisms) to assess geotechnical stability of perimeter embankments; and<br>• Operate TSF in accordance with |

| Emission | Sources | Potential pathways | Proposed controls |
| --- | --- | --- | --- |
| | | | Operational Manual. |
| | | Discharge to land (overtopping) | • Install and maintain water recovery systems in the decant tower for the TSFs;<br>• Maintain an operational freeboard of 0.3 m at the TSFs and water storage ponds. TSFs to also have an additional 0.2 m of beach freeboard, resulting in a total freeboard of 0.5 m;<br>• TSFs capable of temporarily storing rainfall from a 1:100-year Annual Exceedance Probability (AEP), 72-hour storm event, in addition to the operational freeboard;<br>• Undertake routine inspections (twice per shift) of active TSF, water storage ponds and tailings/return water pipelines; and<br>• Maintain a freeboard of 0.5 m in the soakwell associated with the capture trench. |
| | | Discharge to land (pipeline leak or failure) | • TSF2 tailings and return water pipelines to be constructed within earthen bunded corridors with scour pits or sumps along the length to ensure leaks or spills are contained within bunded areas;<br>• TSF2 tailings and return water pipelines fitted with isolation valves or flow/leak detection sensors; and<br>• Undertake routine inspections (twice per shift) of active TSF, water storage ponds and tailings/return water pipelines. |
| | | Discharge to land (horizontal seepage)<br>Infiltration to aquifer (vertical seepage) | • Ensure all externally sourced ore has been adequately characterised in accordance with *Ore Acceptance Procedure* prior to acceptance at the premises;<br>• Install and maintain water recovery systems in the decant tower for the TSFs;<br>• Install a cut-off trench beneath the upstream TSF perimeter embankment to minimise horizontal seepage loss;<br>• Install a gravity underdrainage system for TSF2 to intercept seepage for return to processing plant, increasing tailings density, lowering the phreatic surface and improving embankment stability;<br>• Maintain the supernatant ponds around their respective central decant towers, at the smallest practical operational size (i.e., optimally, <50% of the distance between the pond boundary and embankment crest) |

| Emission | Sources | Potential pathways | Proposed controls |
|---|---|---|---|
| | | | and with as much as distance from all perimeter embankments as feasible;<br>• Install and maintain seepage recovery bores to intercept seepage in groundwater and manage groundwater depth;<br>• Undertake groundwater monitoring around the perimeter of the TSFs to assess impacts of seepage on the local water table; and<br>• Install a 1.5 mm-thick HDPE liner to base and upstream batters of the Process Water Pond and Return Water Pond. |

### 3.1.2 Receptors

In accordance with the *Guideline: Risk Assessment* (DWER 2020b)*,* 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 5 below provides a summary of potential human and environmental receptors that may be impacted as a result of activities upon or emission and discharges from the prescribed premises *(Guideline: Environmental Siting* (DWER 2020a)).

**Table 5: Sensitive human and environmental receptors and distance from prescribed activity**

| Human receptors | Distance from prescribed premises |
|---|---|
| City of Kalgoorlie-Boulder township | South Boulder (part of the City of Kalgoorlie-Boulder) is located approximately 3.2 km west of the premises boundary, with the closest human receptors being commercial and industrial properties. The closest residential premises is located approximately 4.0 km west of the premises boundary.<br><br>The township was not considered a sensitive receptor in the risk assessment of this works approval due to the distance from the premises. |
| Workers at the KCGM operation | The premises is surrounded by mining activities undertaken by KCGM. KCGM site workers are primarily based around the Fimiston Processing Plant, located approximately 3.5 km north-west of the premises boundary.<br><br>KCGM workers were not considered a sensitive receptor in the risk assessment of this works approval due to the distance from the premises. |
| **Environmental receptors** | **Distance from prescribed premises** |
| Remnant native vegetation | Remnant vegetation around the premises consists of mallees, acacia thickets and shrub-heaths on sandplains.<br><br>Vegetation located north of the premises boundary comprises open woodland of marri (*Corymbia calophylla*), wandoo (*Eucalyptus wandoo*) and river red gum (*E. camaldulensis*), while vegetation |

| | |
|---|---|
| | located south of the premises boundary comprises saltbush and bluebush with scrub or open scrubs, such as *Atriplex*, *Marieana*, *Acacia aneura* and *Acacia* spp.<br><br>Due to historical land use within and around the premises, vegetation communities are likely to be degraded to varying degrees. |
| Conservation areas | Lakeside Timber Reserve is located 3.1 km southeast of the premises boundary (Figure 4). |
| Priority flora | A population of Priority 2 flora was recorded northeast of the premises, with the closest individual recorded approximately 2.9 km from the premises boundary. |
| Surface water bodies | Hannan Lake is an ephemeral salt lake that is located approximately 2.25 km south of the premises boundary. There are smaller isolated lakes located north of Hannan Lake, with the closest lake located 1.5 km from the premises boundary.<br><br>Sections of Hannan Lake are also registered as Aboriginal heritage sites with artefacts and/or scatter.<br><br>The premises lies directly in the flow path of an upstream catchment area of approximately 114 $km^2$, with natural drainage lines converging flow from upstream of the premises to the south, towards Hannan Lake (Figure 5). |
| Groundwater aquifer | The premises is located in the Kurnalpi area, which is underlain by weathered and fractured Archean bedrock, overlain locally by paleochannel deposits and by widespread alluvium, colluvium, calcrete and lake deposits. Consequently, several aquifers are present at varying depths beneath the premises.<br><br>Regional groundwater flow direction is expected to be east-southeast, along the Hannan paleochannel towards the Yindarlgooda South playa (salt) lake.<br><br>Groundwater levels in the unconfined, superficial aquifer vary between 0.5 m below ground level (mbgl) to 6.0 mbgl, with total dissolved solids (TDS) concentrations ranging between 37,300 mg/L to 122,000 mg/L (i.e., hypersaline conditions). Groundwater in the superficial aquifer flows southwards, towards the Hannan Lake.<br><br>Groundwater flow and quality in the deeper aquifers are not well understood.<br><br>The premises is located within the Goldfields Groundwater Area and is subject to the *Rights in Water and Irrigation Act 1914*. There are approximately 49 registered groundwater bores within 8 km of the premises, of which nine are within 5 km of the southeast corner of the premises boundary (Figure 6). |

