Government of Western Australia
Department of Water and Environmental Regulation

Decision Report

Application for Works Approval

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

Works Approval Number	W6918/2024/1
Applicant	Northern Star (Thunderbox) Pty Ltd
ACN	107 154 727
File number	2012/006911-1~8
Premises	Thunderbox Mining Operations Mining tenements M36/504 and M36/542 LEINSTER WA 6437
Date of report	19 June 2024
Decision	Works approval granted

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1. Decision summary

This decision report documents the assessment of potential risks to the environment and public health from emissions and discharges during the construction and operation of the premises. As a result of this assessment, works approval W6918/2024/1 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 21 March 2024, Northern Star (Thunderbox) Pty Ltd (the applicant; NSR) 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 relating to Northern Star Resources' Thunderbox Mining Operations (Thunderbox). The premises is approximately 90 km north of Leonora.

NSR is seeking a works approval to construct a Category 6 Process Water Pond with a storage capacity of 24,000 m^3 which will adjoin the existing Mine Dewatering Dam within the mill precinct at Thunderbox Operations. The process water pond will receive water from the existing Mine Services Dam, which receives water from the existing Raw Water Dam. The process water is sourced from Thunderbox Pit and Bannockburn Borefield. Part of the existing pipelines will be rerouted to avoid location of the new pond.

Thunderbox is currently operating with a processing throughput of approximately 4.8 million tonnes per annum (Mtpa) and plans to increase to 6 Mtpa in the near future. The new process pond is proposed to accommodate the increased water demand due to the plant expansion.

The premises relates to the category and assessed production capacity under Schedule 1 of the *Environmental Protection Regulations 1987* (EP Regulations) which are defined in works approval W6918/2024/1. 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 W6918/2024/1.

3. Proposed infrastructure and operations

3.1 Process water pond design

The proposed Process Water Pond will be a singular enclosed paddock cell formed by erecting earth fill embankments downstream. These embankments will be built in one phase, customised to meet storage requirements and make use of available mine waste. With a capacity of 24,400 cubic meters, the pond will cover approximately 1.4 hectares.

Construction of the pond will consist of the following materials:

1. Low Permeability Material (Zone A): Due to insufficient suitable low permeability material onsite, external borrow material from the waste dump will be necessary to compensate. The prepared subgrade will be compacted to at least 95% of maximum dry density according to standard engineering practice. The material should also have sufficient fines content and plasticity to ensure low permeability after conditioning and compaction, and low gravel content

to minimise the risk of puncturing the HDPE liner during installation. A civil contractor will be responsible for sourcing and placing the Zone A material.

2. Embankment Fill (Zone C): material will be obtained from selective excavations related to the earthworks, serving as a structural fill component for the pond embankment.
3. General Fill (Zone D): material sourced from earthwork excavations will be used for constructing safety bunds.
4. Erosion Protection (Zone E): Material for erosion protection will be obtained from mine waste material through screening and selective excavation.
5. Wearing Course: The wearing course material will be obtained from mine waste material using screening and selective excavation.

The basin will be shaped to direct flow toward a sump in the northwestern corner. A compacted soil subgrade, either reworked in situ material (200 mm depth) or imported Zone A material (300 mm depth), will cover the entire basin area. An HDPE geomembrane liner will be installed over the basin area and the upstream embankment face to reduce seepage.

Water removal will be facilitated by an abstraction system located in the northwestern corner during operation. Additionally, an emergency spillway constructed through the embankment will handle overflow and protect embankment integrity.

Groundwater was detected in several test pits within the footprint of the proposed pond at depths ranging from 0.5 to 1.0 meters below the surface. This water is believed to originate from existing water ponds and lower lying areas prone to flooding following rainfall. Historical satellite imagery confirms the retention of water in these lower lying areas, suggesting the possibility of a perched water table in the vicinity.

During construction, assuming construction takes place outside of the wet season, seepage rates are anticipated to be manageable during construction through conventional dewatering methods. It is expected that groundwater will not significantly impact the design and construction of earthworks. Nonetheless, precautions should be taken to divert surface runoff away from working areas and foundations during storm events (Knight Piesold, 2023).

