Decision Report

Application for Works Approval

Division 3, Part V *Environmental Protection Act 1986*

Works Approval Number	W6311/2019/1
Applicant	Northern Star Resources Ltd
ACN	092 832 892
File Number	DER2018/001042-2
Premises	Jundee Operations WILUNA WA 6646 Mining tenements: G53/20, L53/52, L53/60, L53/68, L53/69, L53/70 - L53/73, L53/75, L53/99, L53/100, L53/102, L53/112, L53/113, L53/117, L53/136 - L53/138, L53/142, L53/143, L53/153, L53/169, L53/174, M53/155, M53/156, M53/182, M53/191, M53/192, M53/196 - M53/198, M53/199, M53/221, M53/226, M53/228 - M53/230, M53/235 - M53/237, M53/245 - M53/250, M53/326, M53/347, M53/372, M53/412 - M53/414, M53/441, M53/446, M53/451, M53/452, M53/461, M53/477 - M53/480, M53/492, M53/535 - M53/541, M53/552, M53/588, M53/589, M53/611, M53/707, M53/708, M53/711, M53/712, M53/836, M53/874, M53/895, M53/911, M53/929, M53/935, M53/940, M53/966, PL34
Date of Report	11/02/2020
Status of Report	Final

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1. Definitions of terms and acronyms

In this Decision Report, the terms in Table 1 have the meanings defined.

Table 1: Definitions

Term	Definition
AACR	Annual Audit Compliance Report
ACN	Australian Company Number
AER	Annual Environment Report
Category/ Categories/ Cat.	Categories of Prescribed Premises as set out in Schedule 1 of the EP Regulations
CS Act	*Contaminated Sites Act 2003* (WA)
Decision Report	refers to this document.
Delegated Officer	an officer under section 20 of the EP Act.
Department	means the department established under section 35 of the *Public Sector Management Act 1994* and designated as responsible for the administration of Part V, Division 3 of the EP Act.
DWER	Department of Water and Environmental Regulation As of 1 July 2017, the Department of Environment Regulation (DER), the Office of the Environmental Protection Authority (OEPA) and the Department of Water (DoW) amalgamated to form the Department of Water and Environmental Regulation (DWER). DWER was established under section 35 of the *Public Sector Management Act 1994* and is responsible for the administration of the *Environmental Protection Act 1986* along with other legislation.
EPA	Environmental Protection Authority
EP Act	*Environmental Protection Act 1986* (WA)
EP Regulations	*Environmental Protection Regulations 1987* (WA)
Existing Licence	The Licence issued under Part V, Division 3 of the EP Act and in force prior to the commencement of, and during this Review
GRSMP	Groundwater Recovery Seepage Management Plan
Licence Holder	Northern Star Resources Ltd
m^3	cubic metres
mtpa	million tonnes per annum

NEPM	National Environmental Protection Measure
Noise Regulations	*Environmental Protection (Noise) Regulations 1997* (WA)
Occupier	has the same meaning given to that term under the EP Act.
Prescribed Premises	has the same meaning given to that term under the EP Act.
Premises	refers to the premises to which this Decision Report applies, as specified at the front of this Decision Report
Primary Activities	as defined in Schedule 2 of the Revised Licence
Risk Event	As described in *Guidance Statement: Risk Assessment*
UDR	*Environmental Protection (Unauthorised Discharges) Regulations 2004* (WA)
µg/m^3	micrograms per cubic metre
µg/L	micrograms per litre
WAD CN	Weak acid dissociable cyanide

2. Purpose and scope of assessment

Northern Star Resources submitted an application for a Works Approval to construct embankment raises to their above ground Tailings Storage Facility TSF1 at their Jundee Operations. Jundee is currently licenced under Part V of the EP Act with Licence L6498/1995/11, for prescribed categories 5, 6, 52, 54, 64 and 73. No changes to the prescribed categories or thresholds have been requested as part of this Works Approval application.

2.1 Application details

Table 2 lists the documents submitted during the assessment process.

Table 2: Documents and information submitted during the assessment process

Document/information description	Date received
Application – New Works Approval – Northern Star Resources NSRL – Jundee Mining Operations (DWERDT198751)	10/09/2019
Northern Star Resources Jundee Gold Mine – 2018 Tailings Storage Facility Audit Report (A1788082)	13/05/2019
Northern Star Resources Limited – Annual Environmental Report (report number: N0102-20-verB) (DWERDT 152615)	18/04/2019
Saprolite (2018) Memorandum: Jundee Operations - Proposed TSF1 and TSF2 Tailings Wall Lift 2018 Groundwater Monitoring Review June 2018, 2 October 2018	19/10/2018

3. Background

Northern Star Resources Ltd (Northern Star) mines and processes gold ore at its Jundee Operations (the Premises), 55km north east of Wiluna at the northern extent of the Goldfields. The Jundee Process Plant is currently fed with ore from three underground mines. Jundee has three operational tailings storage facilities (TSFs) to receive tailings from the gold ore processing plant: TSF1, TSF2 (above ground paddock style facilities with a common embankment wall) and the Fisher In-pit TSF.

TSF1 was commissioned in October 1995 and was in operation until November 1999. During 2016 a stage 4 embankment raise was constructed for TSF1, and following the raise, TSF1 was recommissioned. TSF1 and Fisher In-pit TSF were used on a rotational basis until Fisher In-pit TSF reached its design freeboard limit.

Works Approval W6179/2018/1 was issued to Northern Star in January 2019 to facilitate the construction of the stage 5 embankment raise to TSF1. The construction certificate for the works in W6179/2018/1 was received by DWER on 28 August 2019.

An aerial photograph of the Premises is shown in Figure 1 below. TSF1 is identified in red.