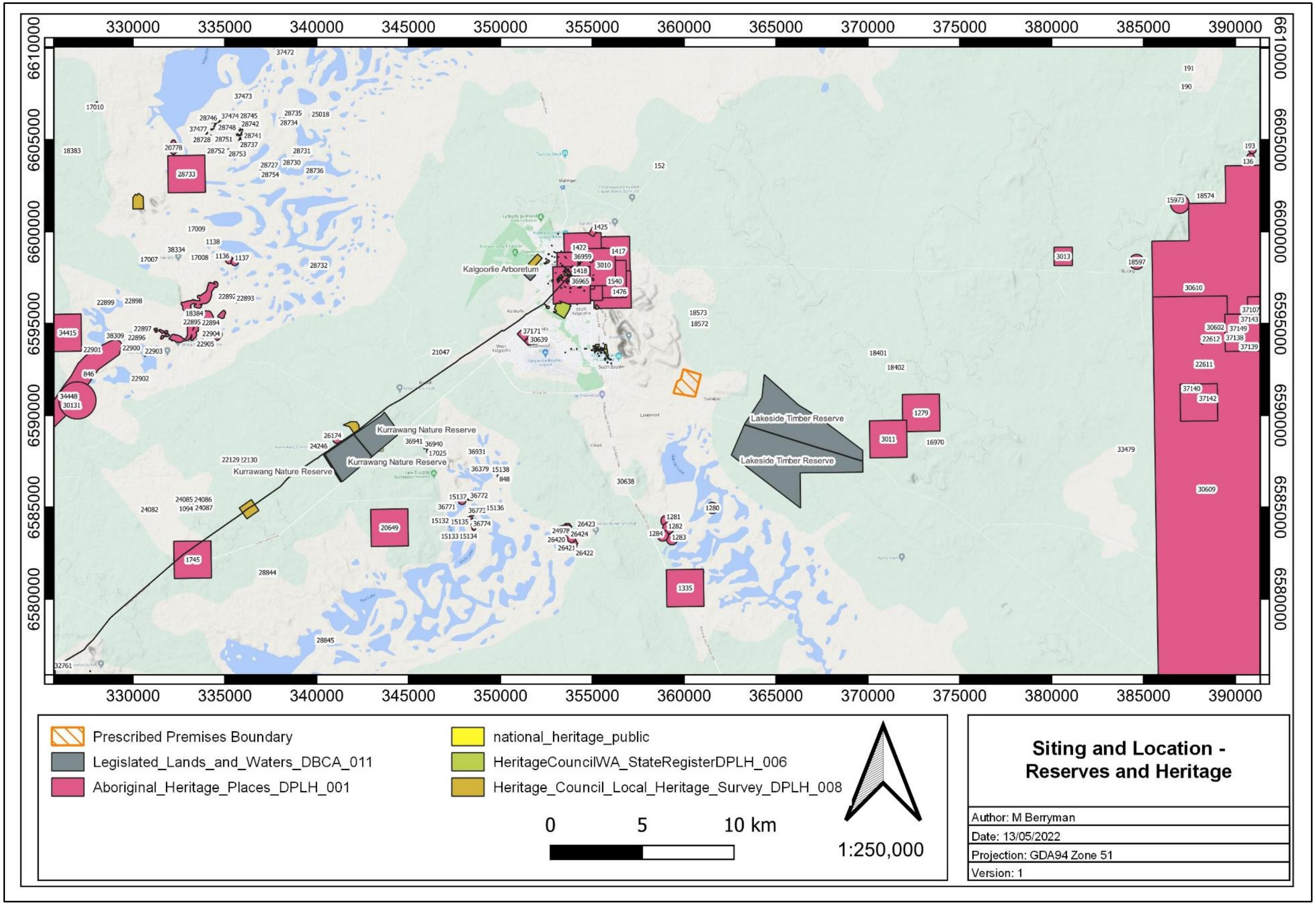



**Figure 4: Reserves and heritage places**

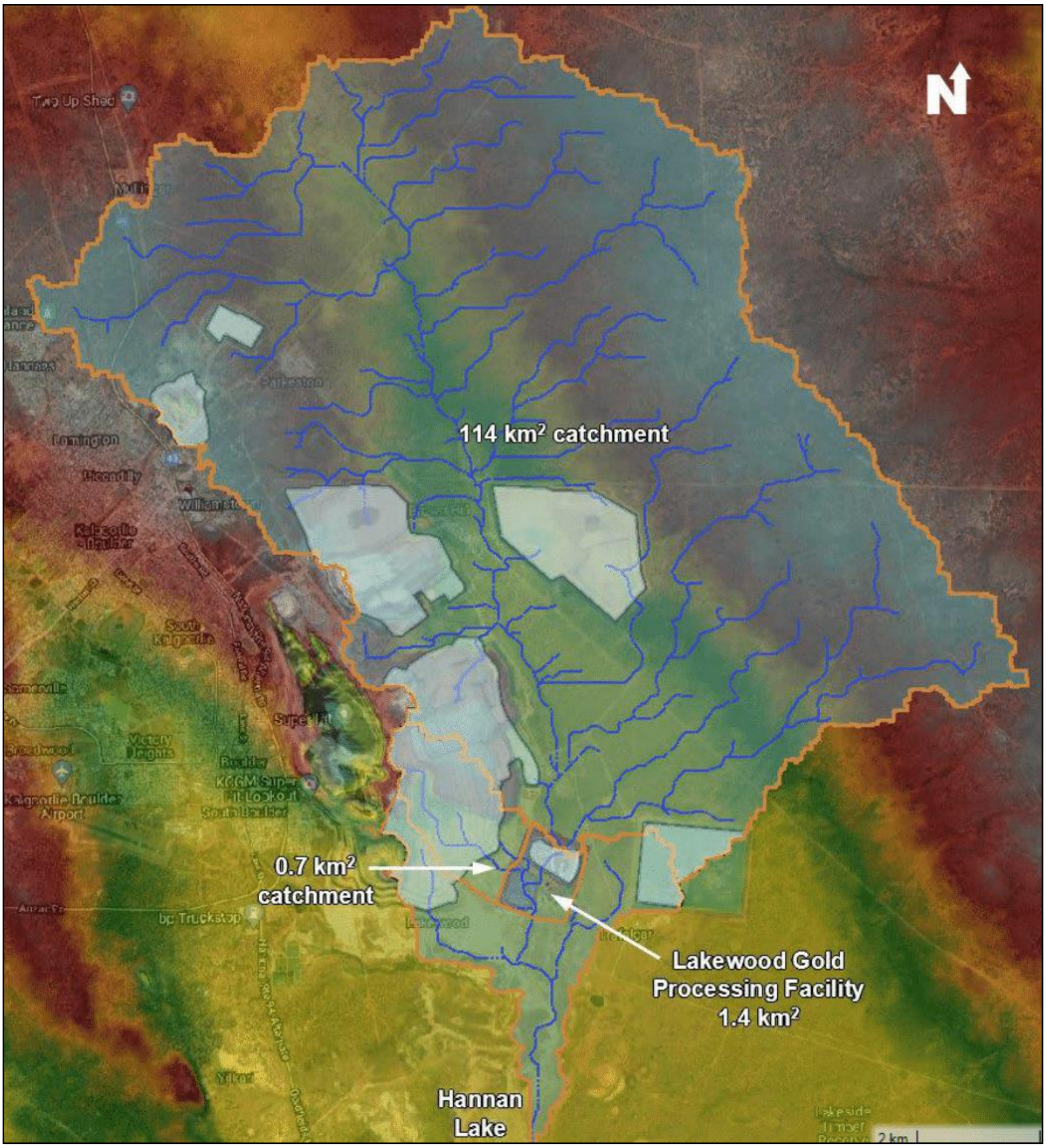



**Figure 5: Lakewood GPF catchment area and terrain**

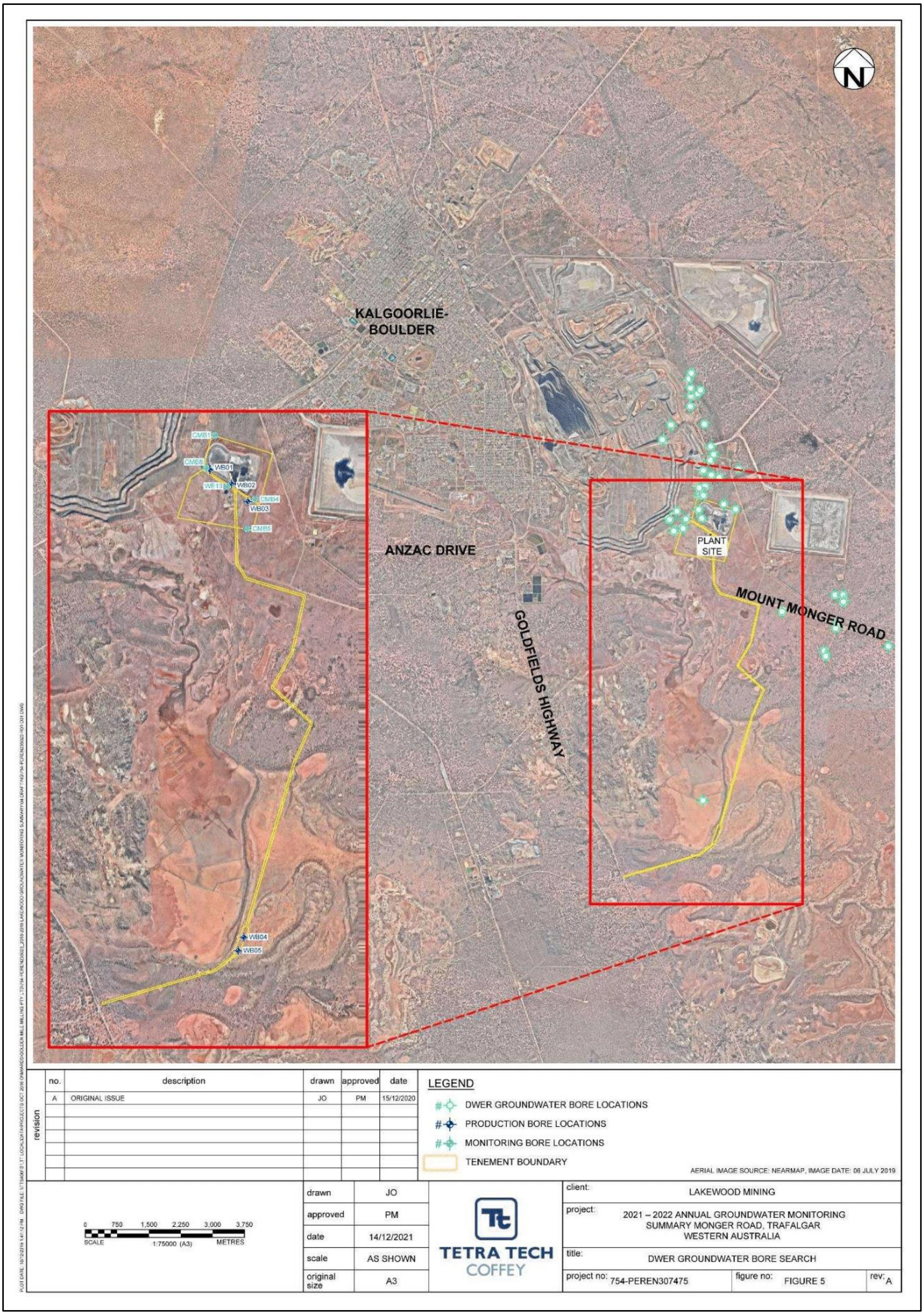



**Figure 6: Registered groundwater bores**

## 3.2 Risk ratings

Risk ratings have been assessed in accordance with the *Guideline: Risk Assessments* (DWER 2020b) for each identified emission source and takes into account potential source-pathway and receptor linkages as identified in Section 3.1. 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 3.1), 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 6.

Works approval W6719/2022/1 that accompanies this decision report authorises construction and time limited operations. The conditions in the issued works approval, as outlined in Table 6 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., ore processing, tailings deposition. 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 6: Risk assessment of potential emissions and discharges from the premises during construction and time limited 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 TSF2 starter embankment (Stage 1)<br>Construction of TSF1 Stage 9 and TSF2 Stages 2 and 3 embankment raises<br>Infrastructure upgrades at the Lakewood processing plant<br>Vehicle movements | Dust | ***Pathway:*** Air/ windborne pathway<br>***Impacts:*** Impacts to ecological health and amenity | Remnant native vegetation, including conservation area and priority flora | Refer to Section 3.1 | C = Slight<br>L = Unlikely<br>**Low risk** | Y | Condition 1<br>Condition 2 | N/A |
| | Sediment laden stormwater | ***Pathway:*** Overland runoff during rainfall events<br>***Impacts:*** Discharge to land, resulting in impacts to ecological health and amenity | Remnant native vegetation<br>Surface water bodies<br>Aboriginal heritage sites | Refer to Section 3.1 | C = Slight<br>L = Unlikely<br>**Low risk** | Y | N/A | N/A |
| **Operation (including time-limited operations)** | | | | | | | | |
| Operation of TSF1 embankment raises, including tailings deposition<br>Operation of TSF2 up to Stage 3 embankment raise, including tailings deposition | Dust | ***Pathway:*** Air/ windborne pathway<br>***Impacts:*** Impacts to ecological health and amenity | Remnant native vegetation, including conservation area and priority flora | Refer to Section 3.1 | C = Minor<br>L = Unlikely<br>**Medium risk** | Y | Condition 1<br>Condition 2<br>Condition 12 | N/A |
| | Sediment laden stormwater | ***Pathway:*** Overland runoff during rainfall events<br>***Impacts:*** Discharge to land, resulting in impacts to ecological health and amenity | Remnant native vegetation, including conservation area and priority flora<br>Surface water bodies<br>Aboriginal heritage sites | Refer to Section 3.1 | C = Slight<br>L = Unlikely<br>**Low risk** | Y | Condition 1<br>Condition 2 | N/A |
| | Tailings release | ***Pathway:*** TSF embankment failure<br>***Impacts:*** Discharge to land, resulting in impacts to ecological | | Refer to Section 3.1 | C = Moderate<br>L = Unlikely<br>**Medium risk** | Y | Condition 1<br>Condition 2<br>Condition 12 | N/A |

| 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 | | | | |
| | | health | | | | | | |
| | | ***Pathway:*** TSF overtopping<br>***Impacts:*** Discharge to land, resulting in impacts to ecological health | | Refer to Section 3.1 | C = Moderate<br>L = Rare<br>**Low risk** | Y | Condition 12 | N/A |
| | | ***Pathway:*** TSF pipeline leak or rupture<br>***Impacts:*** Discharge to land, resulting in impacts to ecological health | | Refer to Section 3.1 | C = Minor<br>L = Unlikely<br>**Medium risk** | Y | Condition 2<br>Condition 12 | N/A |
| | | ***Pathway:*** Vertical seepage from TSF<br>***Impacts:*** Discharge to land, resulting in impacts to ecological health | Groundwater aquifer<br>Remnant native vegetation, including conservation area and priority flora<br>Surface water bodies<br>Aboriginal heritage sites | Refer to Section 3.1 | Refer to Section 3.3 | N | Condition 1<br>Condition 2<br>Condition 3<br>**Condition 12**:<br>Requirement to maintain supernatant pond size and distance to embankment<br>**Condition 17**: Monitoring of supernatant pond water quality and inclusion of additional monitoring parameters<br>**Condition 18**: Inclusion of additional monitoring parameters | Refer to Section 3.3. |
| | | ***Pathway:*** Ingestion of supernatant water and | Transient fauna and birdlife | None. | C = Moderate<br>L = Possible | N | Condition 13<br>**Condition 17**: | Supernatant pond water may become a source of drinking water for |

