Application for Works Approval

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

Works Approval Number	W6765/2022/1
Applicant	Northern Star (Thunderbox) Pty Ltd
ACN	107 154 727
File number	DER2022/000692
Premises	Thunderbox Mining Operations Mining tenements L36/155, L36/157, L36/158, L36/181, L36/193, L36/199, L36/202, L37/61,L37/73, L37/142, L37/166, L37/181, L37/199, L37/215, L37/216, M36/35, M36/177, M36/421, M36/428, M36/462, M36/473, M36/494, M36/503, M36/504, M36/512, M36/525, M36/527, M36/541, M36/542, M36/582, M37/339, M37/340, M37/356, M37/357, M37/358, M37/359, M37/360, M37/361, M37/465, M37/367, M37/368, M37/437 and M36/599 LEINSTER WA 6437
Date of report	21 March 2023
Decision	Granted

Lauren Edmands

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MANAGER, RESOURCE INDUSTRIES
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 operation of the premises. As a result of this assessment, works approval W6765/2022/1 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 and overview of premises

On 1 November 2022, Northern Star (Thunderbox) Pty Ltd (Northern Star, the applicant) submitted an application for a works approval to the department under section 54 of the *Environmental Protection Act 1986* (EP Act). Proposed works will take place at the Thunderbox Mining Operation (currently prescribed under licence L7815/2001/11), approximately 42.5 km south-east of Leinster.

The application is to undertake construction and time limited operations at the premises for:

- tailings storage facility (TSF) cell A and cell B (Figure 1) embankment lifts to 516.7 metres relative level (m RL) to allow a total 25 million tonnes (Mt) tailings storage;
- modifications for associated TSF infrastructure including (see section 2.6 for further detail):

Northern Star originally received Part V approval for this activity under works approval W6181/2018/1 which expired on 26 September 2022. Construction of cell A to embankment height 514.6 mRL and cell B to 508.8 mRL was completed under the original works approval (see section 2.3 for further detail). It is noted that a new assessment, using recent monitoring information from the site (i.e. groundwater monitoring data) as well as current best practice, will be undertaken for this assessment.

Works approval W6601/2021/1 is also active for the site for construction of additional TSF cells C and D abutting cells A and B immediately to the east (Figure 5, Appendix 1) (see section 2.4 for further detail).

The premises relates to the categories and assessed production / design capacity under Schedule 1 of the *Environmental Protection Regulations 1987* (EP Regulations) which are defined in works approval W6765/2022/1. The infrastructure and equipment relating to the premises category and any associated activities which the department has considered in line with *Guideline: Risk Assessments* (DWER 2020) are outlined in works approval W6765/2022/1.

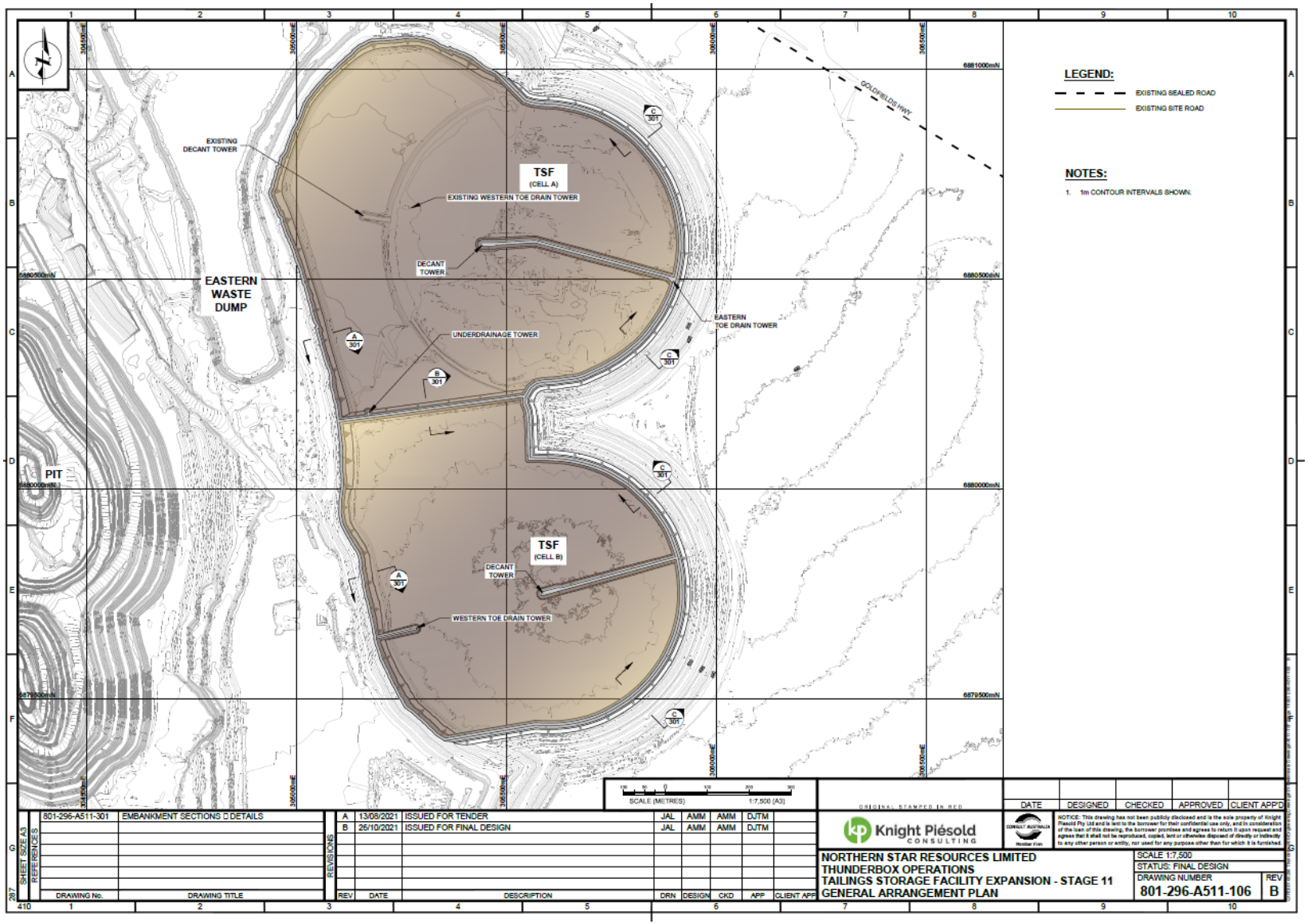

Figure 1 Tailings Storage Facility Cell A and B Expansion

2.3 Previous Works Approval W6181/2018/1 (expired)

Northern Star originally received Part V approval for the embankment lifts under works approval W6181/2018/1 which expired on 26 September 2022. Construction of cell A to embankment height 514.6 mRL[1] and cell B to 508.8 mRL were completed under the approval and compliance documentation submitted to DWER (Table 1).

The naming convention for the embankment lift stages was modified as part of the Knight Piesold (2018) design report from “yearly” stages to “construction” stages. The “yearly” stages 11 to 15, as per the original Knight Piesold 2017 TSF design report, align with “construction” stages 9 to 11 as defined by the 2018 report. DWER’s understanding of how the “yearly stages” align with “construction stages” is presented in Table 1. At the request of Northern Star, DWER will refer to the “construction stages” throughout this report and in the instrument.

Condition 5 of W6181/2018/1 required submission of detailed design reports prior to construction of stages 9 to 11. Detailed design reports have been submitted for construction stages 7 to 9 (DWER ref A1809375) and stages 10 to 11 (DWER ref DWERDT523587).

For further detail on TSF construction, seepage management, tailings characterisation and DWER regulatory controls, see section 3.3.

DWER notes that whilst the current licence L7815/2001/11 includes up to “yearly” stage 6 (to embankment height 509.7 m RL), it has not yet been amended to include more recent lifts (already constructed as indicated in Table 1). Northern Star should apply to amend licence L7815/2001/11 to reflect the constructed stages (including maximum allowable operating height).

[1] The department notes that that construction of cell A to 514.6 m RL was completed in mid-November 2022. It appears construction activities were undertaken without approval as they occurred after the expiration of the Works Approval. Please note that this matter has been referred to the department’s Compliance and Enforcement branch for follow up (DWER ICMS reference 67865).

Table 1 "Year" vs "Construction" stage naming and stages completed under original works approval

"Construction stages"				"Yearly stages"				Total storage capacity (Mt)	Construction completed			
Stage	Cell A (m RL)	Divider (m RL)	Cell B (m RL)	Stage	Cell A (m RL)	Divider (m RL)	Cell B (m RL)		Cell A	DWER ref	Cell B	DWER ref
				8				8.1				
8	508.8	Not provided	508.8	9	508.8	507.5	508.8	10	Mar-20	A1945358	Aug-20	A1945358
				10				12.5				
9	511.4	Not provided	511.4	11	511.4	511.4	511.4	15	Jan-21	A2014681	proposed	-
				12	512.5		512.6	17.5				
10	514.6	Not provided	514.6	13	513.9	514	514	20	Nov-22	A2146559*	proposed	-
				14	515.3		515.3	22.5				
11	516.7	Not provided	516.7	15	516.7	516.7	516.7	25	proposed	-	proposed	-

*Note - cell A completed to 514.6m RL

2.4 Works Approval W6601/2021/1 – TSF cell C and D expansion

Works approval W6601/2021/1 (granted on 3 May 2022) authorises construction of additional TSF cells C and D, immediately to the east of existing cells A and B (Figure 5, Appendix 1). To allow the expansion, vegetation immediately to the east and south (but not north) of cells A and B has been cleared.