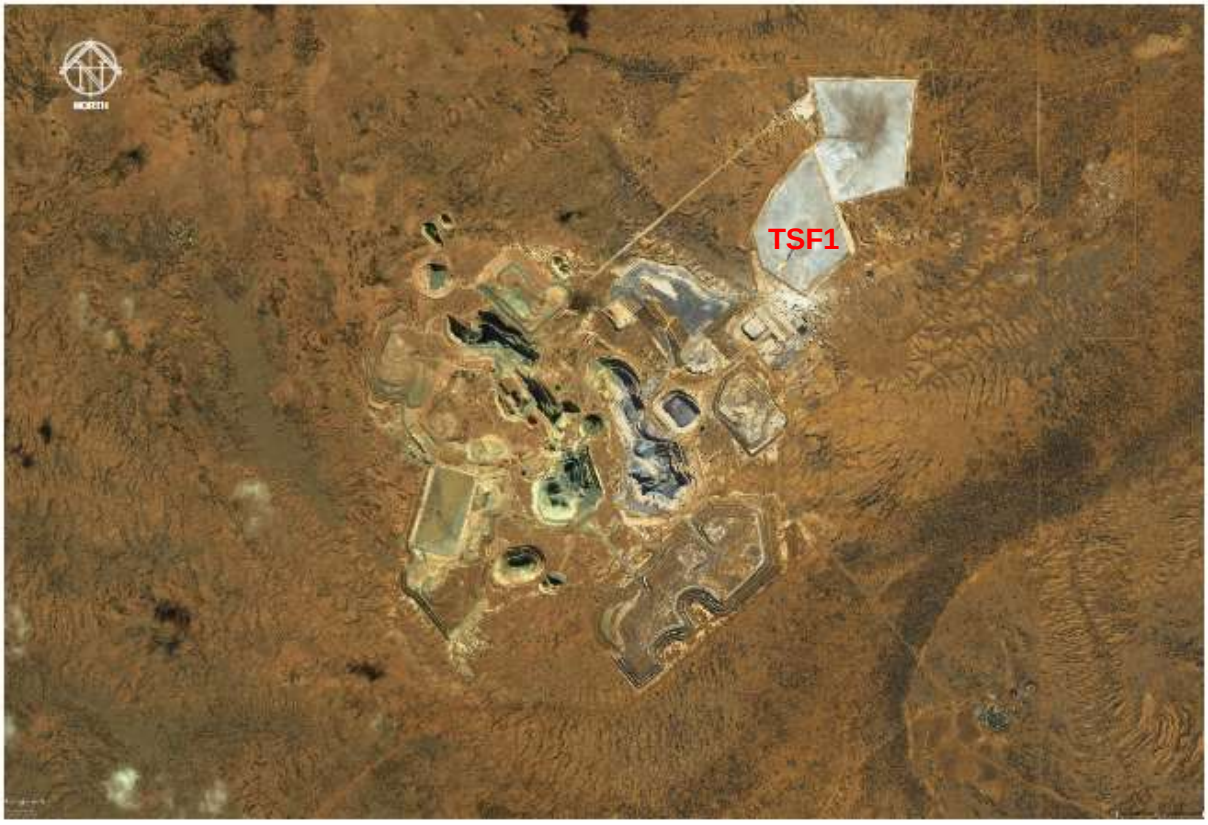


Figure 1: Jundee Operations 2017

4. Overview of Premises

4.1 Operational aspects

The TSF1 facility is an above ground facility with a second facility, TSF2. They conjoin, sharing a common embankment, and share the same overall groundwater system, although have localised characteristics dependent on tailings deposition/seepage and seepage recovery pumping.

The main risk associated with an increase in height to the TSF1 facility with regard to emissions and discharges to the environment, is that the increase in the hydraulic head from additional tailings deposition leads to an increase in seepage rates, which results in vegetation impacts from root zone inundation due to rising groundwater levels (Saprolite 2018). The seepage also impacts on salinity of the receiving groundwater environment.

A monitoring program for ambient groundwater depth and quality surrounding TSF 1 and TSF 2, Fisher In-pit TSF and decommissioned Nimary TSF is required by Licence condition L3.4.1. Works approval W5164/2012/1 for the TSF2 stage 6 embankment raise required Jundee Operations to develop a Groundwater Recovery Seepage Management Plan (GRSMP) to manage seepage associated with TSF2 operations. The GRSMP, dated August 2013, was submitted to the then DER in 2013. The objective of this plan is to prevent impact to vegetation from rising groundwater levels. A vegetation survey conducted as part of the GRSMP has ascertained that the root profile of the locally dominant species *Acacia aneura* and *Acacia pruinocarpa* did not extend beyond the first metre below ground level. Hence a standing water level (SWL) limit of 1 mbgl has been placed on the compliance bores in the Licence as part of condition 3.4.1. This limit is consistent with the levels nominated in the GRSMP.

A monitoring program for ambient groundwater depth and quality surrounding TSF 1 and TSF 2, Fisher In-pit TSF and decommissioned Nimary TSF is required by Licence condition L3.4.1.

Monitoring bores surrounding the TSF1 and TSF2 facilities show predominately stable groundwater levels with a couple of noticeable exceptions. The 2019 Annual Environmental Report (AER) required under L6498/1995/11 shows monitoring bores on the eastern and western embankment of TSF2 (JMB01 and JMB08) with standing water levels less than 1 metre below the surface. In particular, JMB08 was recorded as being only 0.08 mbgl.

4.2 Infrastructure

The TSF1 facility infrastructure, as it relates to Category 5 activities, is detailed in Table 3 and with reference to the Site Plan (attached in the Works Approval).

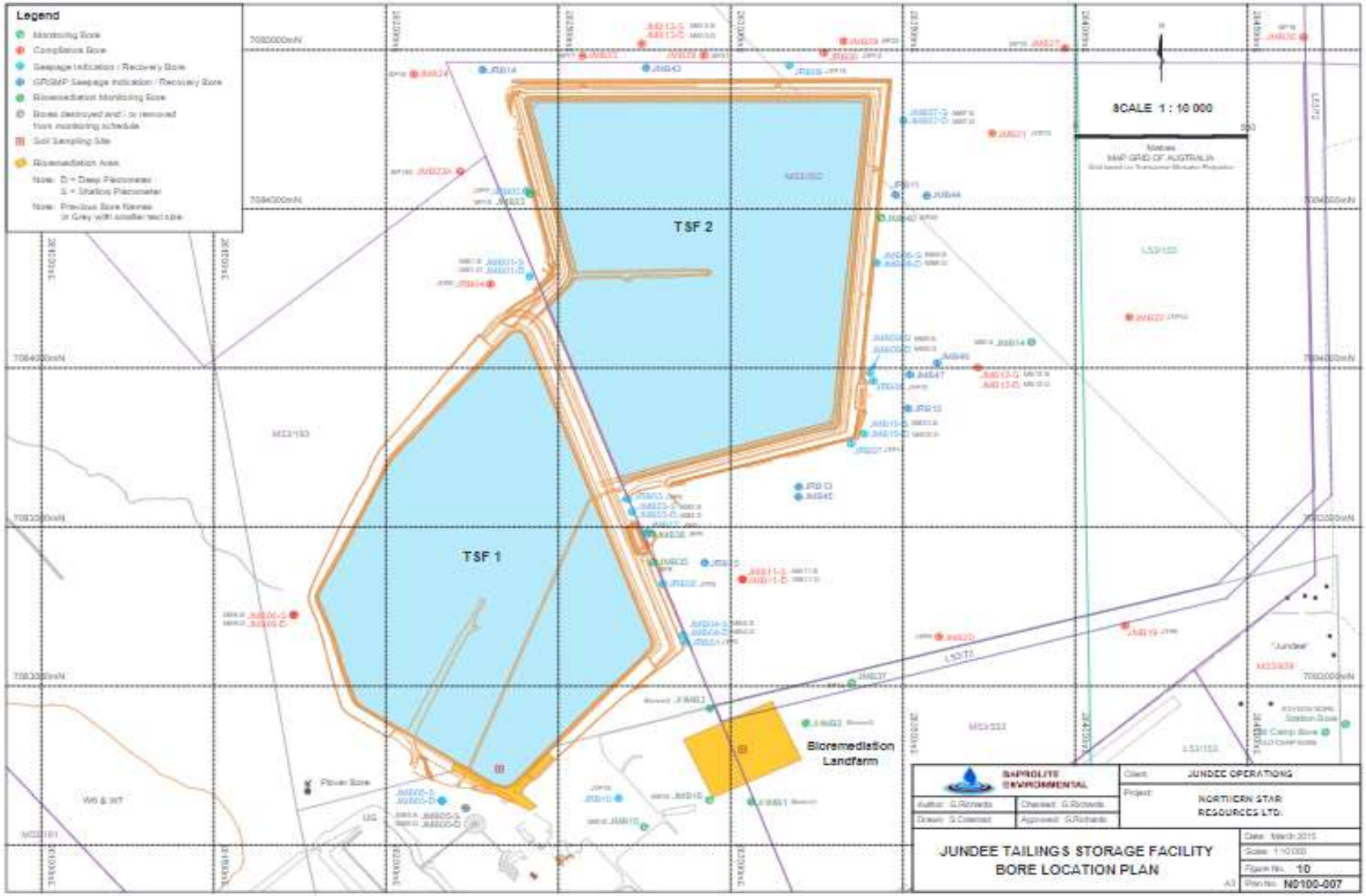
Table 3 lists infrastructure associated with each prescribed premises category.