| Risk events | | | | | Risk rating [1]<br>C = consequence<br>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 | | | | |
| | | return water<br>***Impacts:*** Impacts to wildlife health | | | **Medium risk** | | Monitoring of supernatant pond water quality | wildlife, particularly birdlife in the area. Of particular concern is the concentration of cyanide, which is a reagent added during ore processing.<br>Monitoring of supernatant pond water would ensure that the water quality would not be detrimental to wildlife health, if exposed via ingestion.<br>A limit for WAD CN was also conditioned, in accordance with the *Cyanide Code's Guidance for Use of the Mining Operations Verification Protocol* (ICMI 2021). The limit for WAD CN was removed after consideration of the applicant's comments.<br>See applicant's comments on these additional regulatory controls in Appendix 1. |
| | Saline water release | ***Pathway:*** TSF pipeline leak or rupture<br>***Impacts:*** Discharge to land, resulting in impacts to ecological health | Remnant native vegetation, including conservation area and priority flora<br>Surface water bodies<br>Aboriginal heritage sites | Refer to Section 3.1 | C = Minor<br>L = Unlikely<br>**Medium risk** | Y | Condition 2<br>Condition 12 | N/A |

| 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 | | | | |
| Operation of Lakewood processing facility with maximum throughput of 1,200,000 tpa | Dust | ***Pathway:*** Air/ windborne pathway<br>***Impacts:*** Impacts to ecological health and amenity | Remnant native vegetation, including conservation area and priority flora | Refer to Section 3.1 | C = Minor<br>L = Possible<br>**Medium risk** | Y | Condition 1<br>Condition 12 | N/A |
| | Exhaust emission (point-source) | | | Refer to Section 3.1 | C = Slight<br>L = Unlikely<br>**Low risk** | Y | Condition 1<br>Condition 12<br>Condition 13 | N/A |
| | Sediment laden stormwater | ***Pathway:*** Overland runoff during rainfall events<br>***Impacts:*** Discharge to land, resulting in impacts to ecological health and amenity | Remnant native vegetation<br>Surface water bodies<br>Aboriginal heritage sites | Refer to Section 3.1 | C = Slight<br>L = Unlikely<br>**Low risk** | Y | N/A | N/A |
| | Hydrocarbon or chemical reagent release | ***Pathway:*** Storage leak or pipeline rupture<br>***Impacts:*** Discharge to land, resulting in impacts to ecological health | | Refer to Section 3.1 | C = Slight<br>L = Unlikely<br>**Low risk** | Y | Condition 12 | N/A |

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

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

## 3.3 Detailed risk assessment for seepage from TSF1 and TSF2

### 3.3.1 Background

TSF1 was constructed and has been operational intermittently since 1989. Seepage from TSF1 has been considered a historical issue at the premises. In January 2019, WAD CN concentrations in existing groundwater monitoring bores were found to have exceeded the prescribed limit on the premises' licence L9124/2018/1.

This incident triggered regulatory concerns regarding potential mounding of groundwater beneath the toe of TSF1, which may impact embankment stability. In response, the former TSF1 monitoring network of up to 10 bores (i.e., TSF1 to TSF10) were converted into seepage recovery bores by mid-2019, with an additional 15 monitoring bores installed across eight locations at the premises (i.e., CMB1 to CMB8). Some of the CMB series bores are clustered pairs, aimed at screening both the superficial and deeper rock aquifers. Further, the applicant also undertook a hydrogeological investigation to better understand the impacts of current operations and a mounded water table on the surrounding groundwater environment.

The proposed embankment raises to TSF1 and construction of an additional TSF (i.e., TSF2) may impose additional seepage pressures at the premises, which may exacerbate groundwater mounding.

### 3.3.2 Source: Tailings geochemical characteristics

The risks of seepage from TSF1 are dependent on the geochemical characteristics of its source tailings. An investigation undertaken in 2013 found that (Coffee Mining 2013):

- The potential for acid mine drainage production is low for tailings, with an acid neutralising capacity (ANC) of 110 kg of sulfuric acid per tonne of ore and an ANC/MPA (maximum potential acidity) ratio of 5.7 (i.e., greater than 2.0). As such, the tailings' Acid Forming Potential was classified as Non-Acid Forming (NAF);
- Tailings pH was 10.5 pH units, indicating very low risk of being acid-generating;
- Tailings were enriched with arsenic, antimony, calcium, iron, magnesium, sodium and selenium, as determined by a Geochemical Abundance Index exceeding 3.0 (Table 7);
- Short-term leach testing undertaken in accordance with Australian Standard Leach Procedures (ASLP) indicate increased mobility of certain metals and metalloids under acidic conditions (e.g., barium, calcium, cobalt, iron, magnesium, manganese, nickel, strontium, tungsten, zinc), which will be unlikely given the high pH of the tailings (Table 7); and
- It was noted that cobalt concentration was 0.04 mg/L in deionised water leachate solution (pH 7), which is close to exceeding the long-term irrigation use guideline value of 0.05 mg/L. The leachate concentration increased to 0.13 mg/L under acidic concentrations, which exceeded both long- and short-term irrigation guideline values.

No analytical testing was undertaken to determine the total cyanide or WAD CN concentration within the ore or its leachability. However, data from the 2018 to 2020 TSF annual audit indicated that total cyanide concentration in tailings slurry typically ranged from 0.04 to 0.1 mg/L, with WAD CN concentrations typically <0.05 mg/L (TTC 2021c). Further, the attenuation rate of WAD CN in soil environments was considered in informing its risk to receptors.

**Table 7: Tailings geochemical and ASLP characterisation**

| Element | Irrigation guideline values (mg/L) | | Non-potable domestic guidelines (mg/L) | Leachate concentration (mg/L) | | Tailings concentrations (mg/kg) | Geochemical Abundance Index (GAI) |
|---|---|---|---|---|---|---|---|
| | Short-term | Long-term | | pH 7.0 | pH 2.9 | | |
| Ag | --- | --- | 1 | <0.01 | 0.02 | <1 | 3 |
| Al | 20 | 5 | 2 | 0.2 | **3.4** | 18000 | 3 |
| As | 2 | 0.1 | 0.07 | <0.05 | <0.05 | 61 | **4** |
| B | --- | 0.5 | 40 | <0.2 | 0.2 | 9 | 0 |
| Ba | --- | --- | 7 | 0.11 | 0.45 | 150 | 0 |
| Be | 0.5 | 0.1 | --- | <0.01 | <0.01 | <1 | 0 |
| Ca | --- | --- | --- | 150 | 960 | 25000 | **5** |
| Cd | 0.05 | 0.01 | 0.02 | <0.01 | <0.01 | 0.5 | 1 |
| Cr | 1 | 0.1 | 0.5 | <0.01 | 0.01 | 61 | 0 |
| Co | 0.1 | 0.05 | --- | 0.04 | **0.13** | 22 | 0 |
| Cu | 5 | 0.2 | 20 | <0.01 | 0.02 | 73 | 0 |
| Fe | 10 | 0.2 | 3 | 0.09 | **72** | 42000 | **6** |
| Hg | 0.002 | 0.002 | 0.01 | --- | --- | <0.1 | 0 |
| K | --- | --- | --- | 29 | 38 | 4000 | 3 |
| La | --- | --- | --- | <0.01 | 0.19 | --- | --- |
| Li | 2.5 | 2.5 | --- | --- | --- | --- | --- |
| Mg | --- | --- | --- | 32 | 240 | 16000 | **5** |
| Mn | 10 | 0.2 | 5 | <0.01 | **23** | 840 | 0 |
| Mo | 0.05 | 0.01 | 0.5 | <0.03 | **0.05** | <1 | 0 |
| Na | --- | --- | --- | 780 | 690 | 15000 | **5** |
| Ni | 2 | 0.2 | 0.2 | <0.02 | 0.1 | 48 | 0 |
| Pb | 5 | 2 | 0.1 | <0.03 | 0.04 | 25 | 0 |
| S | --- | --- | --- | --- | --- | --- | --- |
| Sb | --- | --- | --- | <0.1 | <0.1 | <7 | **4** |
| Se | 0.05 | 0.02 | 0.1 | <0.1 | <0.1 | <3 | **5** |
| Si | --- | --- | --- | 1.8 | 22 | --- | --- |
| Sn | --- | --- | --- | <0.05 | <0.05 | 1 | 0 |
| Sr | --- | --- | --- | 1.4 | 3.3 | 95 | 0 |
| Ti | --- | --- | --- | <0.02 | <0.02 | 290 | 0 |
| V | 0.5 | 0.1 | --- | <0.02 | 0.03 | 77 | 0 |
| W | --- | --- | --- | <0.01 | 2.1 | 10 | 2 |
| Zn | 5 | 2 | 30 | <0.02 | 0.21 | 80 | - |
| P | --- | 0.05 | --- | <0.5 | <0.5 | 640 | 0 |

*Note:* Bolded coloured values represent exceedance of a guideline value. The colour of the value corresponds to the relevant guideline exceeded. Highlighted values represent exceedance of multiple guideline values. Red, bolded values represent GAI of 3 or higher.

It was noted that the ore processed at the premises is sourced from a variety of locations and ore deposits. As such, the geochemical characteristics of each ore batch may differ, depending on their origin. In 2021, a DMIRS inspection identified inadequate processes for assessing the potential of toll-treated ore to cause environmental harm while being stored on the ROM pad or once processed as tailings. DMIRS required procedures to be developed to ensure that toll-treated ore were adequately tested prior to arrival at the premises to determine if it posed a risk to the environment. Consequently, the applicant developed an Ore Acceptance Procedure stipulating characterisation testwork required for all externally sourced ore prior to acceptance at the premises (TTC 2022).

### 3.3.3 Pathway: Groundwater flow and seepage migration

Contaminant-loaded seepage water typically drains gravimetrically through the TSF structure. In the soil environment underlying the TSF, seepage may flow vertically or horizontally through the soil profile. Seepage flow rates are driven by the permeability of the soil matrix and seepage pressures imposed by water in the TSF.

A preliminary conceptual site model of the premises indicated four hydrogeological stratigraphic units (HSU) underlying the premises, illustrated in Figure 7 and described in Table 8 (TTC 2021c). Connectivity and mixing between the various HSUs was undetermined, due to the hypersaline nature of the aquifers (i.e., Na-Cl type) masking the concentrations of other major ion parameters.