Licence L7815/2001/11 currently conditions groundwater monitoring from seven bores surrounding TSF Cell A and B (Table 2 below & Figure 3 of Schedule 1). Northern Star have notified DWER that five of these groundwater monitoring bores were destroyed during the TSF cell C and D expansion (Table 2). Four new monitoring bores have been conditioned for installation under works approval W6601/2021/1 (not yet installed) to the east of cells C and D (Figure 4, Appendix 1).

DWER will make a recommendation in the conclusion of this decision report that the licence be updated during the next licence amendment to reflect destroyed wells. As monitoring wells proposed for installation under W6601/2021/1 provide adequate spatial coverage to the east of the TSF, no replacement monitoring bores will be conditioned under this works approval.

Table 2 Monitoring wells destroyed

Monitoring wells on licence L7815/2001/11	Monitoring wells destroyed
TSFMB4S and 4D	TSFMB4S and 4D
TSFMB5	TSFMB5
TSFMB6	TSFMB6
TSFMB7S	TSFMB7S
TSFMB7D	TSFMB7D
TSFMB8S	Not destroyed
TSFMB8D	Not destroyed

2.5 Other relevant approvals

2.5.1 Department of Mines, Industry Regulation and Safety

The Department of Mines, Industry Regulation and Safety (DMIRS) advised on 18 January 2023 that under the *Mining Act 1978*, mining activities for the Thunderbox mine site are approved under Mining Proposal registration identification 99935. This proposal allows for a maximum embankment height of 517 mRL for tailings storage facility cells A and B.

2.6 Modifications to infrastructure associated with the TSF

Proposed modifications for infrastructure associated with the TSF lifts, and DWER's comment regarding potential changes to the risk profile for the premises are captured in Table 3 below.

Table 3 Proposed modifications for infrastructure associated with the TSF

Proposed modifications	Risk profile
Decommissioning of temporary decant towers and construction of permanent decant towers in cell A and B	Installation of permanent decant towers, and raising these towers with each lift will likely assist with water management and will not alter the risk profile for the site. No further risk assessment required.
Raise of TSF cell A and B permanent decant towers with each embankment lift	
Eastern toe drain tower raise for cell A and cell B with each lift	Raising the toe drain tower and underdrainage towers with each lift will assist with facility water management and will not alter the risk profile for the site. No further risk assessment required.
Underdrainage tower raise with each embankment lift	
Installation of nine piezometers as part of the stage 10 embankment lift (see section 2.3 for detail on embankment lift stages) to replace the decommissioned piezometers from stage 9. Subsequently, installation of another nine replacement piezometers as part of the stage 11 embankment lift	Replacing piezometers with each lift will assist with monitoring the phreatic surface (water level) within the embankments and assist Northern Star with water/seepage management. This will not alter the risk profile for the site. No further risk assessment required.

Given that these modifications are unlikely to alter the risk profile for the premises, DWER's risk assessment will only include the embankment lifts themselves.

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 2020).

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

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 operations 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. As there are no human receptors within the vicinity of the proposed activities, noise emissions have not been included within the risk assessment.

DWER notes that the embankment lifts themselves have been included within the risk assessment. The other requested modifications (lifts of associated infrastructure, including decant towers etc) will be included within the works approval but will not result in a modification to the risk profile of the premises and therefore have not been further risk assessed within this decision report (see section 2.6 for further detail).

No new pipelines associated with the TSF have been proposed for construction as part of this works approval. As a condition for pipeline management (automatic cut-outs, secondary containment etc) is

already on the licence, no further risk assessment for pipelines will be undertaken in this decision report.

Table 4: Proposed applicant controls

Emission	Sources	Potential pathways	Proposed controls
Construction			
Dust	Construction activities associated with TSF embankment lifts	Air / windborne pathway causing poor native vegetation health/death	• "Regular and adequate employment of water spraying on unsurfaced areas to control dust emissions." (Knight Piesold, 2017) <u>Dust management controls on licence L7815/2001/11</u> Condition 2.3.1 – prior to or during disturbance to TSF components (including embankments and surface), the areas are continually wetted down using water sprays, dribble bars or other suitable methods to ensure no visible windblown dust
Time limited operations			
Tailings and contaminated water (metalloids)	Discharge and storage of tailings in the TSF (additional tailings and seepage associated with the embankment lifts)	Seepage through base and embankments to soil and groundwater causing vegetation poor health/death and groundwater contamination (adjacent native vegetation and priority flora to the north)	<u>Existing seepage controls (already constructed):</u> • Cut off trench • Low permeability clay liner (to achieve a permeability of at least $<10^{-8}$ m/s or equivalent) • Basin underdrainage collection system • Underdrainage sump and rise pipe • Underdrainage collection tower • Embankment upstream toe drain. <u>Seepage management conditions on licence L7815/2001/11 for TSF</u> Condition 1.3.4 – seepage collection and recovery system Condition 3.3.2 – contingency control for groundwater levels above 6mbgl <u>Existing monitoring</u> • Piezometers • Northern Star have noted that some of the existing monitoring wells under licence L7815/2001/11 were destroyed as part of the cell C and D expansion. See the section 2.4 for further detail. <u>Proposed additional controls:</u> • Decant pond inspection to assist with maintaining the pond area to <5ha
		Overtopping of TSF	Knight Peisold (2017) document indicates:

Emission	Sources	Potential pathways	Proposed controls
		and direct discharge to land causing poor vegetation health/death	• Greater of: (i) 0.35 m above maximum tailings elevation, or (ii) 0.50 m above required stormwater capacity elevation. • Allowance for a 1 in 100 year return interval, 72 hour storm event superimposed over average rainfall sequence with no release, evaporation or decant. <u>Freeboard management conditions on licence L7815/2001/11 for the TSF</u> Condition 1.3.3 - a minimum top of embankment freeboard of 500mm or containment of a 1 in 100 year/72 hour storm event (whichever is greater) is maintained

3.1.2 Receptors

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

Table 5 below provides a summary of potential environmental receptors that may be impacted as a result of activities upon or emission and discharges from the prescribed premises *(Guideline: Environmental Siting* (DWER 2020)). There are no human receptors within the vicinity of the proposed activities.

DWER notes that the current licence L7815/2001/11 includes a 50mg/L decant pond limit for weak acid-dissociable cyanide (WAD CN) for protection of birds and wildlife[2]. Ingestion of decant by birds and wildlife will consequently be excluded from this risk assessment.

Table 5: Sensitive environmental receptors and distance from prescribed activity

Environmental receptors	Distance from prescribed activity
<u>Groundwater</u> Goldfields Groundwater Area – *Rights in Water Irrigation Act 1914*	<u>Groundwater depth</u> Groundwater levels surrounding the TSF have risen ~10m between 2015 and 2022 (Northern Star Annual Environmental Report, 2022). Groundwater levels ranged between ~20 to 30 metres below top of casing (mbTOC) in 2015 and now range between ~5.4 to 15 mbTOC. See Figure 2, section 3.3. <u>Groundwater quality</u> Groundwater quality surrounding the TSF ranges from fresh to marginal (total dissolved solids [TDS] ~300 – 800mg/L). For further discussion see section 3.3.

[2] Research has indicated that gold processing tailings with residual WAD-CN in solution above 50 mg/L with a salinity of less than 50 000 mg/L present a risk to wildlife health (Adams et al 2008).

Environmental receptors	Distance from prescribed activity
	Groundwater flow direction Pennington Scott (2021) modelled groundwater flow direction from the north-east to the south-west in the vicinity of the TSF (towards the open mining pits). Nearby groundwater users Groundwater quality around the TSF is of stock quality, however, the closest active pastoral bore is located approximately 7km to the south of the TSF.
Native vegetation and priority flora Native vegetation and Priority 4[1] flora species Craven - c*alytrix uncinate* (Figure 5 – Appendix 1)	Native vegetation, adjacent to the north, 600m east, 700m south,.1.5km west (down gradient). Flora P4 species, west of the project area DWER notes that the area immediately to the east and south has now been cleared of vegetation for the TSF Cell C and D expansion, see Figure 5 of Appendix 1.
Ephemeral creek lines Hydrography WA 250k – surface water lines (Figure 6 – Appendix 1)	Potential ephemeral creek lines immediately north and south of the tailings storage facility. Note that whilst these appears in 250k hydrography layer, it is uncertain if ephemeral creek lines are actually located here. A more distinct creek line is located 2km south of the TSF.

Note 1. Priority 4: species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring. (DBCA, 2019)

3.2 Risk ratings

Risk ratings have been assessed in accordance with the *Guideline: Risk Assessments* (DWER 2020) 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 W6765/2022/1 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 amendment 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. deposition into the tailings storage facility. 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 operations

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 activities associated with TSF embankment lifts	Dust	Air / windborne pathway causing impacts to health of adjacent vegetation	Adjacent native vegetation and priority flora	Refer to Section 3.1	C = Minor L = Unlikely **Medium Risk**	Y	Existing licence L7815/2001/11 controls: Condition 2.3.1 – TSF dust management Works approval controls: Condition 1 – TSF dust management during embankment construction	The applicant proposed controls are considered sufficient and have been placed on the works approval as a regulatory control.
Time limited operations								
Discharge and storage of tailings in the TSF (additional tailings and seepage associated with the embankment lifts)	Contaminated seepage water (metalloids)	Seepage through base and embankments to soil and groundwater causing vegetation poor health/death and groundwater contamination	Adjacent native vegetation and priority flora	Refer to Section 3.1	C = Moderate L = Possible **Medium Risk**	N	See section 3.3.4	See section 3.3
	Tailings and contaminated water (metalloids)	Overtopping of TSF and direct discharge to land causing poor vegetation health/death	Adjacent native vegetation and priority flora Ephemeral creek lines	Refer to Section 3.1	C = Moderate L = Unlikely **Medium Risk**	Y	Condition 10 – freeboard	The applicant proposed controls are considered sufficient and have been placed on the works approval as regulatory controls.