Table 3: Jundee Operations TSF1 (Category 5) infrastructure

	Infrastructure
	Prescribed Activity Category 5
1	Stage 6 upstream embankment raise to TSF1 to RL2569.0m (3m raise to the perimeter embankment using compacted clay)

Existing groundwater monitoring bores and seepage recovery bores for TSF1 and TSF2 are shown in the Figure 2 below.

Figure 2: TSF1 and TSF2 groundwater monitoring and seepage bores



5. Legislative context

5.1 Part V of the EP Act

5.1.1 Applicable regulations, standards and guidelines

The overarching legislative framework of this assessment is the EP Act and EP Regulations.

The guidance statements which inform this assessment are:

- *Guidance Statement: Regulatory Principles (July 2015)*
- *Guidance Statement: Decision Making (February 2017)*
- *Guidance Statement: Risk Assessments (February 2017)*

5.1.2 Works approval and licence history

Table 4 summarises the works approval and licence history for the premises.

Table 4: Works approval and licence history

Instrument	Issued	Nature and extent of works approval, licence or amendment
W5164/2012/1	25/06/2012	Works approval for Stage 6 embankment raise of 2m on TSF 2 (includes condition to develop a Groundwater Recovery and Seepage Management plan)
L6498/1995/11	22/11/2013	Licence re-issue
W5744/2014/1	22/12/2014	Works approval for Stage 7 embankment raise of 2m on TSF 2
L6498/1995/11	17/09/2015	Licence amendment to current format, including transfer of ownership
L6498/1995/11	04/08/2016	Licence amendment to increase capacity of power station by to 42.2 MW
W6179/2018/1	03/01/2019	Works Approval to construct embankment raises to above ground Tailings Storage Facilities, TSF1 and TSF2
W6311/2019/1	12/02/2020	Works Approval for stage 6 embankment raise to TSF1

6. Location and siting

6.1 Siting context

Jundee is located approximately 55 km north-east of the township of Wiluna and is situated on the Jundee, Lake Violet and Millrose Pastoral Leases. Land use in the Jundee area is a mixture of mining and pastoral enterprise. The major pastoral properties with a direct relationship are Barwidgee/Yandal, Millrose, Lake Violet and Jundee stations. Northern Star is the leaseholder of Jundee, which continues to be sublet to Millrose Station.

Jundee comprises two historically separate operations called Jundee and Nimary. Following aggregation of the operations, the Nimary processing site was decommissioned in 2007 with final rehabilitation completed in 2010. The regional setting for Jundee in relation the adjacent pastoral stations and borefields is shown below in Figure 3.