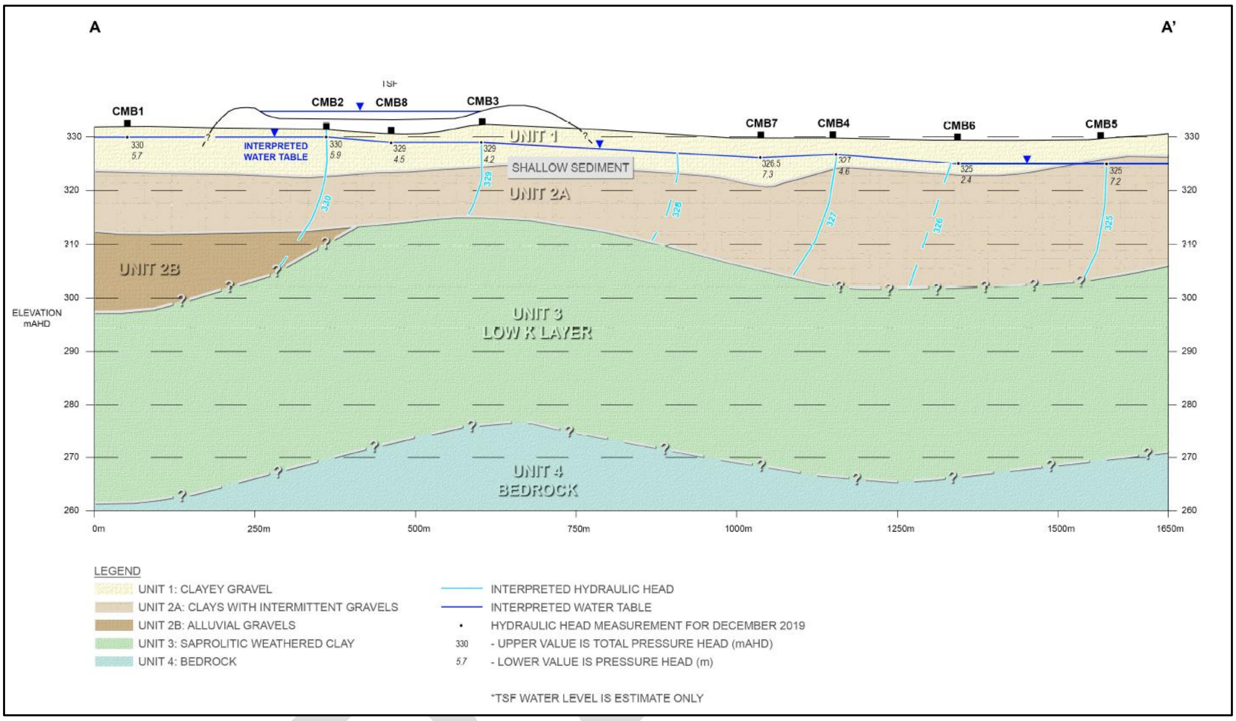



**Figure 7: Hydrogeological conceptual site model at the premises**

**Table 8: Hydrogeological Stratigraphic Units at the premises**

| HSU | Lithology/ geology | Description | Depth (mbgl) | Average saturated thickness (m) | Hydraulic conductivity (m/day) |
|---|---|---|---|---|---|
| 1 | Clayey gravels | Shallow sediment, water table located within this unit. Groundwater flow direction to south. | 0 to 9 | 7.5 | 2.12 |
| 2a | Clay with intermittent gravels | Shallow sediment. Groundwater flow direction to south. | 3 to 33 | 23 | 0.13 |
| 2b | Alluvial gravels | Limited understanding of extent. Groundwater flow direction not known. | 20+ | Not known | Not known |
| 3 | Saprolitic clay (weathered bedrock) | Low K layer (low permeability), sediment. Limited groundwater flow. Groundwater flow direction not known. | 17 to 63 | 35 | 0.008 |

| HSU | Lithology/ geology | Description | Depth (mbgl) | Average saturated thickness (m) | Hydraulic conductivity (m/day) |
|---|---|---|---|---|---|
| 4 | Bedrock | Fractured rock, weathered igneous formation.<br>Groundwater flow direction not known. | 63+ | Not known | 0.02 |

Groundwater flow rate was estimated to be approximately 2.6 m annually, with the migration on contaminants thought to be even slower due to sorption processes between groundwater and soil. Specifically, copper was assessed as it had the lowest soil-water partition coefficient among the contaminants of potential concern at the premises (i.e., migrates at a higher rate), resulting in a migration rate of only 0.01 m annually, though this may be accelerated in the presence of gravel or sand lenses within the colluvial soil matrix.

Furthermore, three production bores WB01, WB02 and WB03 were installed along the south of the TSF1 embankment toe in December 2012. It was understood that the screen interval of these bores ranged from approximately 6 mbgl to 60 mbgl, with WB02 extending to 83.6 mbgl (GRM 2013). Based on the bore logs and current understanding of the premises' hydrogeology (Figure 7), the three productions bores are likely screened across all HSUs and terminates at bedrock, described as '*PORPHYRY, dark grey, hard, fresh porphyry*'. The extensive screen interval was likely selected to maximise abstraction yields. However, given the proximity of the production bores to TSF1, the bores may act as preferential flow pathway for seepage contaminants in the superficial aquifer to mix with the deeper aquifer units, potentially resulting cross-contamination.

### 3.3.4 Receptors

Based on aerial photography, there is likely remnant vegetation surrounding the premises. However, the natural landscape is likely to be heavily degraded, with surface soils observed as being salt-scalded and contaminated with historical tailings (TTC 2021a). Therefore, the likelihood of pristine vegetation communities being present in the area is considered low. Vegetation to the north of the premises appears to be in better condition, compared to the south.

The Bureau of Meteorology groundwater dependent ecosystem online atlas identified a low potential terrestrial groundwater-dependent ecosystem located approximately 11 km southwest of the premises, listed as 'medium woodland; salmon gum'.

Hannan Lake is located approximately 2.25 km south of the premises boundary, hydraulically downgradient of the premises, with the closest lake located 1.5 km from the premises boundary.

Groundwater is abstracted at the premises for use in the gold processing circuit. During the 2019-2020 annual period, a total of 45,734 kL was abstracted. There is potential for seepage-impacted groundwater to be abstracted from these production bores. The applicant also abstracts groundwater from two production bores located 6.3 km south of the premises, within the Hannan Lake area, which contributed 172,281 kL in the same annual period. However, it is understood that these bores were taken offline in 2020, owing to cost issues and increased water availability from the neighbouring KCGM operations. In addition, KCGM also hold an abstraction licence for bores located south of the premises, within the Hannan Lake area. Bore water is transferred to their Fimiston processing plant for use in ore processing.

Further, a search of the Water Information Reporting database returned up to nine registered bores within 5 km to the south-east of the premises (Figure 6). However, aerial photography reference suggests these bores are not operational and were likely a remnant of past mining operations. The bores are unlikely to be located hydraulically downgradient to the premises.

### 3.3.5 Proposed controls

In considering the impacts of TSF2 on seepage and groundwater mounding at the premises and its surrounds, the design of TSF2 was revised from its 2013 iteration to remain in line with current guidelines. Seepage management infrastructure proposed for TSF2 included a decant recovery system, seepage recovery trenches and an underdrainage network. The existing infrastructure at TSF1 will be maintained. The relevant seepage management infrastructure and controls have been discussed in Section 2.4.3 and Table 4, respectively.

The applicant has committed to maintaining the size of the supernatant pond around the decant tower to be as small as practicable to maximise water recovery. The optimal average area and average equivalent radius of the supernatant pond, as well as the minimum distance of the pond boundary from all perimeter embankments, were determined (refer to Sections 2.4.2.2 and 2.4.3.3).

Three seepage recovery bores were proposed to control groundwater levels to the west and south of TSF2. Based on the local hydrogeology and groundwater flow direction, the southern seepage recovery bores are likely necessary to mitigate the migration of contaminant-loaded seepage. The northern boundary of TSF2 is adequately covered by existing recovery bores for TSF1 and production bores, while the processing facility is located to the east.

The applicant has also proposed the installation of groundwater monitoring bores at two locations, one clustered pair to the south and one shallow bore to the north-west of TSF2 (Figure 3). These monitoring bores would provide additional coverage to the monitoring network at the premises, particularly for assessing the seepage impacts of TSF2. The applicant proposed the use of data loggers for the continuous monitoring of groundwater levels in the three proposed bores. The groundwater monitoring suite was proposed to be the same as those used to monitor groundwater at TSF1, in accordance with licence L9124/2018/1.

### 3.3.6 Risk assessment

#### 3.3.6.1 Standing water level and groundwater mounding

Hydraulic heads of monitoring bores screened within HSU 1 and 2a (e.g., CMB1, CMB4 and CMB8) indicated small upward vertical hydraulic gradient, which may be influenced by the TSF1 loading (TTC 2021c). This vertical hydraulic gradient was not as evident in monitoring bores further away from TSF1 (e.g., CMB6). A downward vertical hydraulic gradient was observed at monitoring bores screened at the deeper HSUs 2a, 3 and 4 (e.g., CMB4 and CMB8), indicating movement of groundwater from higher to lower hydraulic head, suggesting lesser influence from TSF1.

Analysis of the older monitoring bore network (i.e., TSF01 to TSF10) indicated an observable decrease in standing water levels between the May 2019 and December 2019 GME (Figure 8). This was likely the result of these bores being converted to seepage recovery bores between the GMEs. If the bores used for seepage recovery were not given adequate time to equilibrate prior to monitoring, the measured standing water level observed during December 2019 may not be representative of the natural water table.

Notwithstanding, the lower standing water levels observed December 2019 may not be representative of the natural water table if the bores had already been recovery seepage and were not given adequate time to equilibrate prior to monitoring.

Nevertheless, standing water levels at monitoring bores screened within the shallowest aquifer unit (i.e., HSU1) have remained relatively stable since December 2019 (Figure 9). Based on the May 2021 groundwater monitoring event, standing water level at HSU1-screened monitoring bores screened ranged from 0.4 mbgl to 2.6 mbgl (Figure 9). The shallowest bores were located on the southern end of TSF1 (i.e., CMB4 and CMB8), with the deepest located north of TSF1 (i.e., CMB1 and CMB3, with CMB2 as an exception).

While CMB5, CMB6 and CMB7 were located at the southern boundary of the premises, the standing water level at these locations were also relatively shallow at above 1.5 mbgl. Groundwater contours of HSU1-screened monitoring bores indicated a consistent southerly flow direction (Figure 10), in line with regional groundwater flow direction. This suggests that the shallow standing water levels observed at the southern bore locations were likely not influenced by groundwater mounding from TSF1.