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

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

3.3 Detailed risk assessment for seepage impacts

3.3.1 Source

Tailings characterisation

Tailings composition testing on an oxide-ore and primary ore tailings sample was undertaken in 2001 by Graeme Campbell and Associates (GCA). The tailings were found to be non-acid forming (NAF) for the oxide-ore sample and potentially acid forming (PAF) (low capacity) for the primary ore sample. The samples were found to be significantly enriched in arsenic (even as compared with other typical gold deposits in Western Australia) and variously enriched in antimony, selenium and molybdenum.

The tailings slurry water samples had a pH between 8.1 and 9.5, TDS of 1,600 to 2,300mg/L and weak acid dissociable cyanide concentrations (WAD CN) up to 33mg/L. GCA (2001) indicated relatively low levels of arsenic, 4.4 – 5.2mg/L for the slurry water from the primary ore sample, attributed to the neutral to alkaline pH. Concentrations of other soluble metals were found to be low with the exception of iron, copper and nickel which form complexes with cyanide.

DWER notes that arsenic in tailings decant has been reported in the most recent AER (2022) as being significantly higher than given in the GCA analysis, generally ranging between 20 and 40mg/L between 2020 and 2022 (Figure 12– Appendix 1).

Estimated seepage

Total estimated seepage for 2023 is expected to be approximately 43m^3/day (through the TSF floor), based an a water balance provided in a recent audit report by CMW Geosciences (2021). This estimate was based on an input of 538,752 tonnes of tailings slurry per month containing 58% solids. When DWER questioned this figure (as being unlikely due to significant water table mounding taking place at site), Northern Star indicated that this volume may be variable depending on facility water management.

3.3.2 Pathway

Hydrogeology

Pennington Scott (2021) indicate that groundwater within the project area occurs in the secondary porosity developed with fractures and faults, or deep with the saprolite weathering profile. The upper saprolite is noted to be mostly unsaturated but can form a “slow seepage zone” where water is present (hydraulic conductivity of 0.1 m/day). The lower saprolite is “typically the most reliable water target in a fractured rock environment” (hydraulic conductivity 0.6 m/day) (Figure 7, Appendix 1). The saprock (the zone of broken fresh rock between the Lower Saprolite and the hard fresh rock) can also contain open water bearing defects, particularly within faults, shears, and joints.

Groundwater levels

Groundwater mounding surrounding the TSF is occurring and levels have risen by up to 10 metres since 2015 (see Figure 2). In 2015, groundwater levels surrounding the TSF ranged between 15 and 30 m bgl. Recent standing groundwater level information indicates groundwater levels ranging between 5.4 and 15 mbgl:

- TSFMB4 recorded standing water levels of 5.4m bgl in October 2022 before it was destroyed; and
- TSFMB8D recorded a standing water level of 6.3m bgl in January 2023 and Northern Star have advised that “It is expected that TSFMB08 will likely breach the 6mbgl limit in Q1 2023”.

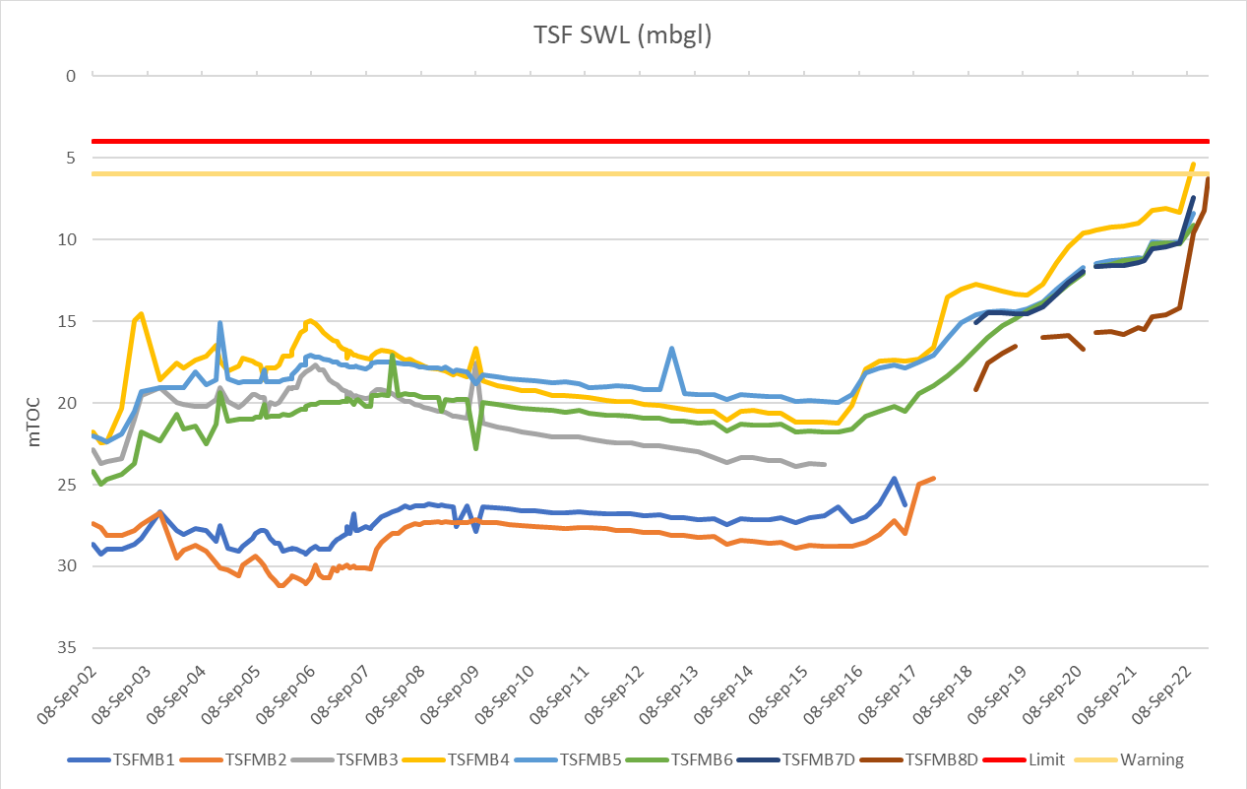

Figure 2 Groundwater levels in the vicinity of the tailings storage facility (Northern Star, 2022). Last readings for TSFMB4, TSFMB5, TSFMB6, TSFMB7S and TSFMB7D were taken on 15 October 2022 before destroyed.

Groundwater quality

Groundwater data, recorded from monitoring bores surrounding the TSF, given as part of the Annual Environmental Report (2021 – 2022) between 2002 and 2022 indicate:

- Groundwater is generally fresh, with TDS ranging between 300 and 800mg/L;
- pH has more recently ranged between 7.5 to 8.5;
- WAD CN below 0.5mg/L; and
- Whilst arsenic decant has been high (20 – 40mg/L) for monitoring between 2020 – 2022, arsenic levels in groundwater have remained below 0.1mg/L.

See Figure 8 to Figure 12 in Appendix 1.

3.3.3 Seepage controls

Northern Star have suggested that seepage and water mounding in the immediate vicinity of cell A and B will not have any adverse effects, as vegetation has been cleared around the perimeter of cell A & B (as part of the cell C and D expansion). Water mounding and seepage surrounding cell C and D is not a concern to Northern Star yet as discharge has not commenced. Quarterly and annual reviews will determine their strategy to reduce seepage to avoid any environmental impacts. These mitigation strategies when required could include a system of seepage recovery wells or a seepage trench.

Northern Star have suggested that their decant pond management may be resulting in additional seepage and have indicated an inspection requirement for pond size (<5 ha) may be helpful to include as part of the next licence amendment.

Seepage controls already constructed for the TSF include:

- Cut off trench
- Low permeability clay liner (to achieve a permeability of at least $<10^{-8}$ m/s or equivalent)
- Basin underdrainage collection system
- Underdrainage sump and rise pipe
- Underdrainage collection tower
- Embankment upstream toe drain.

Existing licence L7815/2001/11 requires use of the existing seepage recovery system, annual water balance monitoring and contingency controls should groundwater levels rise above 6m bgl (see Table 7 for a summary). DWER notes that no seepage was recovered (Table 8) as part of the existing seepage recovery system between 2021 – 2022 (as reported in the 2022 AER).

Table 7 Seepage related conditions on licence L7815/2001/11

Instrument	Condition	Summary
L7815/2001/11	1.3.4	Use of a seepage collection and recovery system to capture seepage and either return it to the TSF or reuse in the process.
	1.3.6	Licence holder to undertake an annual water balance for cells A and B. DWER notes that whilst this includes decant water recovery and seepage recovery – total seepage lost is not included. The 2021 – 2022 Annual Environmental Report indicated that no seepage was recovered as part of existing seepage recovery systems.
	3.3.2	Contingency controls in the event that groundwater levels rise above 6 mbgl. The licence holder must provide the monitoring bore location, root cause analysis for exceedances and a description of the remedial measures taken or planned to be taken, including those taken to prevent recurrence of the exceedances.