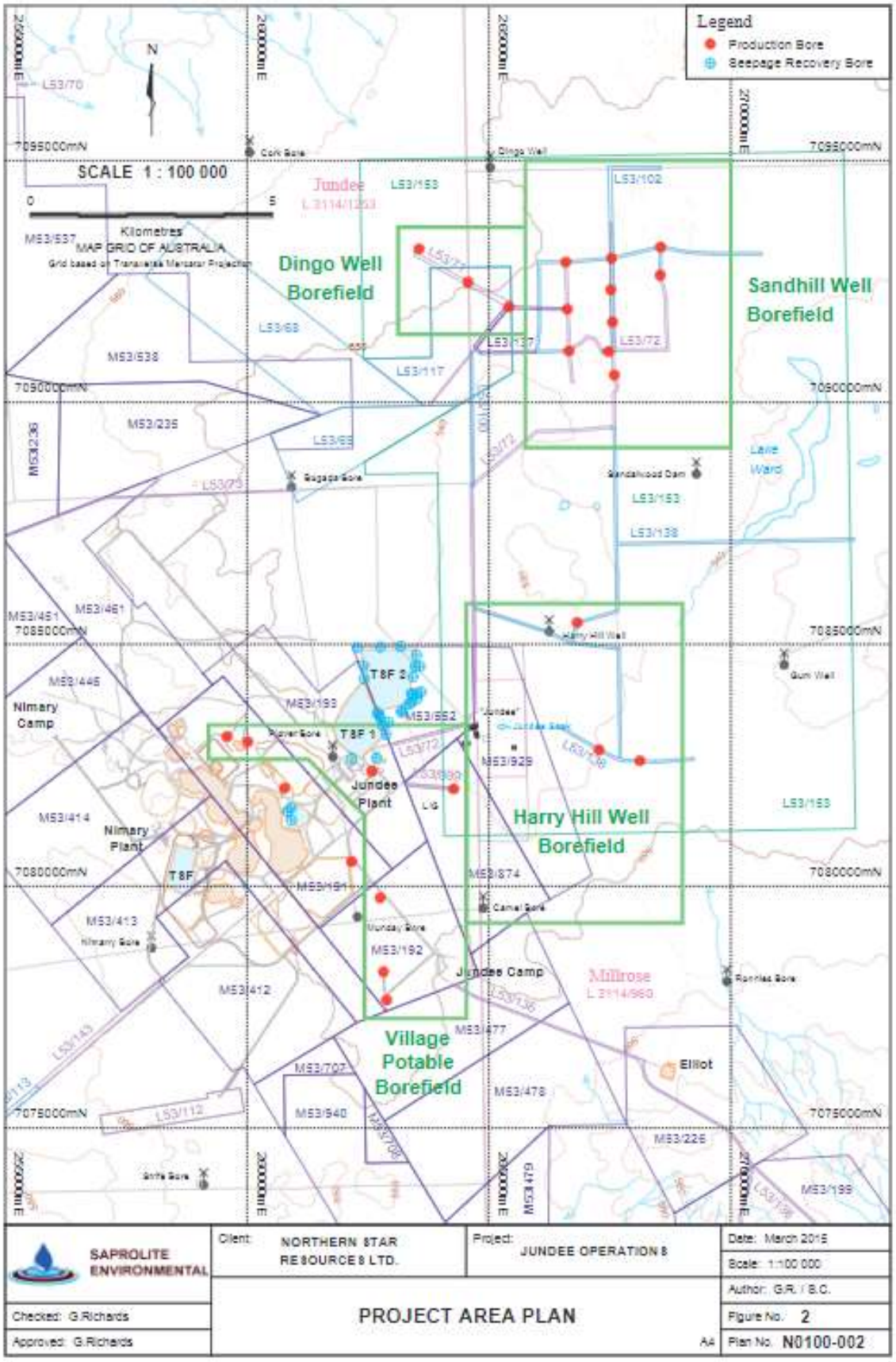


Figure 3: Regional setting of Jundee Operations, showing Premises water borefields, adjacent pastoral stations, pastoral groundwater bores and adjacent salt lakes.

6.2 Residential and sensitive Premises

The distances to residential and sensitive receptors are detailed in Table 5.

Table 5: Receptors and distance from activity boundary

Sensitive Land Uses	Distance from Prescribed Activity
Town of Wiluna	55 km to the south west of the Premises
Millrose Homestead	33 km to the south east of the Premises.

6.3 Specified ecosystems

Specified ecosystems are areas of high conservation value and special significance that may be impacted as a result of activities at or Emissions and Discharges from the Premises. The distances to specified ecosystems are shown in Table 6. Table 6 also identifies the distances to other relevant ecosystem values which do not fit the definition of a specified ecosystem.

The table has also been modified to align with the *Guidance Statement: Environmental Siting.*

Table 6: Environmental values

Specified ecosystems	Distance from the Premises
Ramsar Sites in Western Australia	None in 50km radius
Important wetlands – Western Australia	Nearest listed wetland is Lake Ballard, near Menzies, 130km north of Kalgoorlie
Parks and Wildlife Managed Lands and Waters	Lorna Glen Pastoral Station approximately 95 km east of Jundee

6.4 Groundwater and water sources

The distances to groundwater and water sources are shown in Table 7.

Table 7: Groundwater and water sources

Groundwater and water sources	Distance from Premises	Environmental value
Public drinking water source areas	Nearest public drinking water source area is located at Wiluna, approximately 55km to the south west	N/A
Major watercourses/waterbodies	No major watercourses/ waterbodies within 50km radius of the Premises	N/A
Groundwater	Background water quality of groundwater in the vicinity of TSF1 and TSF2 is approximately 1000 – 2000 mg/L TDS, suitable for stock water. However the hydraulic conductivity of the lithology where the TSFs are located is not high and hence water movement is very slow. Natural groundwater flow direction in the vicinity of the TSF1/2 is from southwest to northeast (Saprolite 2018).	Water is suitable for stock use however the lithology means that the groundwater would be low yielding and likely not a reliable water source.

Groundwater surrounding TSF1 and TSF2 has generally been shallow but stable over the life of the facilities. There are notable exceptions in a handful of monitoring bores that show a sharp rise in localised groundwater. Data supplied in the 2019 Annual Environmental Report show Bores immediately north, west and east of TSF2 have groundwater levels close to the ground surface. The rising of surrounding groundwater due to excess seepage from the facility has the potential to impact localised vegetation, as well as potentially compromising the foundations of the TSF.

Due to the TSF1 and TSF2 being in such close proximity to each other, both facilities are taken into account when determining the potential impacts that may arise due to discharges into the surrounding groundwater.

7. Monitoring data

7.1 Tailings Geochemistry

Tailings at deposition are saline (10 000mg/L), alkaline (pH 8-9), with weak acid dissociable cyanide (WAD CN) concentrations of between 50 – 150 mg/L.

7.2 Tailings Water Balance

The 2017 geotechnical audit and review of the operational TSFs indicated that Fisher In-pit TSF recorded a water return of 102% of slurry water inputs (return includes rainfall) for 2017. TSF1 and 2 had a water recovery of 51% (tailings discharge solids density of 39%, 40% return from pumped decants; a total of 51% when recovery bores and seepage trenches are included) by contrast in 2017 (Coffey 2018c).

One of the recommendations of the Coffey 2017 Audit was to optimise water return from TSF1 and TSF2 when operating. This would aid also in reducing the risk to groundwater from seepage.

7.3 Monitoring of seepage to groundwater – groundwater levels

The TSF monitoring trend in standing water levels over the period 2017 – June 2018 has indicated rising levels to the north east of the TSF2. This is consistent with the groundwater flow path from south west to north east. The five seepage recovery bores (JRB11 – JRB15) installed in 2014 as part of the Groundwater Recovery Seepage Management Plan have steep localised drawdowns associated with each and have made moderate impact in maintaining water levels. If the recovery bores however cease for any period of time, the groundwater levels quickly recover to those of the background levels, reflective that the hydraulic conductivity of the host strata is low, meaning that groundwater transport is slow. Mounding has expressed itself laterally to the north and east and to a lesser extent, to the west of TSF2 (Saprolite 2018).

In 2012, DWER (then DEC) issued a works approval for the Stage 6 embankment raise to the TSF2. This assessment also included a requirement to develop and implement a Groundwater Recovery and Seepage Management Plan (GRSMP). The GRSMP was updated in 2015 and again in 2017. Within the GRSMP was the commitment to operate 15 recovery bores, 13 of which were powered by automated solar pumps and 2 powered from mains power.

A DWER compliance inspection in November 2019 identified a number of issues with the operation of TSF2 such as silting in the toe drain at TSF2 and inefficiency with the recovery bores due to solar-only power. DWER provided Northern Star with a list of actions required to be completed by a specific timeframe.

Northern Star responded to the requirements on 9 December 2019. Commitments were made to improve both the efficiency of the toe drain at TSF2 and the recovery bores surrounding

both facilities. Updated bore readings from October 2019 at the monitoring bores surrounding the facility shows a lowering of the SWL at all sites, indicating the measures taken by Northern Star are having the desired effects on the localised groundwater.