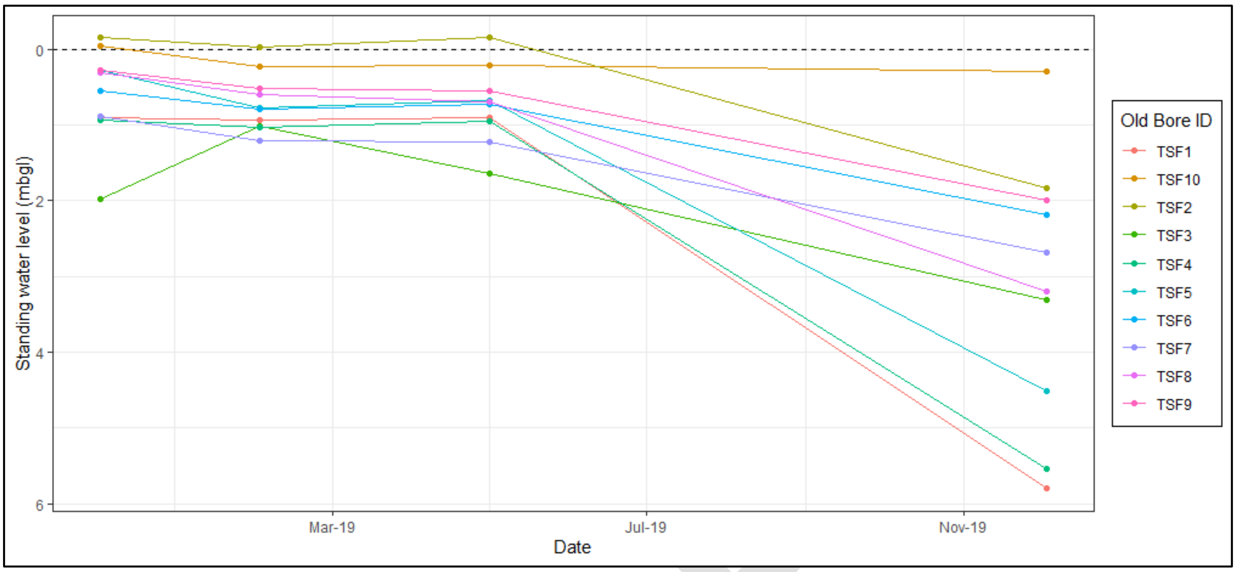



**Figure 8: Standing water level in converted TSF series bores**

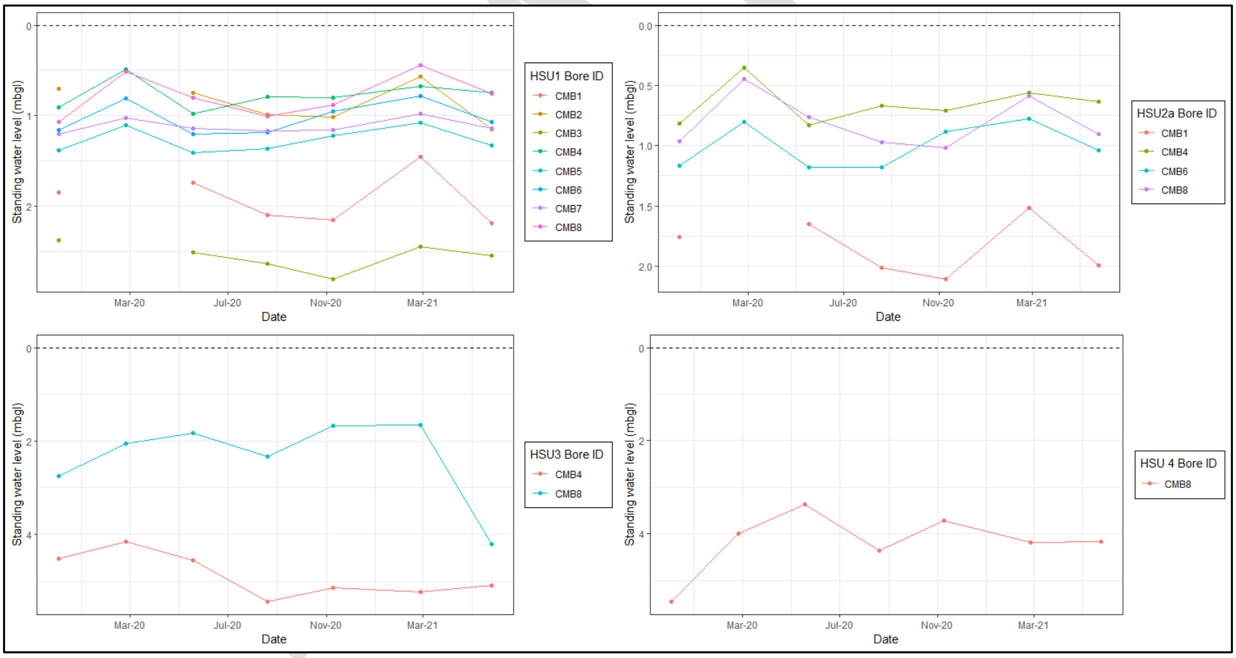



**Figure 9: Standing water level in recently installed CMB series bores**

There is strong evidence in the monitoring data that suggests seepage from TSF1 is resulting in the mounding of the surrounding water table. Consistent with regional groundwater flow, the mounding effect is skewed towards the south of TSF1 (i.e., CMB4 and CMB8), compared to the north (i.e., CMB1, CMB2 and CMB3). An elevated water table represents a potential risk to the environment, as it may enter the root zone of nearby vegetation to the east and north of TSF1. The hypersaline nature of groundwater may cause localised soil salinisation, resulting in vegetation stress or even death of salt-sensitive plant species, as well as potential exposure to elevated concentrations of seepage-derived contaminants (discussed below).

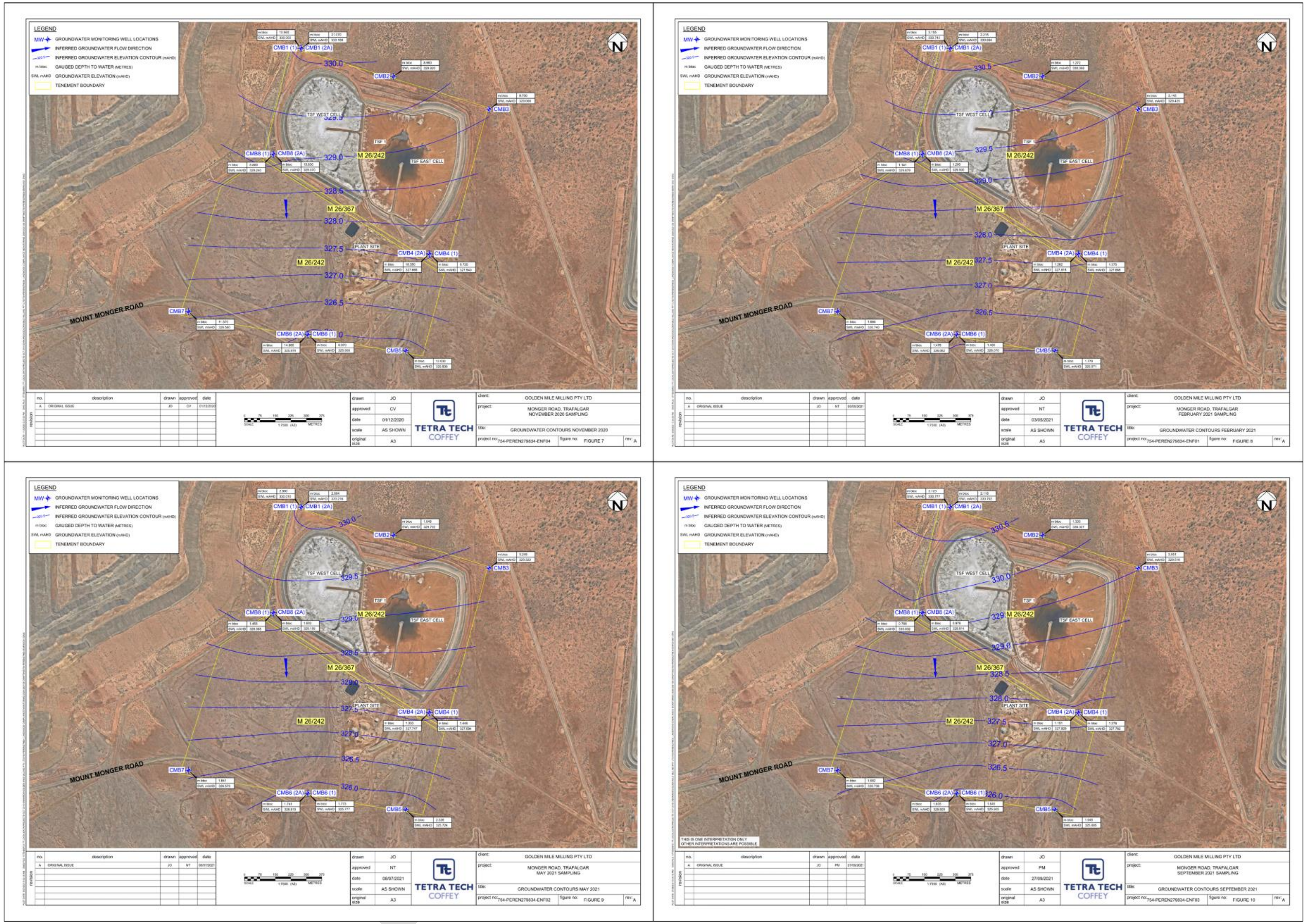



**Figure 10: Groundwater contour of shallow aquifer bores during the (a) December 2020, (b) February 2021, (c) May 2021 and (d) September 2021 groundwater monitoring event**

#### 3.3.6.2 Seepage contaminant migration

Groundwater quality in HSU1-screened monitoring bores do not show any general trends between December 2019 to May 2021. The only exception was groundwater pH, which was lower than pH 5 and showing a decreasing trend over time. Only monitoring bore CMB7 was slightly neutral, with pH between 5.5 to 6.5 pH units. However, a decreasing trend was still observed, suggesting gradual acidification. These findings disagree with the high pH and low acid-generating potential of the characterised tailings (refer to Section 3.3.2; Coffey Mining 2013). The source of widespread acidity could potentially be attributed to a combination of both natural and anthropogenic causes.

Comparison of groundwater quality between monitoring bores screened in HSU1 showed similar concentrations of contaminants, with the following exception:

- Higher groundwater pH at CMB7 (i.e., less acidic);
- Higher electroconductivity (EC) and TDS concentrations at CMB4 and CMB8, compared to monitoring bores hydraulically upgradient of TSF1 (i.e., CMB1, CMB2, and CMB3) and those further downgradient (i.e., CMB6 and CMB7);
- Arsenic concentrations consistently reported below limit of reporting at all locations (typically 0.01 mg/L);
- Higher cadmium concentrations consistently reported at CMB5, which is located on the south-east corner of the premises boundary;
- Higher concentrations of lead consistently reported at CMB4, as well as an increasing trend observed in CMB5;
- Higher concentrations of zinc reported at CMB2 and CMB3 but are showing a decreasing trend over time; and
- WAD CN has been detected at CMB2, CMB3, CMB4, CMB8 and recently CMB5 (i.e., since November 2020). Historically, WAD CN concentrations at CMB4 were the highest, but was shown to decrease over time.

While no exceedance of the WAD CN limit has been reported since monitoring of the new CMB-series bores, the consistent detection of WAD CN at CMB5 since November 2020 is of concern, as it suggests that seepage from TSF1 may have reached the south-eastern boundary of the premises (and potentially beyond). This finding challenges the slow migration rate of contaminants previously estimated in Section 3.3.3.

#### 3.3.6.3 Vertical contaminant migration

While HSU1 is the aquifer unit most likely impacted by tailings and contamination, there is potential for underlying aquifer units to also be impacted, especially when considering the screening of the nearby production bores.

In assessing bores screened at HSU2a, WAD CN was detected above its limit of reporting in CMB4 and CMB8, but not in CMB1 and CMB6. The detection of WAD CN at these bores also correlated to their HSU1 counterparts, where WAD CN was not detected in CMB1 and CMB6. A weak, but positive relationship was observed in the WAD CN concentrations between the HSU1 and HSU2 bores at CMB4 and CMB8 (Figure 11). This suggests that the WAD CN concentrations observed in HSU2a were influenced by WAD CN concentrations in seepage-impacted HSU1 to some degree.