3.1.1 Embankment Construction

The embankment for each cell will be constructed to suit storage requirements and the availability of suitable mine waste. Embankment crest elevations and storage details are shown in Table 1.

Table 1: Embankment construction

Crest Elevation (mRL)	Spillway Inlet Elevation (mRL)	Maximum Embankment Fill Height (m)	Storage Capacity (m^3)	Facility Footprint (m^2)
505.6	505.0	2.0	24,400	14,000

The elevations of the embankment crests have been determined by the applicant, based on the stage storage curve for the facility (Knight Piesold, 2023). The embankment crest height of RL 505.6 m will enable sufficient storage to maintain a 0.3 m freeboard in the event of a 1% Annual Exceedance Probability (AEP) 72 hour rainfall event.

The pond embankment will feature an upstream slope of 3H : 1V and an operating downstream slope of 2.5H : 1V. With a crest width of 5 meters, the embankment includes a structural material zone (Zone C) and incorporates a 300 mm layer of fine-grained material (Zone A) which the applicant believes will safeguard the HDPE liner during installation and operation. Textured HDPE geomembrane liner lines the upstream face of the embankment, ensuring secure passage from the Process Water Pond.

The embankment zones primarily consist of downstream bulk fill (Zone C) with a thin layer of fine-

grained material (Zone A) on the upstream face.

- Zone A Material: Sourced from borrow material to establish the compact soil subgrade beneath the HDPE liner, this material must possess adequate fines content and plasticity to achieve low permeability post-conditioning and compaction. Moreover, it will contain minimal gravel content to prevent puncturing of the HDPE liner during installation. Civil contractors are responsible for sourcing and placing the Zone A material (Knight Piesold, 2023).
- Zone C Material: Sourced from mine waste dumps, Zone C constitutes the structural fill zone of the embankments. It can be supplied by the mining operation, extracted by contractors from existing waste dumps, or acquired through borrowing, moisture conditioning, and layer-wise compaction by civil contractors.

During excavation, the basin is contoured to facilitate drainage towards the collection sump in the northwestern corner of the facility. Excavated material is utilized in the embankment as either Zone A or Zone C, if suitable, or alternatively, it is transported away as waste.

3.1.2 Compacted Soil Subgrade

To establish a sturdy foundation for the HDPE geomembrane liner, a compacted soil subgrade will be formed within the basin area. This subgrade can be comprised of either reworked in situ material (at a depth of 200 mm) or imported Zone A material (also at a depth of 200 mm).

The construction process for the compacted soil subgrade entails several steps:

- Clearing and grubbing the basin area, including the removal of topsoil.
- Shaping borrow areas within the basin to ensure efficient gravity drainage into the collection sump.
- For suitable in situ material (classified as Zone A), scarifying, moisture conditioning, and compacting it to achieve the target density (200 mm depth).
- For unsuitable in situ material (either too coarse for Zone A classification or low plasticity), obtaining suitable material from borrow sources, placing, spreading, moisture conditioning, and compacting it to achieve the desired density (thickness of 200 mm).

The surface of the compacted soil subgrade will be smooth, devoid of angular gravels and depressions, and will facilitate effective drainage. A smooth drum vibratory roller will be utilized for finishing.

It is imperative to maintain the properties of the compacted soil subgrade (including moisture content, dry density ratio, and thickness) post-compaction until the installation of the HDPE liner.

3.1.3 HDPE Geomembrane Liner

A geomembrane basin liner, consisting of a 1.5 mm smooth HDPE layer, will be installed directly on the compacted soil surface. To secure the HDPE, it will be anchored within a rectangular trench on the embankment crest. Additionally, the embankment's upstream face will feature a 1.5 mm textured HDPE liner, facilitating safe movement during construction and operation. The same textured HDPE liner will also be installed within the collection sump.

3.1.4 Abstraction System

The facility will employ a water abstraction system tailored to its development. A collection sump, measuring approximately 0.5 m deep and 5 m by 5 m at the base, will be positioned in the northwestern corner—the lowest point of the facility. The sump will be situated beneath a compacted soil subgrade overlaid with an HDPE liner.