Table 8 Monthly TSF water balance data (as required by condition 1.3.6 of L7815/2001/11)

		TSF Cell A / B / Voids			
Parameter		Known Water in Slurry	Solids in Tailings	Seepage Recovered	Tails Return
Units		kL	Dry Tonnes	kL	kL
Monthly Throughput	Oct-21	190.104	287,509	0	NA
	Nov-21	151,959	229,818	0	NA
	Dec-21	145,652	220,280	0	NA
	Jan-22	182,962	276,706	0	NA
	Feb-22	163,054	246,599	0	NA
	Mar-22	180,015	272,250	0	NA
	Apr-22	143,953	217,711	0	NA
	May-22	165,607	250,460	0	NA
	Jun-22	195,864	296,219	0	NA
	Jul-22	172,528	260,926	0	NA
	Aug-22	128,908	194,957	0	NA
	Sep-22	140,181	212.006	0	NA

3.3.4 DWER assessment and controls

Native vegetation immediately to the north of TSF cell A may be sensitive to impacts from additional seepage associated with the embankment lifts. Native vegetation immediately to the east and south of cells A and B has been cleared as part of the cell C and D expansion (Figure 5, Appendix 1). The consequence rating for impacts to vegetation from groundwater mounding are considered “Moderate”.

Standing water levels to the north of the TSF have been recorded at ~6.3m bgl (TSFMB8D) and it is expected that this bore will likely breach the 6m bgl limit in Q1 2023. The likelihood rating for impacts from seepage on native vegetation is therefore considered “possible”.

The Delegated Officer therefore considers the overall risk rating for impacts of seepage to vegetation (and priority flora) to the north of TSF cell A as “Medium”.

The licence currently includes a condition for remedial measures to be undertaken once standing water levels rise higher than 6m bgl (condition 3.3.2). DWER consequently recommends Northern Star commence planning potential remedial measures for vegetation to the north of TSF cell A if a breach is expected in Q1 of 2023. DWER will review efficacy of measures undertaken and may undertake further assessment and implement additional controls as necessary at the licence amendment stage.

DWER recommends that groundwater levels continue to be monitored in the new bores installed surrounding cells C and D (installed as part of W6601/2021/1) and that, following installation, these be added to the licence during the next amendment. It is recommended that, once on the licence, these monitoring bores be subject to the requirements of condition 3.3.2 which requires seepage management once water levels reach 6m bgl.

Given the risk ratings, and low efficacy of current controls, the following DWER regulatory controls will be placed on the works approval.

Table 9 DWER regulatory controls (seepage)

Condition/control	Justification
Tailings: Condition 11 – authorised emissions	Tailings from other ore sources may present additional risk associated with contaminants of concern which have not been considered or risk assessed within this approval. These may present additional contaminants of concern being present within facility seepage. Only tailings from the Northern Star Thunderbox project are therefore permitted to be deposited into the TSF during time limited operations. To deposit tailings from other ore sources, a works approval amendment would be required.
Monitoring Condition 12 – monitoring during time limited operations	Monthly monitoring for the vibrating wire piezometers, to track phreatic surface within the embankments (which would assist in facility water management), has been placed on the works approval as a regulatory control. Additionally, the applicant proposed monitoring for the size of the decant pond has also been included.
Water balance: Condition 13 – water balance monitoring	While an estimated water balance has been provided, the calculations are approximate only. To verify expected seepage, DWER has placed a requirement for monitoring monthly water balance during time limited operations on the works approval.
Time limited operations – starter embankments Conditions 6 to 10 – time limited operations	Time limited operations has been authorised for each embankment lift stage to allow the works approval holder sufficient time to apply for a licence amendment for the new operating height to be authorised under licence L7815/2001/11. DWER notes that whilst the current licence L7815/2001/11 specifies a TSF embankment height to 509.7 m RL, it has not yet been amended to include more recent lifts constructed. Northern Star should apply to amend licence L7815/2001/11 to reflect the current operating embankment heights (and current maximum allowable operating height).

4. Consultation

Table 10 provides a summary of the consultation undertaken by the department.

Table 10: Consultation

Consultation method	Comments received	Department response
Application advertised on the department's website on 6 January 2023	None received	N/A
Local Government Authority advised of proposal on 6 January 2023	None received	N/A

Consultation method	Comments received	Department response
Department of Mines, Industry Regulation and Safety (DMIRS) advised of proposal on 6 January 2023	DMIRS replied on 18 January 2023 advising that "Under the Mining Act, mining activities for the Thunderbox mine site are approved under Mining Proposal REG ID 99935. This proposal allows for max embankment height of 517 mRL for cells A and B."	N/A
Applicant was provided with draft documents on 3 March 2023	Replied on 20 March 2023. Confirmed that cell B will also have an eastern tower toe drain. Otherwise, no further comments and a request to waive the remaining comment period.	Approval updated to include eastern toe drain in TSF cell B.

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.

5.1 Recommendations for licence amendment

DWER has the following recommendations for upcoming licence amendments:

- DWER notes that whilst the current licence L7815/2001/11 includes TSF embankment height to 509.7 m RL, it has not yet been amended to include more recent lifts constructed. Northern Star should apply to amend licence L7815/2001/11 to reflect the current operating embankment heights (and maximum allowable operating height).
- Vegetation to the north of TSF cell A may be vulnerable to impacts from seepage (mounding groundwater levels). DWER notes that standing water levels for monitoring bore TSFMB8D, to the north, are likely to rise above 6m bgl in Q1 2023. Current licence condition 3.3.2 includes a requirement for remedial measures when standing water levels rise above 6m bgl. The efficacy of any remedial measures should be assessed during the next licence amendment. If ineffective, additional seepage management may be conditioned by DWER at this time.
- Northern Star have suggested that their decant pond management may be resulting in additional seepage and have indicated an inspection requirement for pond size (<5 ha) may be beneficial to include as part of the next licence amendment;
- DWER notes that, during the most recent annual period (as reported in the AER) no seepage was recovered from existing seepage management infrastructure in place. This should also be considered for assessment of seepage and efficacy of controls during the next licence amendment.
- The licence requires updating to reflect the monitoring wells which have been destroyed as part of the TSF cell C and D expansion (TSFMB4, TSFMB5, TSFMB6, TSFMB7S, TSFMB7D).
- As monitoring wells proposed for installation under W6601/2021/1, surrounding cells C and D, provide adequate spatial coverage to the east of the TSF for all cells, no additional monitoring bores were conditioned under this works approval to replace destroyed wells. DWER recommends that groundwater levels continue to be monitored in these new bores and that, following installation, they be added to the licence. It is recommended that, once on the licence, these monitoring bores be subject to the

requirements of condition 3.3.2 which requires seepage management once water levels reach 6m bgl.

- It is recommended that condition 1.3.6, requiring annual water balance monitoring, be amended to include seepage loss.

References

1. Adams, et al. 2008, *Influences of Hypersaline Tailings on Wildlife Cyanide Toxicosis; MERIWA Project M398 (II) 'Cyanide Ecotoxicity at Hypersaline Gold Operations'* Final Report Volume 2 - Definitive Investigation, MERIWA: Perth
2. Department of Biodiversity, Conservation and Attractions, 2019. *Threatened Plants*, https://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/threatened-plants
3. Department of Environment Regulation (DER) 2015, *Guidance Statement: Setting Conditions*, Perth, Western Australia.
4. Department of Water and Environmental Regulation (DWER) 2020, *Guideline: Environmental Siting*, Perth, Western Australia.
5. DWER 2020, *Guideline: Risk Assessments*, Perth, Western Australia.
6. Northern Star 2022, *2021 – 2022 Annual Environmental Report L7815/2001/11 1st October 2021 – 30 September 2022 Thunderbox Operations*
7. Pennington Scott 2021, *Water studies for TSF cells C and D*