No WAD CN was detected in monitoring bores screened within the HSU3 and HSU4 aquifer units. Further monitoring is required to better understand long-term trends.

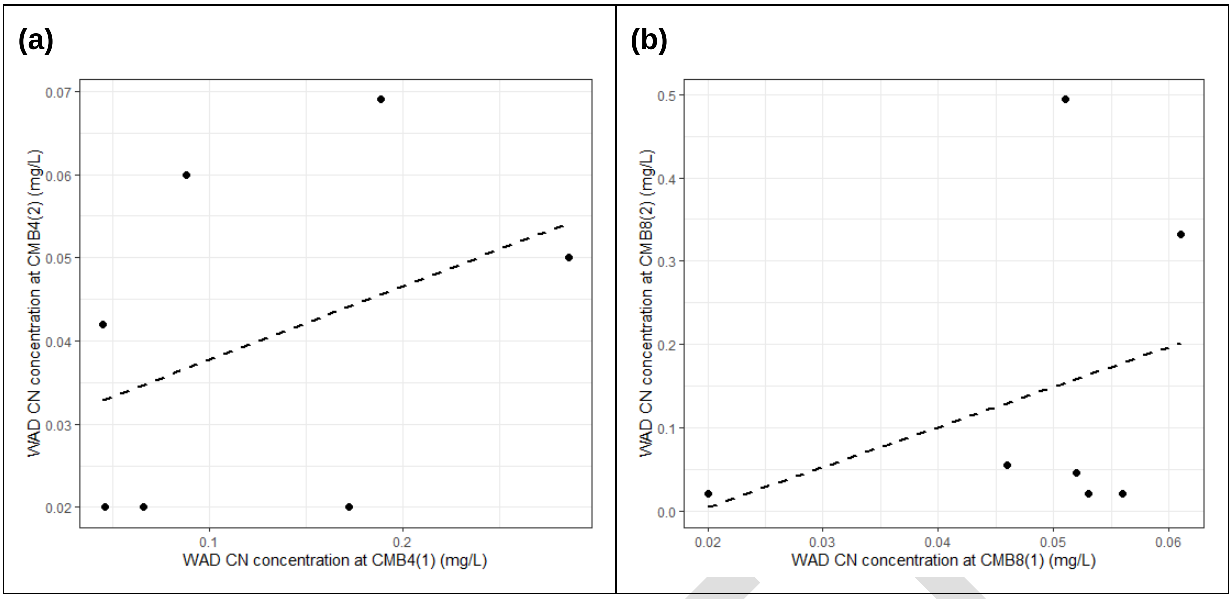



**Figure 11: Comparison of WAD CN concentrations in HSU1-screened and HSU2-screened bores at (a) CMB4 and (b) CMB8**

### 3.3.6.4 Seepage modelling and analysis

The proposed TSF2 is not lined, and the foundation soil material was assumed to have a permeability of 1 x $10^{-7}$ m/s. To support the design, the applicant undertook seepage monitoring to predict the effect of the proposed works (e.g., TSF1 embankment raises up to Stage 10, TSF2 construction) on the groundwater regime (Figure 12). The results of the seepage analysis are provided in Table 9.

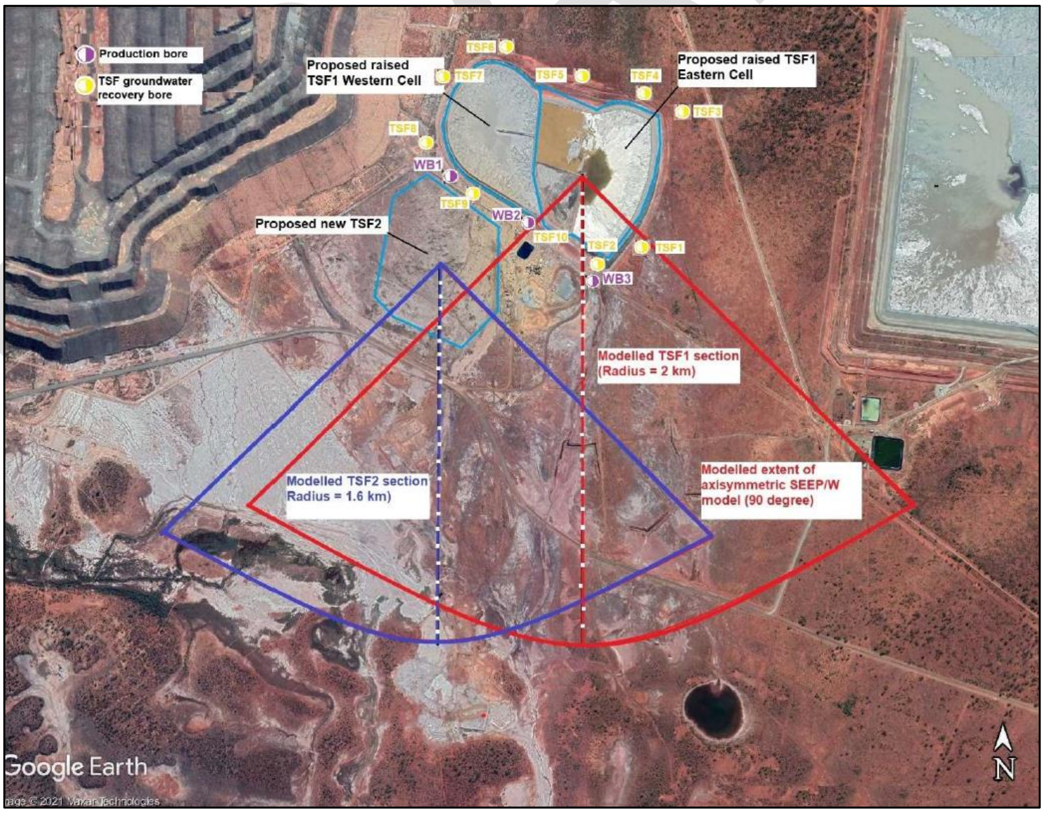



**Figure 12: Modelling domain of TSF1 and TSF2 for seepage analysis**

**Table 9: Seepage analysis output**

| Scenario | Seepage from tailings slurry ($m^3$/day) | Seepage from seepage collection trench ($m^3$/day) | Seepage into production bore WB03 ($m^3$/day) | Seepage into internal underdrainage lines for TSF2 ($m^3$/day) |
|---|---|---|---|---|
| Case 1: Stage 6 of TSF1 – Eastern Cell (current operation) | 4.0 | 2.5 | 2.7 | N/A |
| Case 2: Stage 10 of TSF1 – Eastern Cell (proposed operation) | 16.7 | 10.4 | 10.6 | N/A |
| Case 3: Stage 5 of TSF2 (proposed operation) | 16.3 | 11.0 | N/A | 44.7 |
| Sum of Case 2 and Case 3 (cumulative impact of proposed operations) | 33.0 | 21.4 | N/A | N/A |

The operation of the Stage 10 embankment would increase estimated seepage from TSF1 would increase from 4.0 $m^3$/day to 16.7 $m^3$/day. TSF2 would contribute another 16.3 $m^3$/day, resulting in a cumulative discharge of 33.0 $m^3$/day. Based on the seepage analysis, the following conclusions were made:

- Proposed works at TSF1 was unlikely to cause the water table to mound above 1.5 mbgl, assuming current seepage recovery rates were maintained; and
- The inclusion of TSF2 would only cause an additional 0.5 m of mounding.

The findings of the seepage analysis should be considered along with empirical evidence currently available. In particular, standing water levels in most HSU1-screened monitoring bores were already observed to be within 1.5 mbgl. Furthermore, the modelled increase in the water table from the operation of TSF2 should be considered within the current hydrogeological context. An increase of 0.5 m is relatively significant around TSF1, where the water table is shallow, especially south of TSF1.

Seepage rates typically increase with the height of a TSF embankment crest due to the raising of the phreatic surface. Therefore, the proposed control to operate seepage recovery infrastructure at their current state might not be adequate for maintaining groundwater levels after several embankment raises.

Finally, variability in the material permeability and operational conditions (e.g., supernatant pond size) were considered uncertainties in the modelled seepage flows. This highlights the importance of good water management practices in controlling seepage from TSF1 and TSF2.

### 3.3.7 Decision and additional regulatory control

Based on the information provided on the source, pathway and receptors for this risk event, it was determined that a complete linkage could potentially be present, where:

- Groundwater mounding has been observed to occur around TSF1. While groundwater levels are currently stable, they remain relatively shallow and may potentially be exacerbated by the proposed works. An elevated water table would increase the risk of vegetation stress or death, where the root zone is inundated with hypersaline water and exposure to contaminants from the TSF seepage. Given the history of the surrounding environment, it is unlikely that the current vegetation communities are pristine or of significant environmental value; and

- The dominant groundwater flow direction is to the south, which may facilitate the migration of contaminants from TSF seepage towards sensitive receptors in that direction, namely the Hannan Lake playa. Currently, the ecology of the playa and its sensitivity towards seepage/contaminant exposure is not well understood. While contamination migration analysis utilising the soil-water partition coefficient of relevant contaminants was used to demonstrate the slow migration rates, the recent detection of WAD CN in shallow groundwater bores at the southern premises boundary may suggest a greater rate than previously estimated.

A complete source-pathway-receptor is unlikely to be present for human receptors as there are no active third-party groundwater users located hydraulically downgradient of the premises. While both the applicant and KCGM abstract water south of the premises, which may be impacted by seepage, there is reduced risk to human health as the water feeds directly into their respective gold processing circuits. No other domestic groundwater users were found around the premises.

Furthermore, potential migration and contamination of deeper aquifers appears limited at this stage. While WAD CN was detected within two hydrogeological stratigraphic units (i.e., HSU1 and HSU2a), there is limited evidence to suggest that the deeper saprolitic and fractured bedrock aquifers have been impacted by seepage from TSF1, despite the presence of existing production bores. No definitive trends or conclusions can be drawn at the time of the assessment, due to the lack of comprehensive, long-term monitoring data available.

In considering its geochemical characteristics and potential impacts to surrounding receptors, the Delegated Officer considers the consequence of seepage from TSF1 and TSF2 to be **moderate**. The likelihood of seepage from both TSFs is **possible**, given historical observations of TSF1, as well as monitoring and modelling undertaken as part of this application. As such, the risk rating for the impacts of seepage from TSF1 and TSF2 on sensitive receptors is classified as **medium risk**.

Furthermore, the Delegated Officer has considered additional regulatory controls to be necessary, in addition to those that have been proposed by the applicant (Table 10).