Within the sump, two 450 mm outer diameter HDPE riser pipes will extend from the center to the embankment crest elevation. These pipes will connect to pipe supports fixed to concrete plinths at

their base, equipped with foot valves and vortex breakers.

Downstream of the PWP embankment, a 6.5 m wide x 10 m long pump pad (constructed from Zone C material) will facilitate water pumping to the process plant via the return pipeline.

The abstraction system will operate automatically, reclaiming water from the facility and pumping it to the process plant through the existing tailings and decant return trench.

3.1.5 Emergency Spillway

The Process Water Pond is designed to handle the specified design storm event. In the event of a storm surpassing the design criteria, excess rainfall and water unable to be stored within the pond will be safely discharged via an engineered emergency spillway, integrated into the embankment construction. The spillway will feature an inlet cut into the embankment and will be lined with an HDPE geomembrane to prevent erosion.

The spillway channel will discharge downstream into the tailings and decant return trench from the embankment toe. This saline overflow is then proposed to be discharged to the Thunderbox Pit (see Section 3.1.7).

To manage erosion during emergency overflow, a rockfill platform made of 300 mm thick Zone E material (underlain by geotextile) will be provided at the spillway outlet. The spillway system is designed to safely discharge single storm events with an average recurrence interval of up to the 1% Annual Exceedance Probability (AEP), while protecting the embankment from overtopping.

The spillway will have a base width of 5 m and side slopes of 3H:1V, flattening to 12.5H:1V on the embankment crest for ease of traffic. Its longitudinal grade from inlet to outlet will be 1%, steepening to 40% to direct overflow down the embankment slope. The spillway will maintain a minimum depth of 0.6 m before discharging onto a rockfill platform at the base of the embankment.

3.1.6 Existing pipelines

The entire Thunderbox water pipeline system is connected through telemetry, controlled through the mill, with automatic shut offs that will be engaged should significant variation in flow be detected. The existing pipelines will be rearranged around the existing mine water pond to accommodate the new proposed pond. No new pipelines are proposed to transfer process water to and from Thunderbox Pit.

3.2 Emergency discharge to Thunderbox pit

In the event of a significant rain event the process water pond will have capacity to pump water back to the Thunderbox Pit. Discharge to this pit is already approved for the Mine Dewatering Dam that abuts the process water pond.

Thunderbox Pit water has a measured pH of 7.6 to 8.5 and total dissolved solids (TDS) range of 800 to 1,000 mg/L. The groundwater surrounding Thunderbox pit ranges from pH 7.6 to 8.5 with a TDS 800 to 1,000 mg/L (Madras and Rogan Josh bore). The depth of groundwater surrounding the pit is 15-30 m.

The water contained within the existing Process Water Pond has a TDS of 10,500 mg/L with a pH of 8.17, with no significant water quality issues (per the applicant supporting documents).

4. Legislative context

4.1 Native vegetation clearing approvals

Clearing of 0.4 ha of degraded vegetation will be required. The remainder of the project site has already been cleared. CPS10369 is currently under assessment with the Department of Energy,

Mines, Industry Regulation and Safety (DEMIRS). Clearing to support works under this works approval cannot commence until this clearing permit has been granted.

4.2 Mining Act 1978

The new pond will be constructed using the same design principles that were previously approved under Mining Proposal REG ID 113984. This mining proposal authorises the new process water pond. The following relevant tenement conditions were specified in the Mining Proposal:

- All reasonable measures will be taken to ensure all hydrocarbons, environmentally hazardous chemicals, process water and other environmentally hazardous substances or waste are stored and managed in a manner to prevent discharges to the environment.
- All activities to be undertaken to avoid or minimise damage, disturbance, or contamination of waterways, including their beds and banks, and riparian and other water dependent vegetation.
- The development and operation of the project being carried out in such a manner to create the minimum practicable disturbance to the existing native vegetation and natural landform.
- The lessee taking all reasonable and practicable measures to prevent or minimise the generation of dust from mining operations.