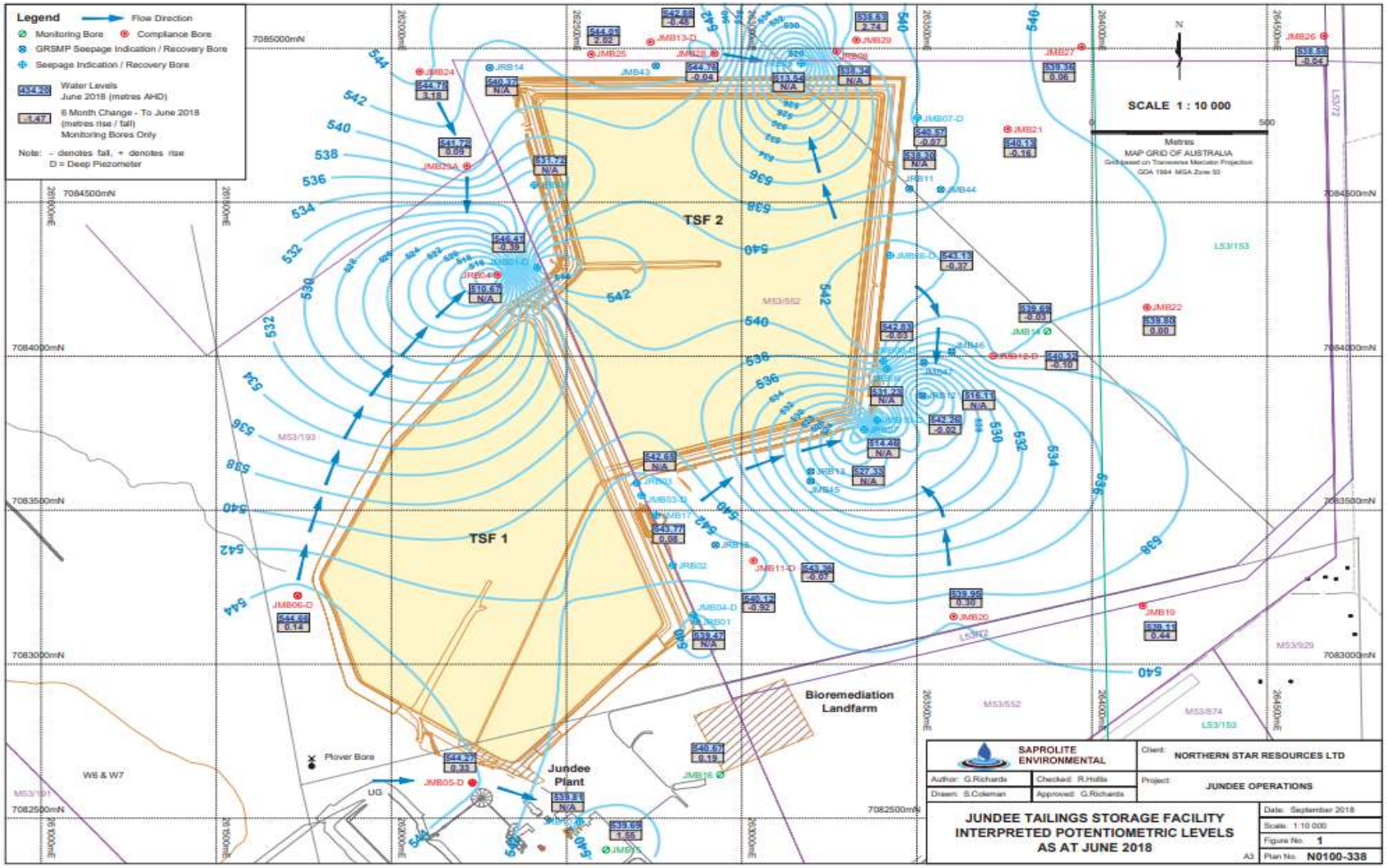


Figure 4: TSF1 and TSF 2 groundwater levels as at June 2018 (Saprolite 2018)