Appendix 1: Additional Figures

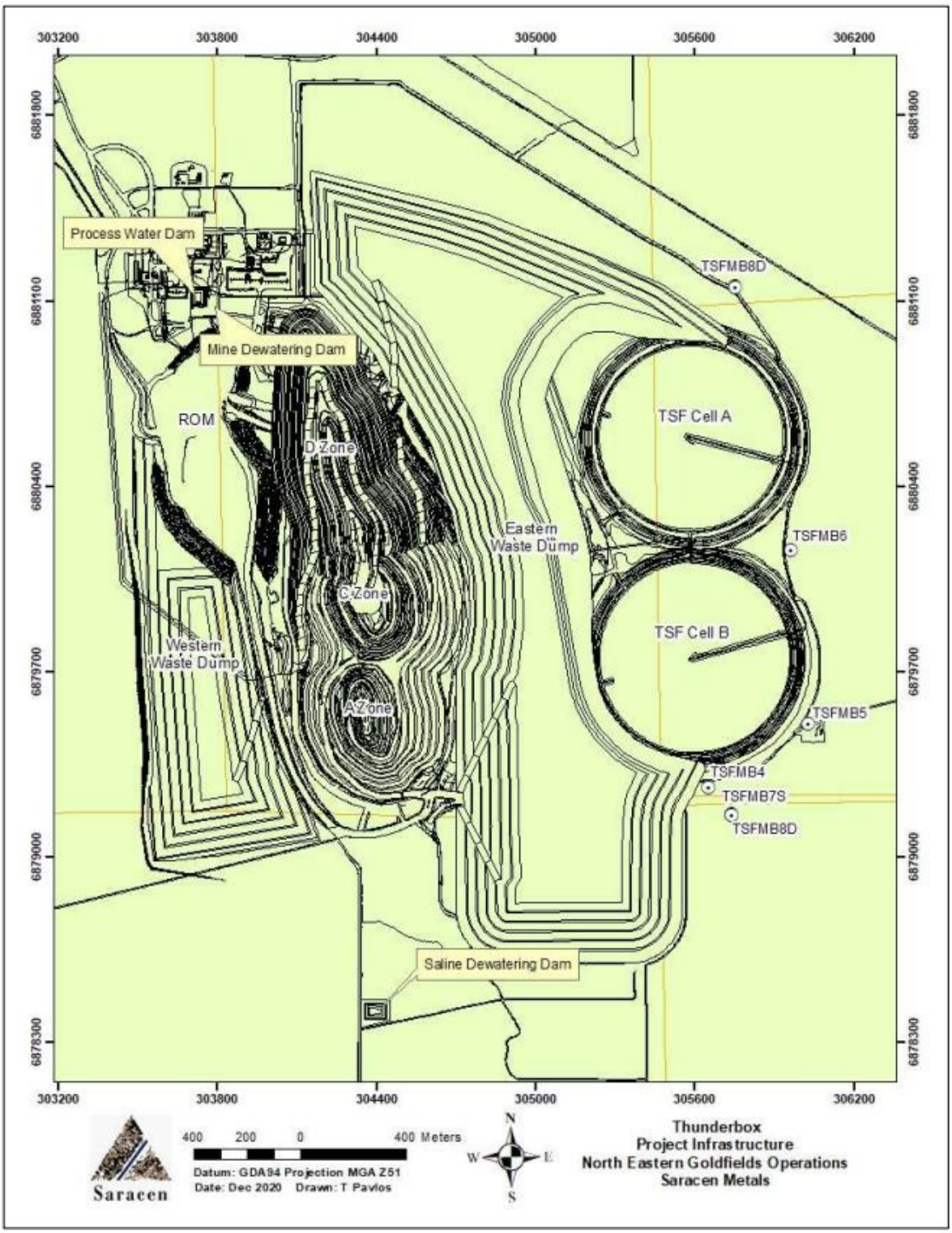

Figure 3 Groundwater monitoring wells for TSF Cell A and B currently on licence L7815/2001/11

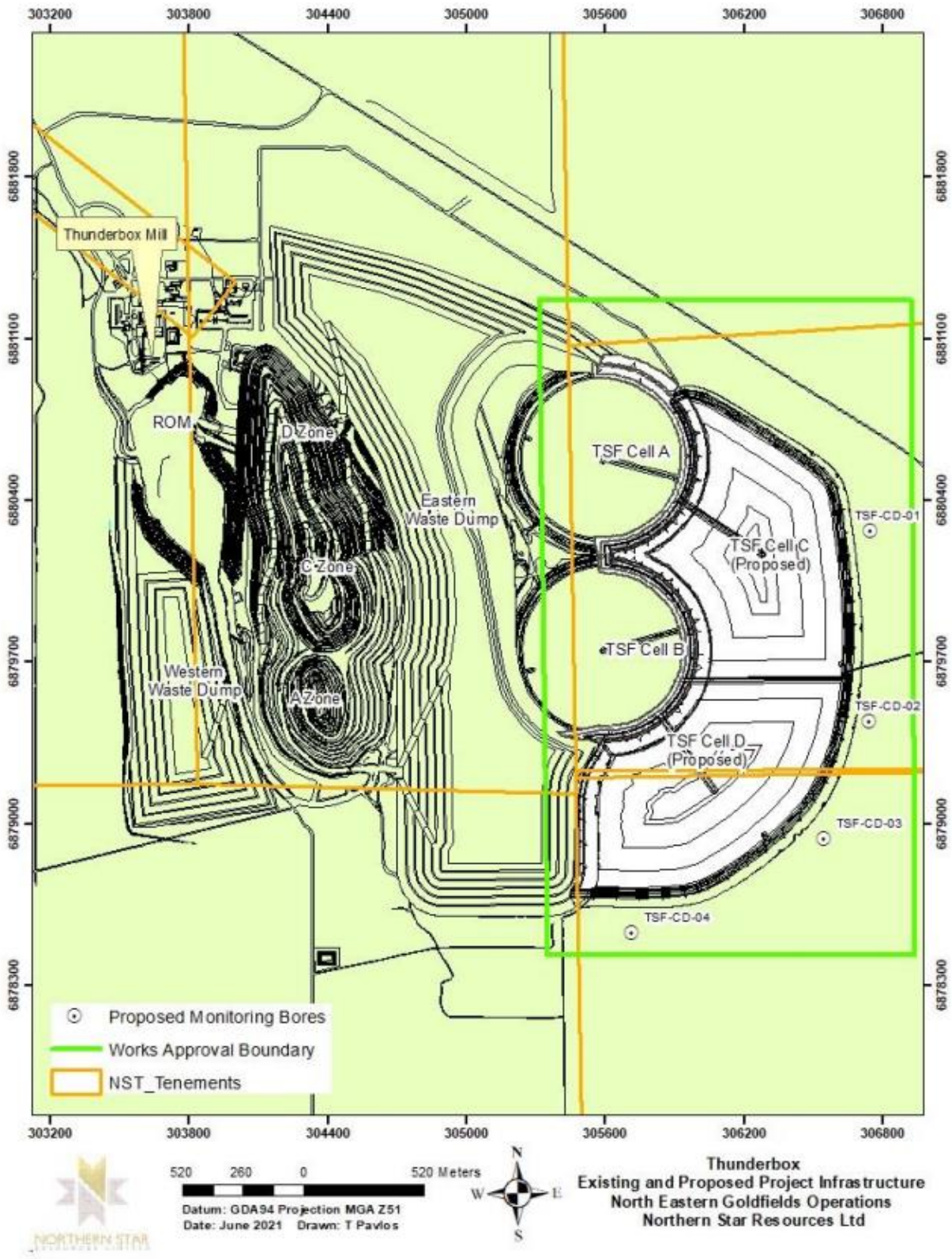

Figure 4 TSF cells C and D and groundwater monitoring wells approved under W6601/2021/1

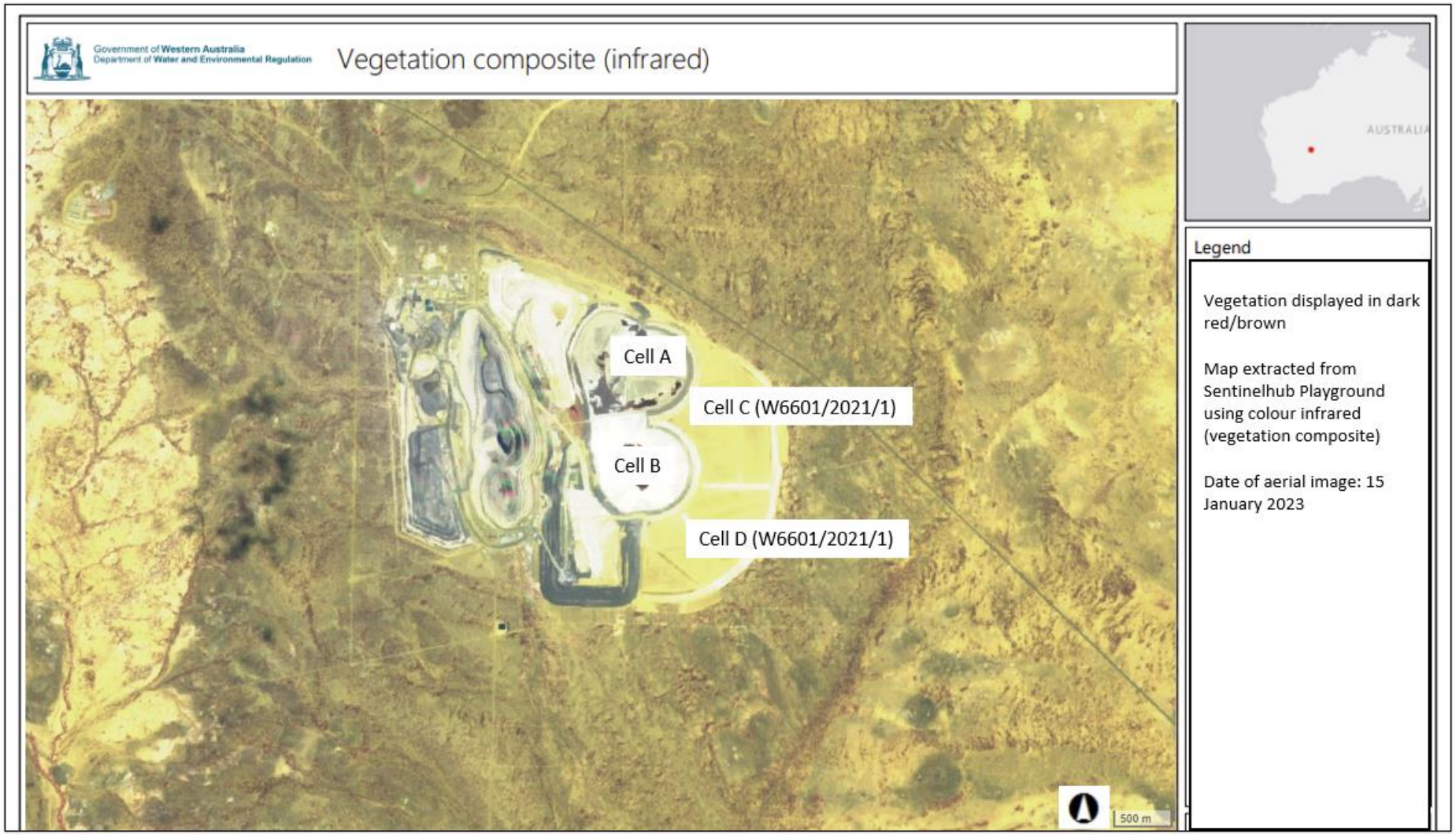

Figure 5 Colour infrared (vegetation composite) surrounding the tailings storage facility