The Delegated Officer notes it is the applicant's (tenement holder) responsibility to ensure mining operations are conducted in accordance with Mining Act approvals and tenement conditions. If the proposed works documented in this report will result in any changes to mining activities outside of the scope of the Mining Act approvals, it is the tenement holder's responsibility to seek further approval or amendments under the *Mining Act 1978*.

5. 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.

5.1 Source-pathways and receptors

5.1.1 Emissions and controls

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

Table 2: Proposed applicant controls

Emission	Sources	Potential pathways	Proposed controls
Construction			
Fugitive dust	Compacting of pond wall, vehicle movements, lift-off from earthworks.	Air / windborne pathway	Water carts to be used if required to manage dust emissions

Emission	Sources	Potential pathways	Proposed controls
Operation			
Pond process water (saline)	Operation of process water pond / heavy rainfall event	Overtopping of Process water pond and overland runoff to vegetated areas / infiltration to soils Seepage through pond liner to soil and groundwater	• The Thunderbox water pipeline system is connected through telemetry, controlled through the mill, with automatic shut offs that will be engaged should significant variation in flow be detected. All pipelines will be bunded in v drains; • Pond designed to store rainfall from 1% AEP 72 hour event while maintaining 300 mm freeboard; • Emergency spillway • In the event of significant rainfall, process water will be discharged into Thunderbox pit; and • Soil subgrade will be compacted to 200 mm depth before being lined with a 1.5 mm smooth HPDE geomembrane liner
	Operation of pipelines transferring process water	Direct discharge to soils/vegetation	• All new and relocated pipelines will be within the processing plant area; • Pipelines to be fitted with flowmeters, telemetry and automatic shutoff systems.
	Use of process water pond for dust suppression	Runoff to vegetated areas / infiltration to soils	No controls proposed in application.
	Discharge into Thunderbox Pit	Changes to pit water quality and seepage through pit walls to underlying groundwater/soil	No controls proposed in application.

5.1.3 Receptors

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

Table 3 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 2020)).

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

Human receptors	**Distance from prescribed activity**
Town of Leonora	90 km from Premises. *Not considered further as a sensitive receptor due to separation distance.*
Weebo Pastoral Station	20 km northwest from the Premises. *Not considered further as a sensitive receptor due to separation distance.*
Environmental receptors	**Distance from prescribed activity**
Surface water	Minor surface water drainage lines exist approximately 435 m west of the proposed process water pond; and No major surface water features located within 5 km of the Thunderbox mill operations area.
Native Vegetation Vegetation in the area is generally sparse, with some patches of vegetation found in lower lying areas that retain water after rainfall.	Native vegetation located west of Thunderbox mill operations area; Priority flora (P4) *Calytix Uncinata* has been located 1 km from the Thunderbox mill precinct; and No Threatened/ priority ecological communities within 5 km of the project area.
Designated Area (as defined in section 57 of the EP Act). *RIWI Act 1914* – Groundwater Area Water quality data from the Rogan Josh and Madras borefields provide an indication of groundwater quality in the area. TDS within Madras and Rogan Josh borefields range from 800 to 1500 mg/L, with pH ranging from 7.6 to 8.5 (Northern Star, 2022).	Premises is within the Goldfields Groundwater Area. Groundwater (fresh, with total dissolved solids (TDS) ranging from 370 – 740 mg/L; pH neutral to slightly alkaline (7.1 – 8.0); Depth to groundwater in the area is approximately 15 -30 meters below ground level (mbgl), however groundwater was detected in several test pits within the footprint of the proposed pond at depths ranging from 0.5 to 1.0 meters below the surface. Water intercepted in these test pits is believed to be seepage from the existing water ponds and lower lying areas which are subject to flooding following rainfall. Refusal was encountered at shallow depths in all test pits, indicated the existence of a ferricrete hardpan across the area.

	Groundwater flows from the north-east to the south-west; and Groundwater quality recorded at the Thunderbox TSF monitoring bores is of stock quality, however, the closest active pastoral bore is located approximately 7 km to the south of the TSF.

5.2 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 5.1. 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 5.1), these have been considered when determining the final risk rating. Where the Delegated Officer considers the applicant's proposed controls to be critical to maintaining an acceptable level of risk, these will be incorporated into the works approval as regulatory controls.