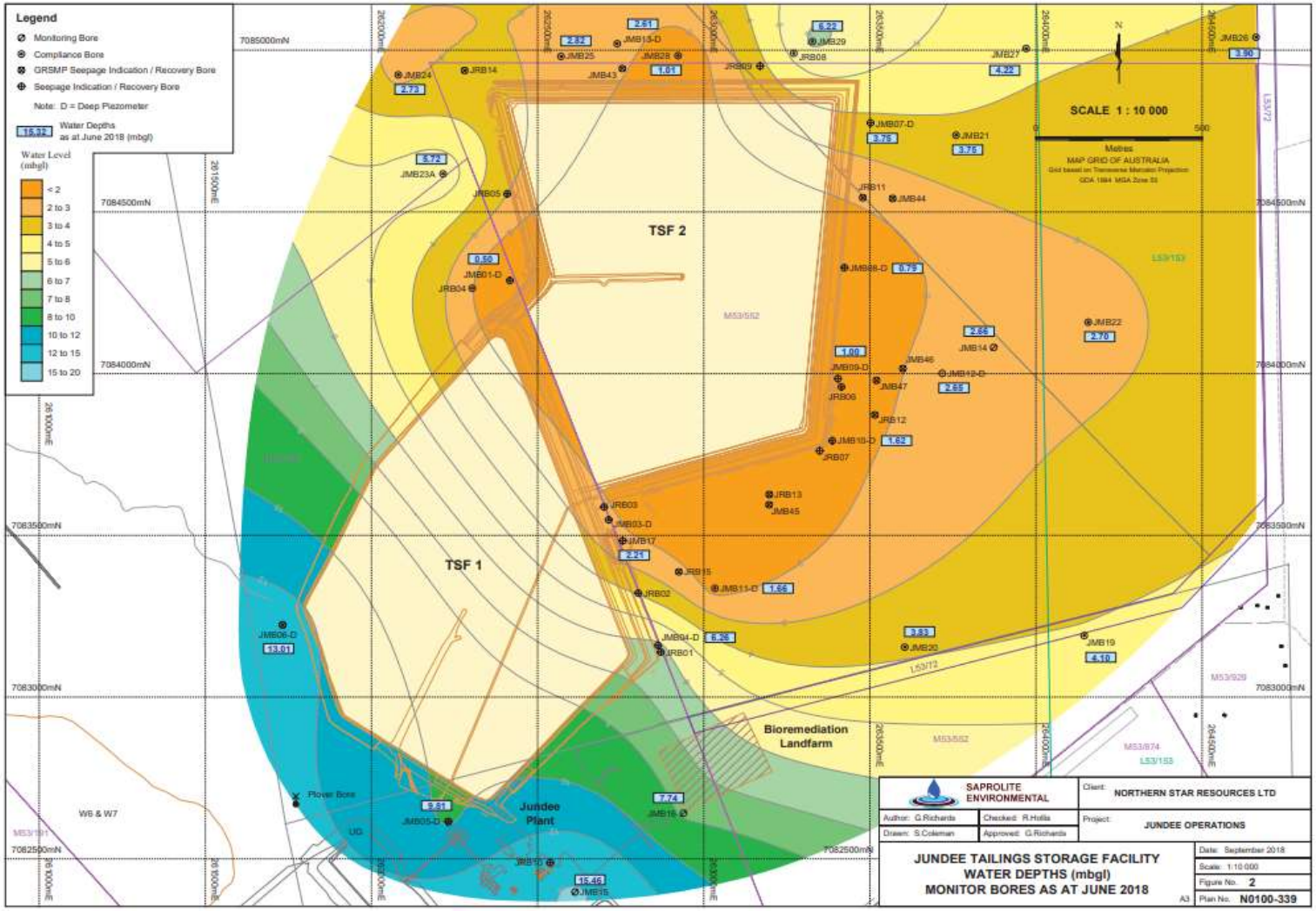


Figure 5: TSF1 and TSF2 Groundwater contours as at June 2018 (Saprolite 2018)

7.4 Monitoring of seepage to groundwater – salinity

Salinity of the tailings deposited to the TSF is ~10 000mg/L TDS, which results in seepage that is between 3 000 and 6 000 mg/L, causing an increase in salinity in the vicinity of the TSF (refer to Figure following). Monitoring of the changes in salinity over the six months to June 2018 is included on the following Figure .

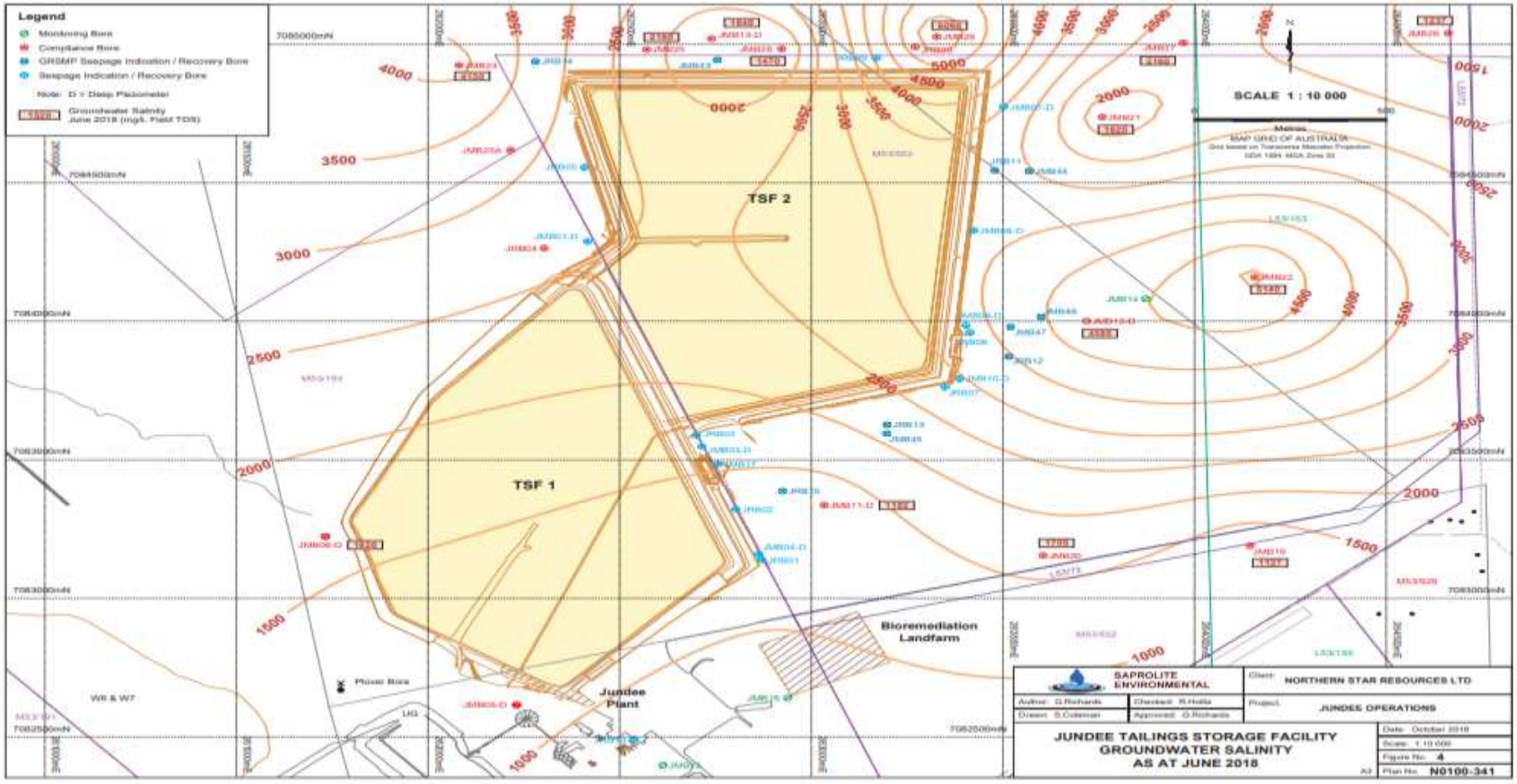


Figure 6: Groundwater salinity in vicinity of TSF1 and TSF2 as at June 2018 (Saprolite 2018)