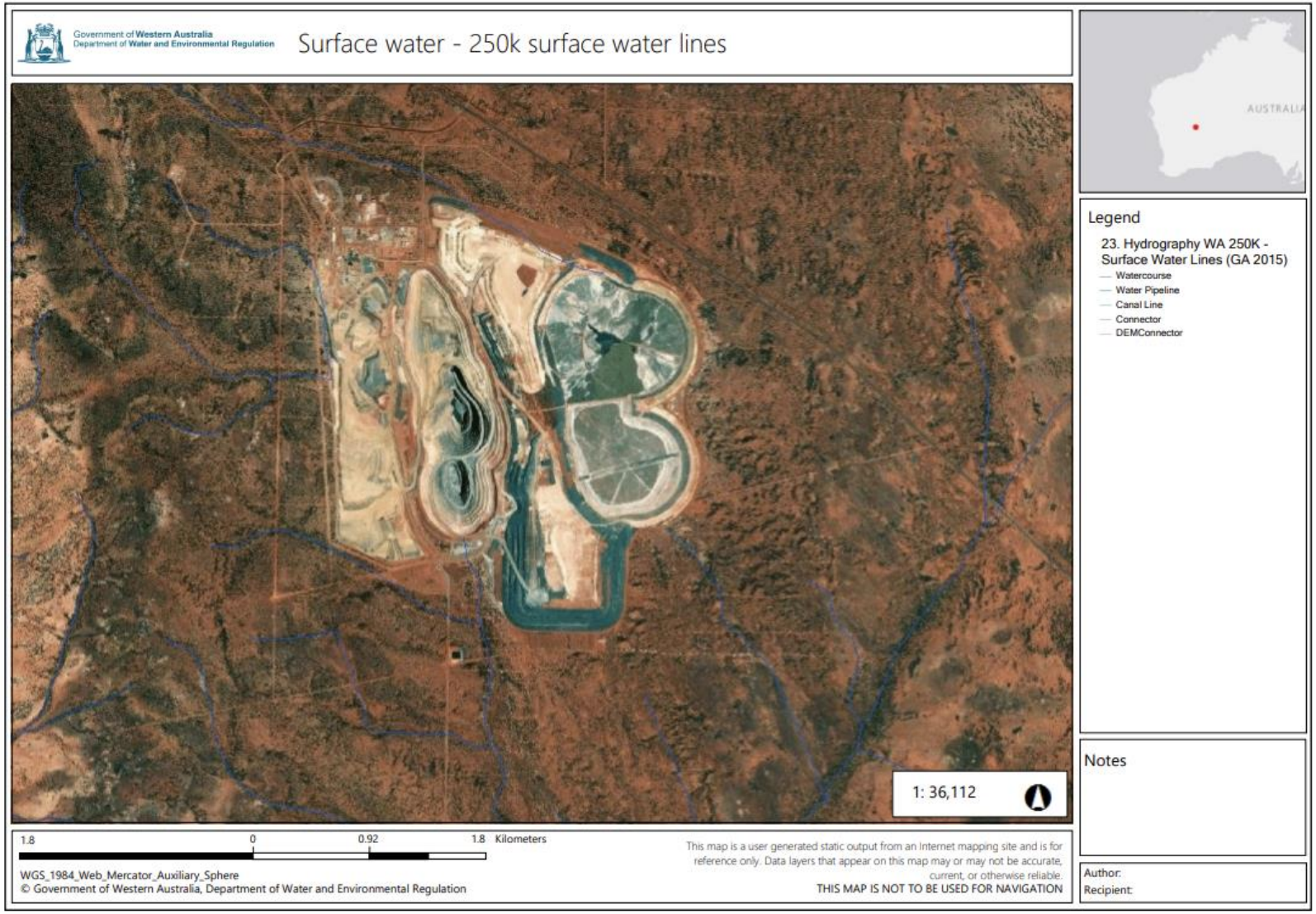

Figure 6 Surface water – 250k surface water lines (GA, 2015)