**Table 10: Additional regulatory controls for managing seepage discharge**

<table>
<tr><th>Conditions of the works approval</th><th>Additional regulatory controls</th><th>Comments</th></tr>
<tr><td rowspan="2">Condition 12</td><td>Specified limit to supernatant pond size for TSF1 and TSF2.</td><td rowspan="2">Seepage analysis undertaken suggests that the supernatant pond size plays a major role in determining seepage outflows from the TSF. The optimal pond size was determined for optimal water recovery and minimising seepage.<br><br>Furthermore, the same was determined for the separation distance between the supernatant pond and perimeter embankments. The length of the tailings beach determines the phreatic surface, and subsequently, seepage pressures.<br><br>As a control for managing seepage at the TSFs, the applicant has committed to maintaining the supernatant ponds at the smallest practical operational size.<br><br>Therefore, the Delegated Officer has conditioned the specifications for optimal water recovery in the works approval.</td></tr>
<tr><td>Specified separation distance between supernatant pond boundary and perimeter embankments for TSF1 and TSF2.</td></tr>
</table>

| Conditions of the works approval | Additional regulatory controls | Comments |
|---|---|---|
| Condition 17 | Monitoring of supernatant pond water quality<br><br>Limit for WAD CN in supernatant pond water | Monitoring of contaminants at the supernatant pond is aimed at complimenting the existing monitoring undertaken at the surrounding bores. Routine monitoring of the pond water quality not only assesses whether the water would pose a risk to wildlife and birdlife accessing it as drinking water, it also enables early detection of contaminants prior to seeping and entering the underlying groundwater system.<br><br>Additionally, a limit for WAD CN of 50 mg/L was also considered to further manage the risk to wildlife and birdlife exposed to supernatant pond water. The limit value was decided based on the *Cyanide Code's Guidance for Use of the Mining Operations Verification Protocol* (ICMI 2021).<br><br>Therefore, the Delegated Officer conditioned the requirement to undertake water quality monitoring and added a limit for WAD CN concentration for the supernatant pond at TSF1 and TSF2 during time limited operation. The limit for WAD CN was removed after consideration of the applicant's comments.<br><br>Refer to Appendix 1 for the applicant's comments on these additional regulatory controls. |
| Condition 17<br><br>Condition 18 | Monitoring of sulfate, cobalt, chromium, mercury, molybdenum, selenium, thalium, uranium in supernatant pond and monitoring bores of TSF1 and TSF2 | While the concentration of certain metal and metalloids (e.g., arsenic, cadmium, copper, nickel, lead and zinc) have been monitored previously, there is no existing monitoring data for other potential contaminants that may be associated with gold processing and gold tailings.<br><br>The Ore Acceptance Procedure (TTC 2022) that is being implemented has a limited suite of analytes. Furthermore, the tailings geochemical characterisation study provided was undertaken in 2012/2013 and relied on the ASLP methodology to characterise contaminant concentrations in leachate. This methodology is generally not as applicable as other recently developed methods (e.g., Leaching Environmental Assessment Framework [LEAF]) because they only reflect limited leaching conditions (DER 2015).<br><br>As such, the Delegated Officer has conditioned additional parameters to be monitored at TSF1 (to identify any existing contaminants of concern) and TSF2 (to establish pre-deposition baseline data) under condition 17 and condition 18.<br><br>Should any of these parameters be of potential concern, the preliminary groundwater monitoring data collected during time limited operation would be useful in determining baseline concentrations going forward. The pre-deposition/early monitoring of these parameters at TSF2 is crucial as many of these contaminants do not have relevant guideline values for assessment, or where available, may be overly conservative and not applicable to the premises' hydrogeochemical setting.<br><br>The monitoring data should be reviewed upon completion of time limited operation and considered when amending the licence to authorise the operation of TSF1 raised embankments and TSF2.<br><br>Refer to Appendix 1 for the applicant's comments on these additional regulatory controls. |

# 4. Consultation

Table 11 provides a summary of the consultation undertaken by the department.

**Table 11: Consultation**

| Consultation method | Comments received | Department response |
|---|---|---|
| Application advertised on the department's website on 20 August 2021 | None received. | N/A |
| City of Kalgoorlie-Boulder advised of proposal on 9 September 2022. | City of Kalgoorlie-Boulder responded on 16 September 2022, indicating no objection to the application. | N/A |
| Department of Mines, Industry Regulation and Safety (DMIRS) advised of proposal on 9 September 2022. | DMIRS responded on 10 October 2022, indicating no concerns with the scope of the application, including the geotechnical aspects of proposed works relating to the TSF.<br>DMIRS noted that the relevant Mining Proposal (Reg ID 11925 and 106144) was undergoing assessment at the time of the response. | N/A |
| Applicant was provided with draft documents on 9 December 2022. | Refer to Appendix 1. | Refer to Appendix 1. |

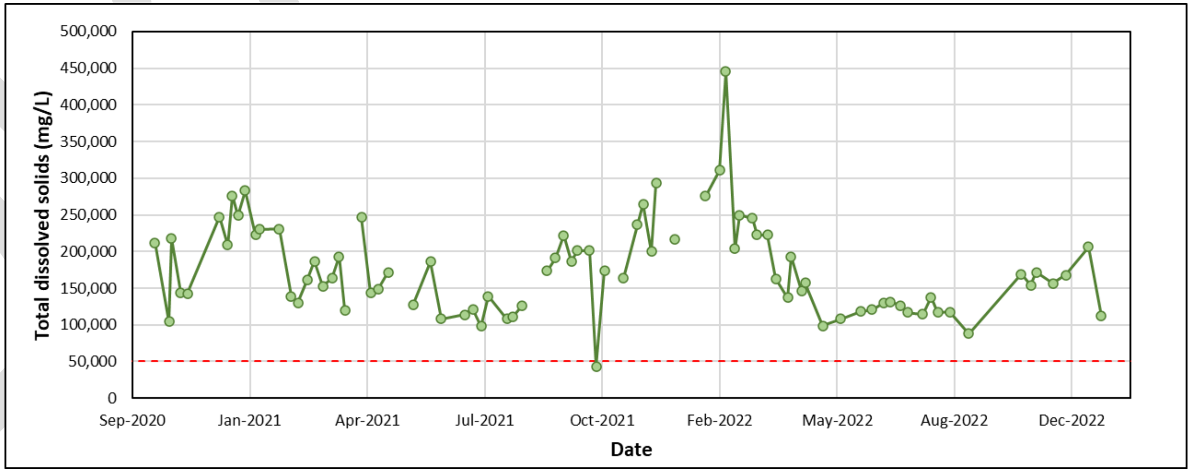
# 5. Conclusion

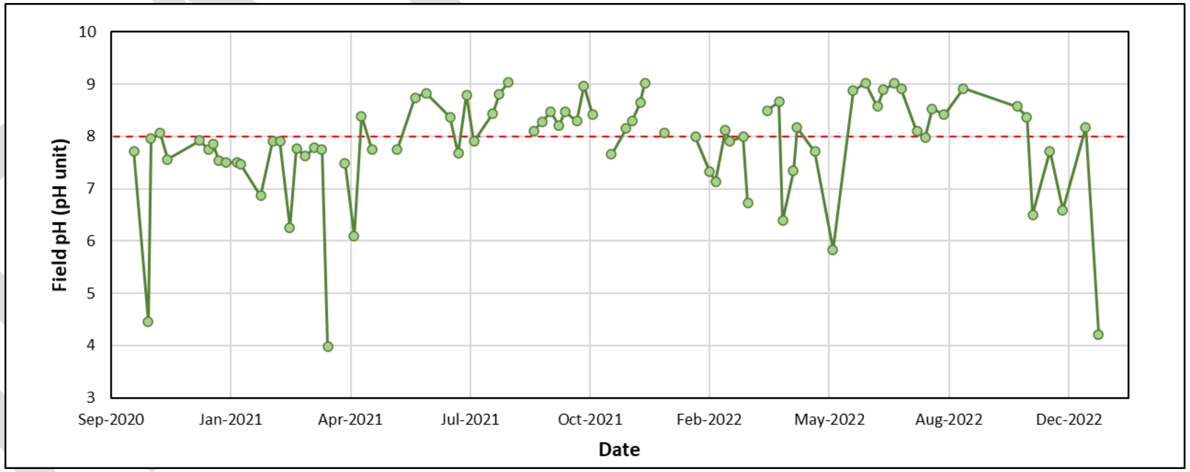
Based on the assessment in this decision report, the delegated officer has determined that a works approval will be granted, subject to conditions commensurate with the determined controls and necessary for administration and reporting requirements.

# References


1. Adams MD, Donato, DB, Schulz RS, Smith GB, Gibbons T, Davies S, Hillier D 2013, *Hypersaline-Induced Reduction in Cyanide Ecotoxicity at Gold Operations, thereby Obviating Detoxification Plants*, World Gold Conference, Brisbane, Queensland.
2. Coffey Mining Pty Ltd (Coffey Mining) 2013, *Tailings Geochemical Characterisation – Lakewood Project*, Perth, Western Australia.
3. Department of Environment Regulation (DER) 2015, *Background paper on the use of leaching tests for assessing the disposal and re-use of waste-derived materials*, Perth, Western Australia.
4. Department of Environment Regulation (DER) 2015, *Guidance Statement: Setting Conditions*, Perth, Western Australia.
5. Department of Water and Environmental Regulation (DWER) 2020a, *Guideline: Environmental Siting*, Perth, Western Australia.
6. DWER 2020b, *Guideline: Risk Assessments*, Perth, Western Australia.
7. Groundwater Resource Management (GRM) 2013, *Water Supply Investigation Lakewood Gold Processing Facility*, South Perth, Western Australia.
8. International Cyanide Management Institute (ICMI) 2021, *Guidance for Use of the Minign Operations Verification Protocol*, Washington, DC.
9. RaSiM6 Australia 2005, *Controlling Seismic Risk*, pp446-447.
10. Smith GB, Donato DB, Madden-Hallett D 2010, *Influences of hypersaline tailings on wildlife cyanide toxicosis: Granny Smith Gold Mine*, Donato Environmental Services, Darwin.
11. Tetra Tech Coffey (TTC) 2021a, *Lakewood Gold Processing Facility New TSF2 and TSF1 Raise Design – Design Report*, Perth, Western Australia.
12. Tetra Tech Coffey (TTC) 2021b, *Lakewood Gold Processing Facility New TSF2 and TSF1 Raise Design – TSF Operation Manual*, Perth, Western Australia.
13. Tetra Tech Coffey (TTC) 2021c, *Lakewood TSF2 Groundwater Study – Lakewood Gold Processing Facility*, Perth, Western Australia.
14. Tetra Tech Coffey (TTC) 2022, *Lakewood Gold Processing Mill – Ore Acceptance Procedure*, Perth, Western Australia.