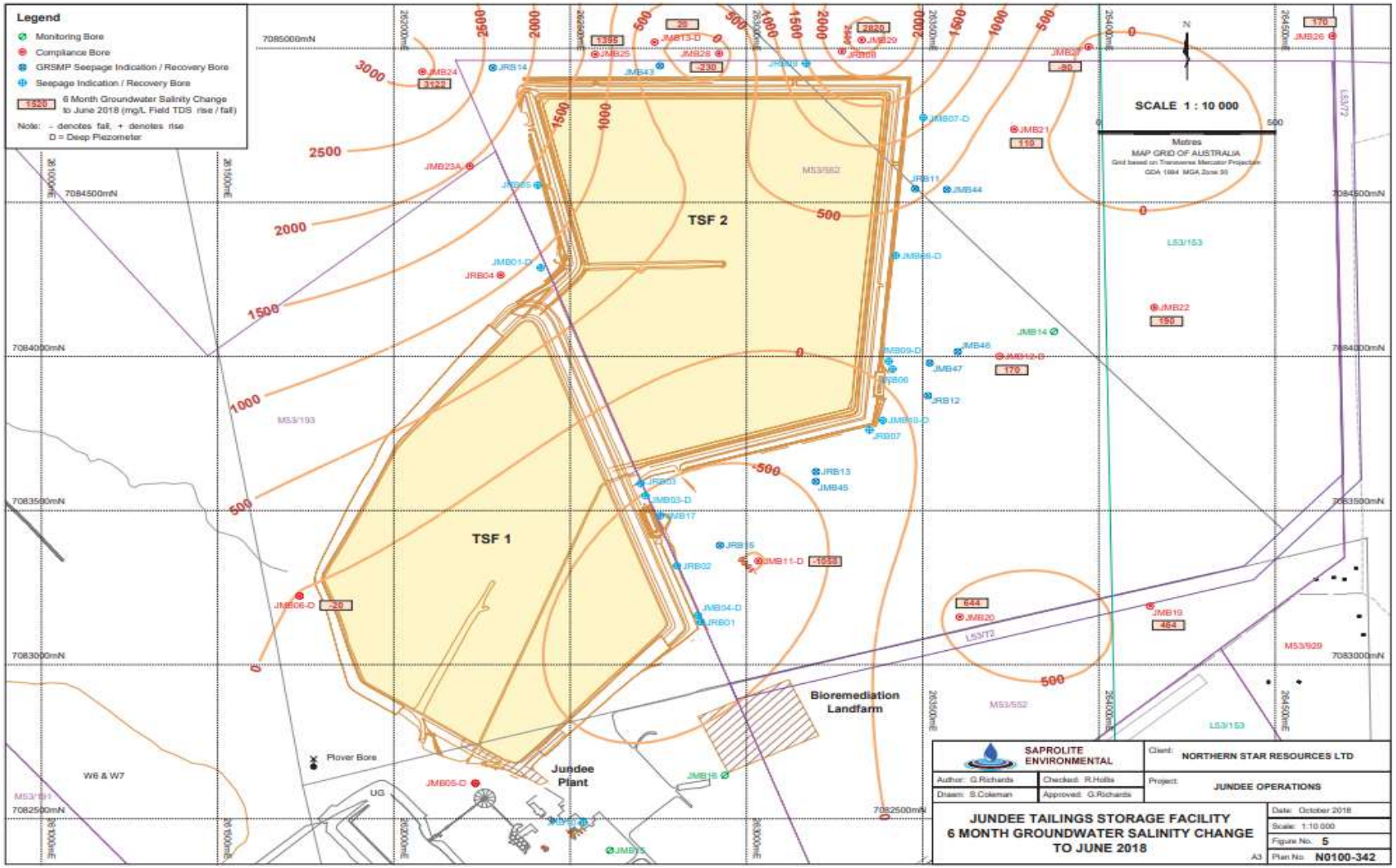


Figure 7: Six month change in groundwater salinity levels to June 2018 (Saprolite 2018)

8. Risk assessment

8.1 Determination of emission, pathway and receptor

In undertaking its risk assessment, DWER will identify all potential emissions pathways and potential receptors to establish whether there is a Risk Event which requires detailed risk assessment.

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. Where there is no actual or likely pathway and/or no receptor, the emission will be screened out and will not be considered as a Risk Event. In addition, where an emission has an actual or likely pathway and a receptor which may be adversely impacted, but that emission is regulated through other mechanisms such as Part IV of the EP Act, that emission will not be risk assessed further and will be screened out through Table 9.

The identification of the sources, pathways and receptors to determine Risk Events are set out in Tables 8 and 9 below.

Table 8. Identification of emissions, pathway and receptors during construction

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		**Potential emissions**	**Potential receptors**	**Potential pathway**	**Potential adverse impacts**		
Construction, mobilisation and positioning of infrastructure	Construction of new buildings, plant and infrastructure	Noise	No residences or other sensitive receptors in proximity	Air / wind dispersion	None	No	No receptor present
		Dust			None	No	No receptor present

Table 9: Identification of emissions, pathway and receptors during operation

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		**Potential emissions**	**Potential receptors**	**Potential pathway**	**Potential adverse impacts**		
Operation of TSF 1 to new height	Tailings pipeline	Rupture of pipeline causing tailings discharge to land	Vegetation adjacent to tailings pipeline alignment	Direct discharge	Soil contamination inhibiting vegetation growth and survival	No	No changes to existing pipeline route and pipelines design and operation is already conditioned adequately in existing Licence L6894/1995/11
	Tailings deposition	Seepage to groundwater	Adjacent native vegetation	Inundation of roots zones with rising saline groundwater	Groundwater mounding	Yes	Tailings seepage containing heavy metals, cyanide and elevated salinity as compared to background levels (background TDS of 1000mg/L to 2000mg/L with seepage being in excess of 3000 -6000 mg/L) resulting in an alteration of groundwater quality. Groundwater mounding due to seepage also has the potential to impact adjacent vegetation through inundation of vegetation root systems.
					Groundwater contamination	Yes	
		Tailings	Adjacent native vegetation Soil/groundwater	Overtopping of facility	Vegetation death due to inundation with tailings Soil/groundwater contamination	No	The basis of the TSF design is unchanged and adequate freeboards are available to ensure capacity for 1 in 100 year, 72 hour rainfall event. Requirement for a minimum freeboard and twice daily inspections of embankment freeboards are conditioned as conditions 1.2.4 and 1.2.5 in Licence L6498/1995/11.
		Tailings supernatant	Wildlife (birds, bats)	Direct ingestion of supernatant	Death or poor health to wildlife ingesting water with high WAD CN concentrations (in excess of 50 mg/L).	No	This is a matter for consideration within the Licence L6498/1995/11. Research has shown that WAD CN above 50 mg/L in solutions that are less than 50 000 mg/L may pose a risk to birds / bats and other wildlife.

8.2 Consequence and likelihood of risk events

A risk rating will be determined for risk events in accordance with the risk rating matrix set out in Table 10 below.

Table 30: Risk rating matrix

Likelihood	Consequence				
	Slight	Minor	Moderate	Major	Severe
Almost certain	Medium	High	High	Extreme	Extreme
Likely	Medium	Medium	High	High	Extreme
Possible	Low	Medium	Medium	High	Extreme
Unlikely	Low	Medium	Medium	Medium	High
Rare	Low	Low	Medium	Medium	High

DWER will undertake an assessment of the consequence and likelihood of the Risk Event in accordance with Table 11 below.