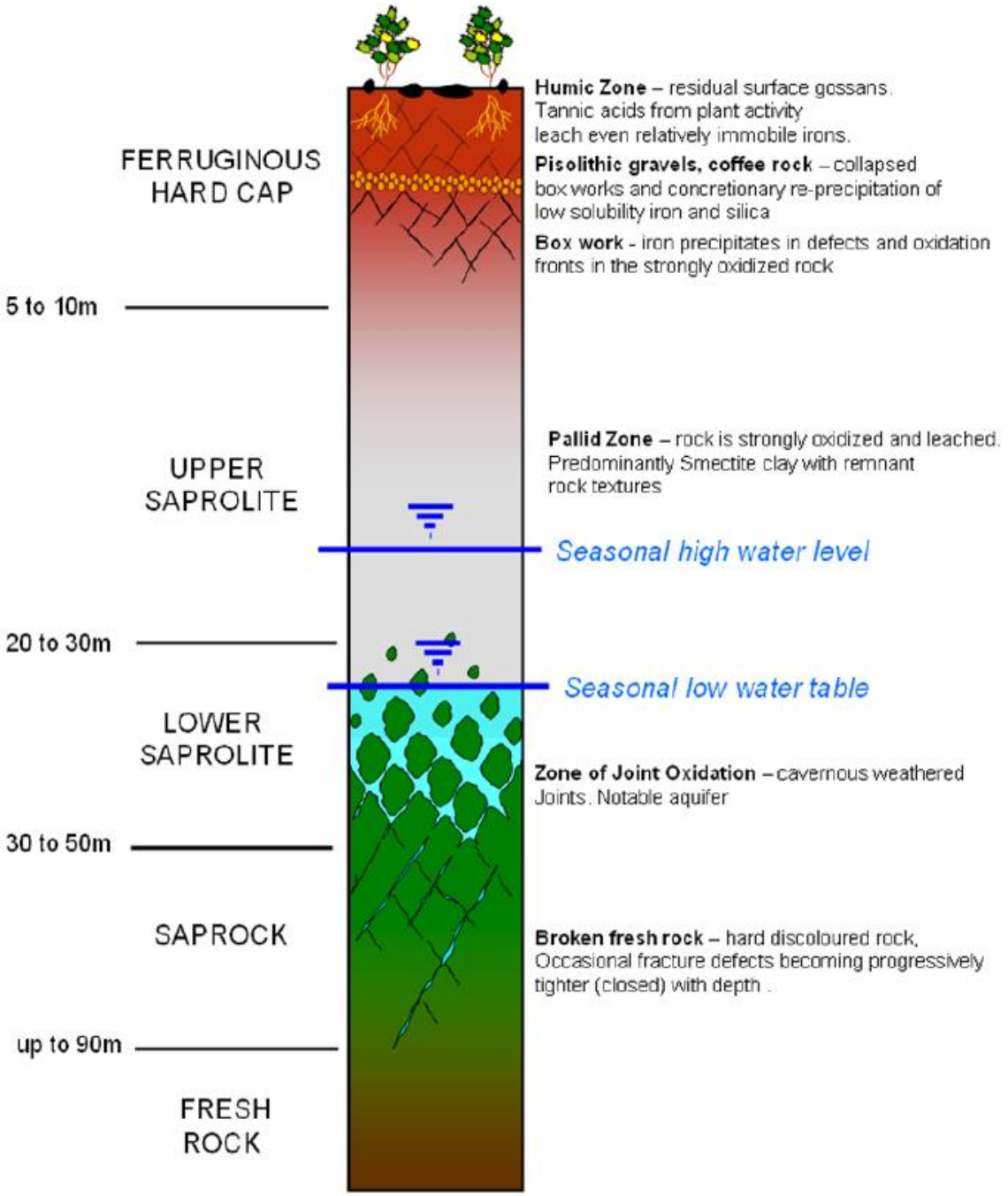

Figure 7 Typical saprolite weathering profile

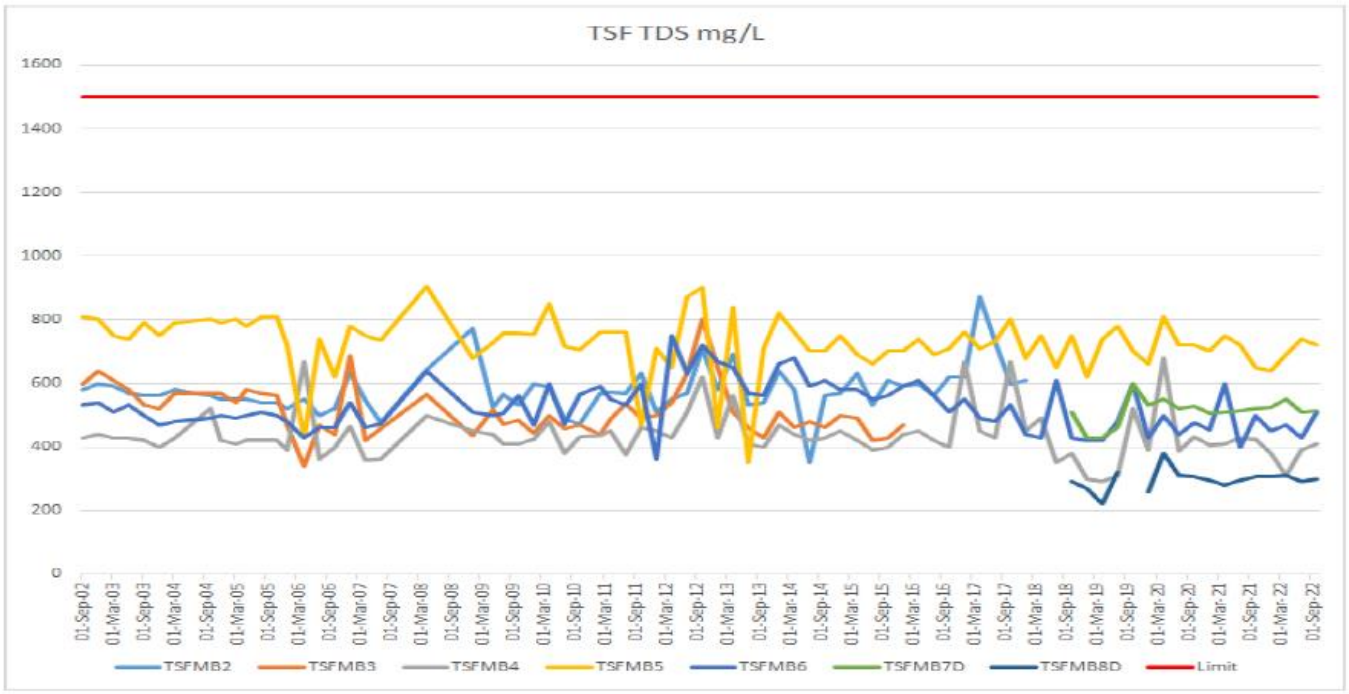

Figure 8 Groundwater monitoring data – total dissolved solids (mg/L)

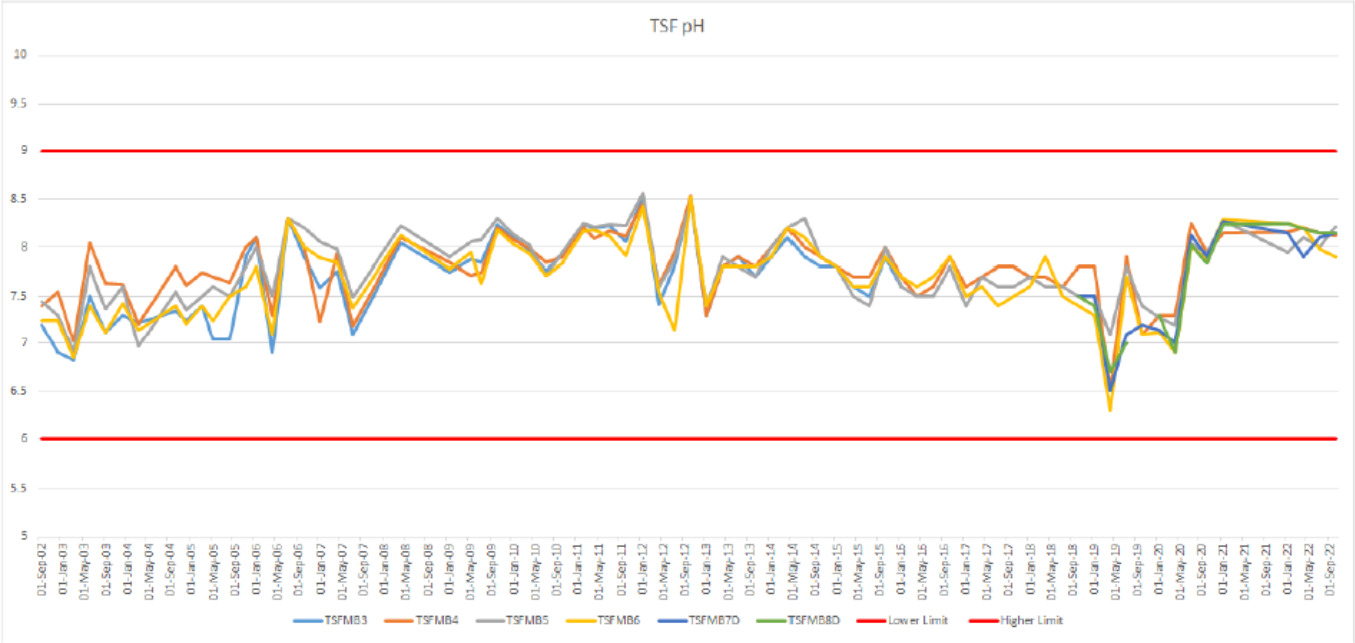

Figure 9 Groundwater monitoring data - pH

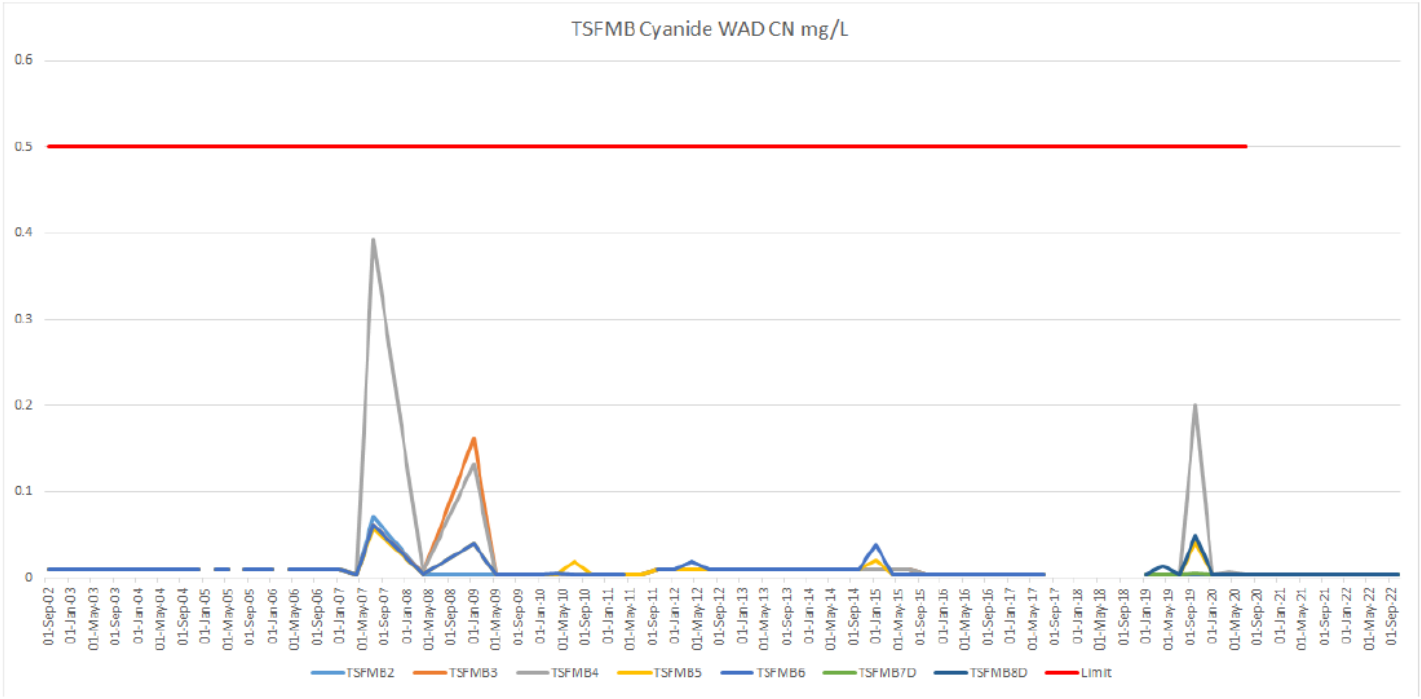

Figure 10 Groundwater monitoring data – WAC CN (mg/L)