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

| Condition | Summary of applicant's comment | Department's response |
|---|---|---|
| General | The applicant has addressed the outstanding matters highlighted in the draft conditions and provided the necessary information required by the department. | The department has assessed the information provided and conditioned them appropriately in the works approval. |
| 17 | **WAD CN limit for supernatant pond water** (Additional regulatory control)<br><br>The applicant understands that a limit of 50 mg/L was applied for WAD CN concentration in supernatant pond water to protect wildlife from ingesting supernatant pond water with high levels of cyanide.<br><br>The applicant understood that birdlife will not drink saline, and especially hypersaline, water. Given that groundwater in the local area has a TDS concentration ranging between 37,300 mg/L to 122,000 mg/L, it was considered very unlikely that wildlife would utilise the supernatant pond water as a drinking water resource.<br><br>As such, the applicant requests the WAD CN limit be removed from condition 17.<br><br>To support this, the applicant has provided TDS monitoring data of return water from TSF1 (i.e., water pumped from the supernatant pond). | The department has assessed the additional data provided to support the hypersaline condition of the supernatant pond water. Previous studies undertaken in the Goldfields region have found that saline and hypersaline conditions may not necessarily be able to deter wildlife from accessing supernatant ponds as a drinking water resource (Smith et al. 2010, Adams et al. 2013). As such, some level of residual risks remains.<br><br>A recommended TDS concentration of nominally 50,000 mg/L (or higher) in supernatant ponds have been nominated to provide a natural barrier for wildlife exposure to water containing WAD CN (Smith et al. 2010).<br><br>Since October 2020, the return water extracted from the supernatant pond was considered to be hypersaline, with TDS concentrations generally higher than 50,000 mg/L (Figure 13).<br><br><br>**Figure 13: Total dissolved solids concentration in TSF1 return water** |

| Condition | Summary of applicant's comment | Department's response |
| --- | --- | --- |
| | | This is further supported by the hypersaline condition of raw water sourced from the neighbouring KCGM operations, with an average TDS concentration of 118,694 mg/L, ensuring that the resultant tailings would continue to be hypersaline.<br><br>As such, the department considers the supernatant water to be adequately hypersaline to deter wildlife and birdlife from accessing it as a drinking water resource. The limit for WAD CN at the supernatant pond has been removed, though the requirement for monitoring of WAD CN remains. The applicant is still required to undertake TDS monitoring to ensure that the supernatant pond water is adequately saline (i.e., >50,000 mg/L TDS). |
| 17 | **Monitoring of dissolved metals in supernatant pond water** (Additional regulatory control)<br><br>The applicant understands that the pH of the TSF1 supernatant pond was approximately 9 pH unit, and under such alkaline conditions, metals were unlikely to become dissolved/soluble at detectable concentrations, even in trace amounts.<br><br>As such, the applicant requests the condition be reworded to only require monitoring of dissolved metals when the pH of the supernatant pond is measured below 8 pH units. | To support this comment, the department requested monitoring data of the supernatant pond water to demonstrate the alkaline conditions and low dissolved metals concentrations.<br><br>Subsequently, the applicant provided pH monitoring data for the return water drawn from the TSF1 supernatant pond. An assessment of the monitoring data (since October 2020) indicated that pH in the return water fluctuated over time, with an average pH of 7.84 pH units, though it was detected at as low as 3.97 pH units (Figure 14).<br><br><br>**Figure 14: pH of TSF1 return water**<br><br>Furthermore, the raw water sourced from the neighbouring KCGM operation had an average pH of 4.52 pH units. As such, the pH of the resultant tailings would likely be acidic and cause the pH at the supernatant pond to decrease over time.<br><br>No data on the dissolved metal concentrations found in the TSF1 supernatant pond was provided.<br><br>In light of this, it is unlikely that the pH of the supernatant pond would be adequately alkaline to reduce the |

| Condition | Summary of applicant's comment | Department's response |
|---|---|---|
| | | solubility of metals and metalloids. Given the pH of the raw water being used for processing, it is likely that the supernatant pond water would decrease over time, becoming more acidic and mobilising metals and metalloids at a greater degree.<br><br>Furthermore, the lack of existing monitoring data further stressed the need to acquire monitoring information on the supernatant pond water quality during time limited operations.<br><br>The department considers the conditions in the works approval to be necessary and justified. Given the large number of monitoring events where the measured pH of the return water was lower than 8 pH units, the applicant's request to alter the occurrence of the monitoring program is likely redundant.<br><br>The need for continual monitoring of metals and metalloids in the supernatant pond will be assessed during the subsequent application to amend licence L9124/2018/1, informed by the monitoring undertaken under this works approval. |

# Appendix 2: Application validation summary

<table>
<tr><th colspan="6">SECTION 1: APPLICATION SUMMARY (as updated from validation checklist)</th></tr>
<tr><td colspan="6">Application type</td></tr>
<tr><td>Works approval</td><td>☒</td><td colspan="4"></td></tr>
<tr><td rowspan="5">Licence</td><td rowspan="5">☐</td><td>Relevant works approval number:</td><td></td><td>None</td><td>☐</td></tr>
<tr><td colspan="2">Has the works approval been complied with?</td><td colspan="2">Yes ☐ No ☐</td></tr>
<tr><td colspan="2">Has time limited operations under the works approval demonstrated acceptable operations?</td><td colspan="2">Yes ☐ No ☐ N/A ☐</td></tr>
<tr><td colspan="2">Environmental Compliance Report / Critical Containment Infrastructure Report submitted?</td><td colspan="2">Yes ☐ No ☐</td></tr>
<tr><td>Date report received:</td><td colspan="3"></td></tr>
<tr><td>Renewal</td><td>☐</td><td>Current licence number:</td><td colspan="3"></td></tr>
<tr><td>Amendment to works approval</td><td>☐</td><td>Current works approval number:</td><td colspan="3"></td></tr>
<tr><td rowspan="2">Amendment to licence</td><td rowspan="2">☐</td><td>Current licence number:</td><td colspan="3"></td></tr>
<tr><td>Relevant works approval number:</td><td></td><td>N/A</td><td>☐</td></tr>
<tr><td>Registration</td><td>☐</td><td>Current works approval number:</td><td></td><td>None</td><td>☐</td></tr>
<tr><td colspan="2">Date application received</td><td colspan="4">14 June 2022</td></tr>
<tr><td colspan="6">Applicant and premises details</td></tr>
<tr><td colspan="2">Applicant name/s (full legal name/s)</td><td colspan="4">Lakewood Mining Pty Ltd</td></tr>
<tr><td colspan="2">Premises name</td><td colspan="4">Lakewood Gold Processing Facility</td></tr>
<tr><td colspan="2">Premises location</td><td colspan="4">Mining tenements M26/242 and M26/367</td></tr>
<tr><td colspan="2">Local Government Authority</td><td colspan="4">City of Kalgoorlie-Boulder</td></tr>
<tr><td colspan="6">Application documents</td></tr>
<tr><td colspan="2">HPCM file reference number:</td><td colspan="4">DER2022/000261</td></tr>
<tr><td colspan="2">Key application documents (additional to application form):</td><td colspan="4"><ul><li>Supporting Information Report</li></ul>The appendices of the Supporting Information Report included:<ul><li>Proof of Occupier Status</li><li>ASIC Company Extract</li><li>Design Report for TSF1 and TSF2</li><li>Geotechnical investigation reports for TSF1 and TSF2</li><li>Scope of Works for TSF2 Stage 1 and Generic Future Embankment Raises</li><li>Liquefaction assessments</li><li>Seepage/phreatic surface analyses</li><li>Stability and crest deformation analyses</li></ul></td></tr>
</table>

| SECTION 1: APPLICATION SUMMARY (as updated from validation checklist) | |
|---|---|
| | • TSF water balance analysis<br>• Dam break analyses<br>• TSF Risk Assessment<br>• TSF Operation Manual<br>• Tailings Geochemical Characterisation<br>• Surface Water Management Report<br>• TSF2 Groundwater Study<br>• Stakeholder Engagement Register |

**Scope of application/assessment**

| | |
|---|---|
| Summary of proposed activities or changes to existing operations. | ***Works approval***<br>Construction and time limited operation of:<br>• Additional infrastructure at Lakewood processing plant, comprising additional carbon-in-leach tank, refurbishment of Dunford regrind mill, upgrade to power grinding mill power and carbon regeneration kiln, resulting in an increase in Category 5 throughput from 900,000 tonnes per annum to 1,200,000 tonnes per annum;<br>• TSF1 Stage 9 and 10 embankment raises; and<br>• TSF2 Stage 1 to Stage 5 embankments. |

Category number/s (activities that cause the premises to become prescribed premises)

**Table 1: Prescribed premises categories**

| Prescribed premises category and description | Proposed production or design capacity | Proposed changes to the production or design capacity (amendments only) |
|---|---|---|
| Category 5: Processing or beneficiation of metallic or non-metallic ore | 1,200,000 tonnes per annual period | N/A |

**Legislative context and other approvals**

| | | |
|---|---|---|
| Has the applicant referred, or do they intend to refer, their proposal to the EPA under Part IV of the EP Act as a significant proposal? | Yes ☐ No ☒ | N/A |
| Does the applicant hold any existing Part IV Ministerial Statements relevant to the application? | Yes ☐ No ☒ | N/A |
| Has the proposal been referred and/or assessed under the EPBC Act? | Yes ☐ No ☒ | N/A |
| Has the applicant demonstrated occupancy (proof of occupier status)? | Yes ☒ No ☐ | **Mining lease / tenement** ☒<br>**Expiry:**<br>• M26/242 – 17/10/2030<br>• M26/367 – 11/05/2035 |

| SECTION 1: APPLICATION SUMMARY (as updated from validation checklist) | | |
|---|---|---|
| Has the applicant obtained all relevant planning approvals? | Yes ☐ No ☐ N/A ☒ | Premises is on mining tenement, regulated under *Mining Act 1978* by DMIRS. |
| Has the applicant applied for, or have an existing EP Act clearing permit in relation to this proposal? | Yes ☒ No ☐ | **CPS No:** 9743/1<br>Permit needed to clear TSF2 footprint; granted on 23 June 2022. |
| Has the applicant applied for, or have an existing CAWS Act clearing licence in relation to this proposal? | Yes ☐ No ☒ | N/A |
| Has the applicant applied for, or have an existing RIWI Act licence or permit in relation to this proposal? | Yes ☒ No ☐ | **Licence/permit No:**<br>• GWL203328(1) – located on M26/242 with annual allocation of 370,000 kL until September 2029; and<br>• GWL203329(1) – located on L26/234 with annual allocation of 530,000 kL until September 2029. |
| Does the proposal involve a discharge of waste into a designated area (as defined in section 57 of the EP Act)? | Yes ☒ No ☐ | **Name:** Goldfields Groundwater Area<br>**Type:** Proclaimed Groundwater Area<br>**Has Regulatory Services (Water) been consulted?**<br>Yes ☐ No ☐ N/A ☒ |
| Is the Premises situated in a Public Drinking Water Source Area (PDWSA)? | Yes ☐ No ☒ | N/A |
| Is the Premises subject to any other Acts or subsidiary regulations? | Yes ☒ No ☐ | • Dangerous Goods Safety Act 2004;<br>• Health (Miscellaneous Provisions) Act 1911;<br>• Mining Act 1978; and<br>• Rights in Water and Irrigation Act 1914. |
| Is the Premises within an Environmental Protection Policy (EPP) Area? | Yes ☐ No ☒ | N/A |
| Is the Premises subject to any EPP requirements? | Yes ☐ No ☒ | N/A |

| SECTION 1: APPLICATION SUMMARY (as updated from validation checklist) | | |
|---|---|---|
| Is the Premises a known or suspected contaminated site under the *Contaminated Sites Act 2003*? | Yes ☒ No ☐ | **Classification:** Possibly contaminated – Investigation required (classification relates to neighbouring KCGM operation)<br>**Date of classification:** N/A |