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

Works approval W6918/2024/1 that accompanies this decision report authorises construction and time-limited operations. The conditions in the issued works approval, as outlined in Table 4.

have been determined in accordance with *Guidance Statement: Setting Conditions* (DER 2015).

A licence is required following the time-limited operational phase authorised under the works approval to authorise emissions associated with the ongoing operation of the premises i.e. Category 6 activities. A risk assessment for the operational phase has been included in this decision report, however licence conditions will not be finalised until the department assesses the licence application.

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

Risk events					Risk rating [1] C = consequence L = likelihood	Applicant controls sufficient?	Conditions [2] of works approval	Justification for additional regulatory controls
Sources / activities	**Potential emission**	**Potential pathways and impact**	**Receptors**	**Applicant controls**				
Construction								
Construction of process water pond	Dust	**Pathway:** air / windborne pathway **Impact:** smothering of nearby vegetation	Nearby vegetation	Refer to Section 3.1	C = Slight L = Unlikely **Low Risk**	Y	Condition 1 – infrastructure requirements	N/A
Operation (including time-limited-operations operations)								
Operation of new process pond and pipelines Emergency discharge of overflow process water into Thunderbox Pit during heavy rainfall events	Saline process water	**Pathway:** Overtopping event or loss of containment (structural failure) causing run off and infiltration **Impact:** Contamination to groundwater quality and soil / vegetation	Nearby vegetation Surface water lines	Refer to Section 3.1	C= Moderate L = Unlikely **Medium Risk**	Y	Condition 1 – infrastructure requirements Condition 6 – Operational requirements Condition 7 – authorised emergency discharge point to Thunderbox Pit	N/A
		Pathway: seepage to groundwater **Impact:** contamination to water quality and soil / vegetation	Nearby vegetation Surface water lines Groundwater (RIWI *Goldfields Proclaimed Groundwater*		C = Minor L = Unlikely **Medium Risk**	Y	Condition 1 – infrastructure requirements Condition 6 – Operational requirements	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**				
			Area (15-30 mbgl))					
		Pathway: Seepage through base and wall of Thunderbox pit **Impact:** Groundwater mounding with water table rising to vegetation root zone, impacting health of native vegetation	Groundwater (RIWI *Goldfields Proclaimed Groundwater Area* Native vegetation surrounding the pit	Refer to Section 3.1	C = Slight L = Unlikely **Low Risk**	Y	Condition 1 – Dewater pipeline construction requirements Condition 6 – Operational requirements	The risk event is not considered likely given the relatively low discharge volumes into the pit which will be non-routine/infrequent, the capacity of the pit, distance to receptors, evaporation rates and depth to groundwater. The Delegated Officer has specified that volumes discharged to the pit will be recorded and reported during time limited operations.
Use of process pond water for dust suppression	Saline process water	**Pathway:** Run off **Impact:** contamination to soil / vegetation	Nearby vegetation	Refer to Section 3.1	C= Minor L = Unlikely **Medium Risk**	Y	Condition 1 – use of process water for dust suppression.	N/A

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.

6. Consultation

Table 5 provides a summary of the consultation undertaken by the department.

Table 5: Consultation

Consultation method	Comments received	Department response
Application advertised on the department's website on 13 May 2024	None received	N/A
Applicant was provided with draft documents on 19 June 2024	The applicant responded on 17 June 2024, confirming they had no comment on the draft condition set was provided. Additional information sought by the department was provided to the satisfaction of the Delegated Officer.	N/A

7. 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. Department of Environment Regulation (DER) 2015, *Guidance Statement: Setting Conditions*, Perth, Western Australia.
2. Department of Water and Environmental Regulation (DWER) 2020, *Guideline: Environmental Siting*, Perth, Western Australia.
3. DWER 2020, *Guideline: Risk Assessments*, Perth, Western Australia.
4. Knight Peisold Consulting, 2023, *Thunderbox Gold Project – Process Water Pond Design Summary,* Perth, Western Australia.
5. Northern Star Resources Limited, 2022, *Annual Environmental Report 1st October 2021 – 30 September 2022.* Perth, Western Australia.