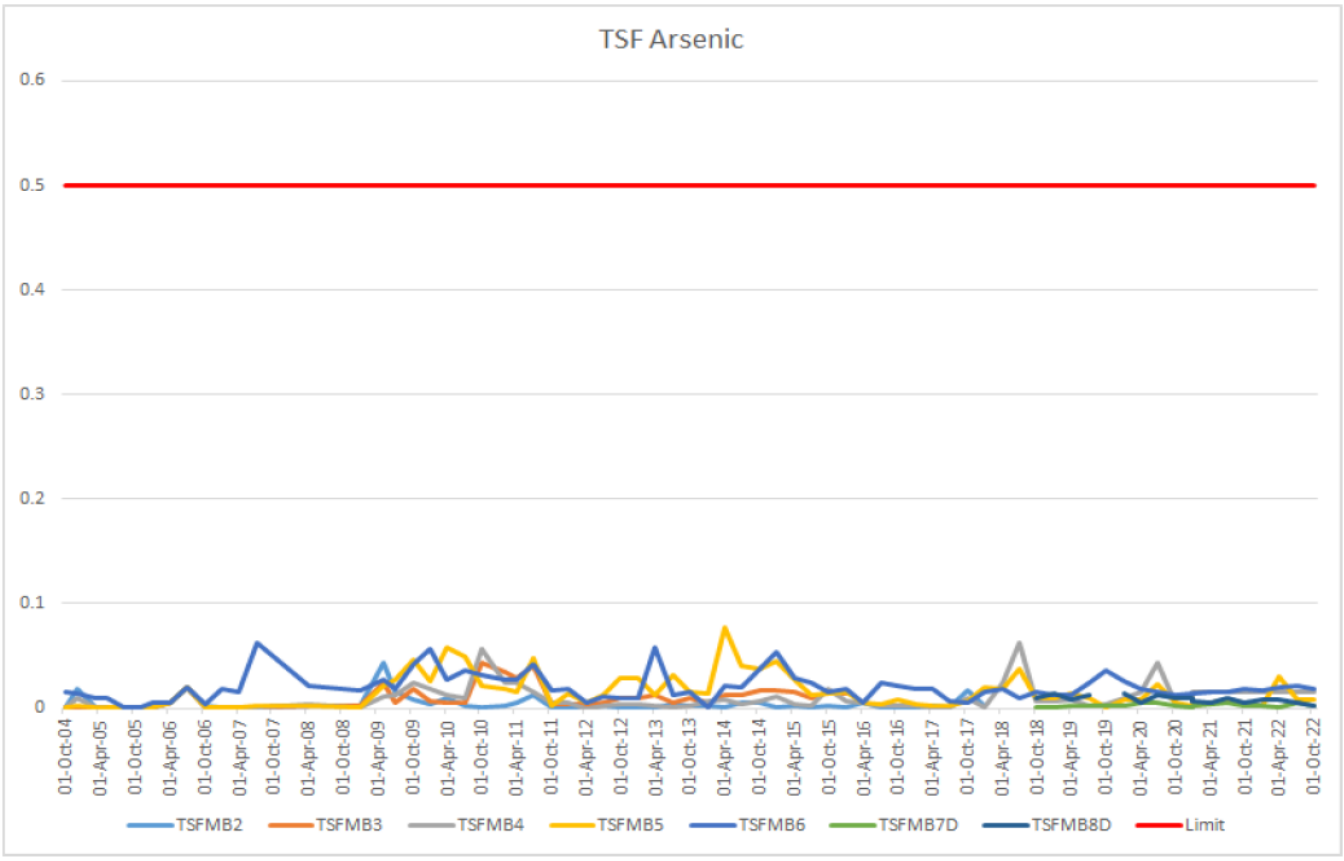

Figure 11 Groundwater monitoring data – arsenic (mg/L)

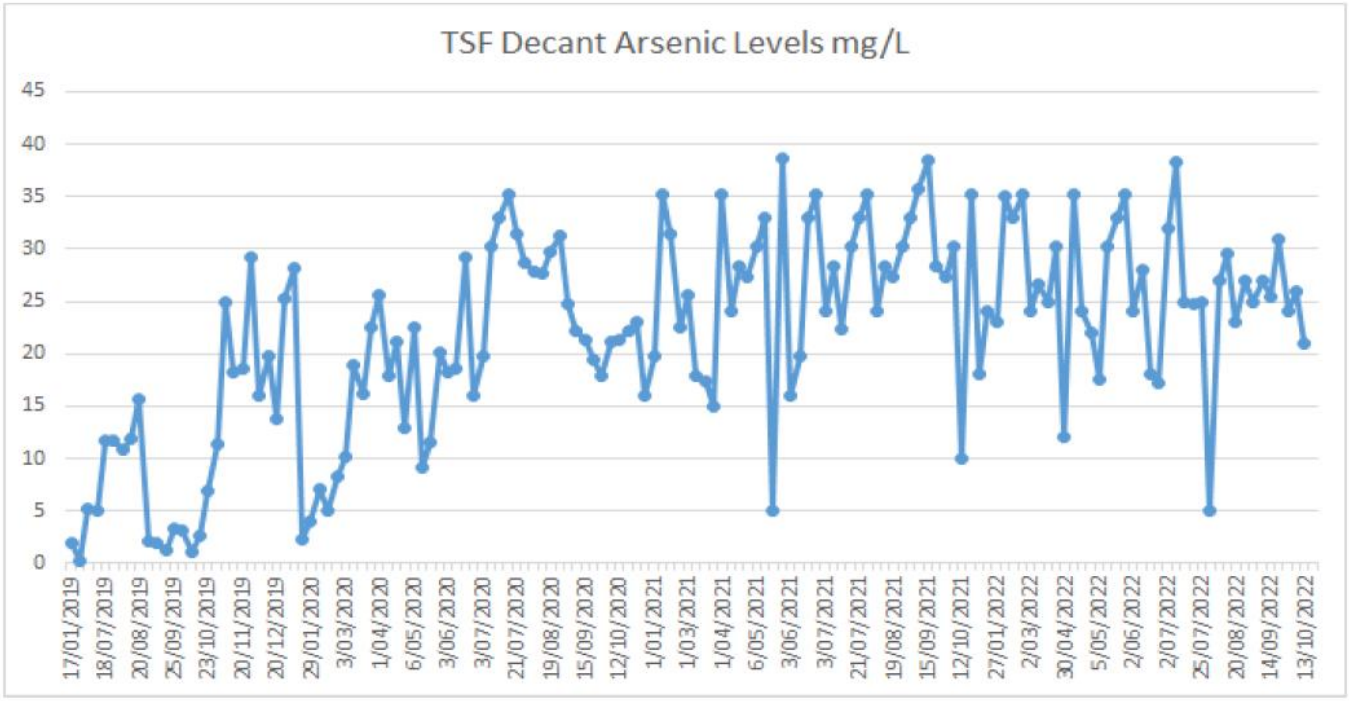

Figure 12 Decant monitoring data - arsenic (mg/L)

Appendix 2: Application validation summary

SECTION 1: APPLICATION SUMMARY		
Application type		
Works approval	☒	
Date application received		1/11/22
Applicant and Premises details		
Applicant name/s (full legal name/s)		Northern Star (Thunderbox) Pty Ltd
Premises name		Thunderbox Mining Operations
Premises location		Works approval specific mining tenements M36/504 and M36/512 Overall premises: L36/155, L36/157, L36/158, L36/181, L36/193, L36/199, L36/202, L37/61, L37/73, L37/142, L37/166, L37/181, L37/199, L37/215, L37/216, M36/35, M36/421, M36/428, M36/462, M36/473, M36/494, M36/503, M36/504, M36/512, M36/525, M36/527, M36/541, M36/542, M36/582, M37/339, M37/340, M37/356, M37/357, M37/358, M37/359, M37/360, M37/361, M37/465, M37/367, M37/368, M37/437 and M36/599
Local Government Authority		Shire of Leonora
Application documents		
HPCM file reference number:		DER2022/000692 (W6181 ref DER2018/001480)
Key application documents (additional to application form):		Knight Piesold 2017 TSF design report
Scope of application/assessment		
Summary of proposed activities or changes to existing operations.		Works approval • Construction of year stages 11 to 15 (DWER note - these coincide with construction expansion stages 9 to 11) as per Knight Piesold 2017 drawings. • Extension of east toe drain tower of cell A and B (as per Knight Piesold 2017 drawings) • Decommissioning of temporary decant towers and construction of permanent decant towers in Cell A and B (as per Knight Piesold 2017 drawings) • Underdrainage riser raise with each embankment lift (as per Knight Piesold 2017 drawings)

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 and beneficiation of metallic and non-metallic ore	2.5Mtpa	

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 ☒	Referral decision No: Managed under Part V ☐ Assessed under Part IV ☐
Does the applicant hold any existing Part IV Ministerial Statements relevant to the application?	Yes ☐ No ☒	Ministerial statement No: EPA Report No:
Has the proposal been referred and/or assessed under the EPBC Act?	Yes ☐ No ☒	Reference No:
Has the applicant demonstrated occupancy (proof of occupier status)?	Yes ☒ No ☐	Certificate of title ☐ General lease ☐ Expiry: Mining lease / tenement ☒ Expiry: M36/504 and M36/512 (current and held by Northern Star as per check on MINEDEX 19/12/2022) Other evidence ☒ Expiry:
Has the applicant obtained all relevant planning approvals?	Yes ☐ No ☐ N/A ☒	Approval: N/A Expiry date: If N/A explain why? Exempt under the *Mining Act 1978*
Has the applicant applied for, or have an existing EP Act clearing permit in relation to this proposal?	Yes ☐ No ☒	CPS No: N/A No clearing is proposed.
Has the applicant applied for, or have an existing CAWS Act clearing licence in relation to this proposal?	Yes ☐ No ☒	Application reference No: N/A Licence/permit No: N/A No clearing is proposed.
Has the applicant applied for, or have an existing RIWI Act licence or permit in relation to this proposal?	Yes ☒ No ☐	Application reference No: Licence/permit No: <u>Six groundwater licences:</u> 1106648 exp 2/2/2025 150981 exp 2/2/2025 154472 exp 6/11/2026 158766 exp 6/11/2026 168808 exp 2/2/2025 182499 exp 17/4/2026

Does the proposal involve a discharge of waste into a designated area (as defined in section 57 of the EP Act)?	Yes ☒ No ☐	Name: RIWI Act 1914 Type: Goldfields Groundwater Area Has Regulatory Services (Water) been consulted? Yes ☒ No ☐ N/A ☐ Regional office: Goldfields
Is the Premises situated in a Public Drinking Water Source Area (PDWSA)?	Yes ☐ No ☒	Name: N/A Priority: N/A Are the proposed activities/ landuse compatible with the PDWSA (refer to WQPN 25)? Yes ☐ No ☐ N/A ☒
Is the Premises subject to any other Acts or subsidiary regulations (e.g. *Dangerous Goods Safety Act 2004, Environmental Protection (Controlled Waste) Regulations 2004, State Agreement Act xxxx*)	Yes ☒ No ☐	*RIWI Act 1914* *Mining Act 1978* *Dangerous Goods Safety Act 2004*
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
Is the Premises a known or suspected contaminated site under the *Contaminated Sites Act 2003*?	Yes ☒ No ☐	CSS ID 17928, 17929 and 37862 – remediated for restricted use Classification: Remediated for restricted use (RRU) Date of classification: 23/10/2019