Table 4: Risk criteria table

Likelihood		Consequence		
The following criteria has been used to determine the likelihood of the Risk Event occurring.		**The following criteria has been used to determine the consequences of a Risk Event occurring:**		
			Environment	**Public health* and amenity (such as air and water quality, noise, and odour)**
Almost Certain	The risk event is expected to occur in most circumstances	Severe	• **onsite impacts**: catastrophic • **offsite impacts local scale**: high level or above • **offsite impacts wider scale:** mid-level or above • Mid to long-term or permanent impact to an area of high conservation value or special significance^ • Specific Consequence Criteria (for environment) are significantly exceeded	• Loss of life • **Adverse health effects:** high level or ongoing medical treatment • Specific Consequence Criteria (for public health) are significantly exceeded • **Local scale impacts:** permanent loss of amenity
Likely	The risk event will probably occur in most circumstances	Major	• **onsite impacts**: high level • **offsite impacts local scale**: mid-level • **offsite impacts wider scale**: low level • Short-term impact to an area of high conservation value or special significance^ • Specific Consequence Criteria (for environment) are exceeded	• **Adverse health effects:** mid-level or frequent medical treatment • Specific Consequence Criteria (for public health) are exceeded • **Local scale impacts**: high level impact to amenity
Possible	The risk event could occur at some time	Moderate	• **onsite impacts**: mid-level • **offsite impacts local scale**: low level • **offsite impacts wider scale**: minimal • Specific Consequence Criteria (for environment) are at risk of not being met	• **Adverse health effects:** low level or occasional medical treatment • Specific Consequence Criteria (for public health) are at risk of not being met • **Local scale impacts:** mid-level impact to amenity
Unlikely	The risk event will probably not occur in most circumstances	Minor	• **onsite impacts**: low level • **offsite impacts local scale**: minimal • **offsite impacts wider scale**: not detectable • Specific Consequence Criteria (for environment) likely to be met	• Specific Consequence Criteria (for public health) are likely to be met • **Local scale impacts:** low level impact to amenity
Rare	The risk event may only occur in exceptional circumstances	Slight	• **onsite impact**: minimal • Specific Consequence Criteria (for environment) met	• **Local scale**: minimal to amenity • Specific Consequence Criteria (for public health) met

^ Determination of areas of high conservation value or special significance should be informed by the *Guidance Statement: Environmental Siting.*

* In applying public health criteria, DWER may have regard to the Department of Health's *Health Risk Assessment (Scoping) Guidelines.*

"onsite**"** means within the Prescribed Premises boundary.

8.3 Acceptability and treatment of Risk Event

DWER will determine the acceptability and treatment of Risk Events in accordance with the Risk treatment table 12 below:

Table 5: Risk treatment table

Rating of Risk Event	Acceptability	Treatment
Extreme	Unacceptable.	Risk Event will not be tolerated. DWER may refuse application.
High	May be acceptable. Subject to multiple regulatory controls.	Risk Event may be tolerated and may be subject to multiple regulatory controls. This may include both outcome-based and management conditions.
Medium	Acceptable, generally subject to regulatory controls.	Risk Event is tolerable and is likely to be subject to some regulatory controls. A preference for outcome-based conditions where practical and appropriate will be applied.
Low	Acceptable, generally not controlled.	Risk Event is acceptable and will generally not be subject to regulatory controls.

8.4 Risk Assessment – Adverse Vegetation Impact due to Seepage from TSF1

8.4.1 Adverse Vegetation Impact due to Seepage

Rising groundwater levels due to mounding from tailings seepage may inundate the root zone of adjacent native vegetation, causing death or poor growth.

8.4.2 Identification and general characterisation of emission

Tailings seepage has a TDS (total dissolved solids) concentration of approximately 3 000 – 6 000 mg/L (Saprolite 2018). Background water quality has a TDS of 1 000 – 2000 mg/L.

8.4.3 Description of potential adverse impact from the emission

Rising groundwater levels may inundate the rootzones of adjacent vegetation and result in vegetation deaths or poor growth. As part of the GRSMP, Northern Star assessed the rootzone of the vegetation of the local Acacia species and determined that the roots did not extend beyond 1 mbgl.

8.4.4 Applicant controls

The Applicant has an active Groundwater Recovery Seepage Management Plan (GRSMP) to manage potential impacts to vegetation from rising groundwater levels. Targets for standing water levels in groundwater bores in the vicinity of TSF1 and TSF2 have been set in the GRSMP, with these targets adopted as limits where applicable in the corresponding Licence.

The majority of the rising groundwater issues are situated around TSF2. As TSF1 is immediately adjacent to TSF2, the assumption is that the groundwater impacts are influenced by operations in both TSF1 and TSF2. The groundwater contours, as described in Figure 5 above, show the groundwater flowing from TSF1 to TSF2, possibly contributing to the current

issues with rising groundwater. The Applicant has committed to updating their GRSMP to make the groundwater recovery more efficient. These include modifications to the TSF2 toe drain to improve removal of pooling waters and the upgrading of the groundwater recovery bores to ensure 24 hrs/day pumping, where previously, the majority of bores were solar powered and only pumping 6-8 hrs/day.

An inspection of the two TSF's was conducted by DWER in November 2019. From this inspection, a number of commitments were made by Northern Star to improve seepage collection and recovery from the TSF's. Northern Star replied to the inspection in December 2019 with the following commitments relating to the TSF's and surrounding groundwater:

- Provide an action plan outlining works to improve seepage collection and recovery from the TSF2 toe drain;
- Ensure all recovery bores have sufficient power to operate 24 hours a day/7 days a week;
- Implement a Trigger Action Response Plan (TARP) developed by Coffey Engineering designed specifically of the effective management of the two TSF's. The TARP will contain accepted trigger points associated with decant pond size and piezometer monitoring surrounding the TSF's. The trigger points will be based on key design parameters as per engineering design advice.

8.4.5 Consequence

If adverse impacts to vegetation due to seepage occurs, then the Delegated Officer has determined that the impact will be a mid-level impact to an onsite receptor. Therefore, the consequence is ***moderate***.

8.4.6 Likelihood of Adverse Vegetation Impact due to Seepage Impacts

The Delegated Officer has determined that the likelihood of vegetation impacts occurring will be more likely associated with an increase in deposition to TSF2, given the topography and local groundwater levels. TSF1 contributes to the overall groundwater issue but the majority of the management corrections are associated with the operation of TSF2.

Recent trends over the past two years in groundwater levels to the north and north east of the TSF2 have been rising, apart from the recovery bores. After the inspection of November 2019, groundwater levels have recovered to see all but 1 monitoring bore showing greater than 1 metre separation distance to the surface. It is also noted that the lithology is such that groundwater flow is slow. It is considered that the likelihood of seepage rising such that vegetation will be impacted is ***possible***.

8.4.7 Overall rating of Adverse Vegetation Impact due to Seepage Impacts

The Delegated Officer has compared the consequence and likelihood ratings described above with the risk rating matrix (Table 10) and determined that the overall rating for the risk of vegetation impacts associated with increased seepage from increased tailings deposition is ***medium***.

8.5 Summary of acceptability and treatment of Risk Events

A summary of the risk assessment and the acceptability or unacceptability of the risk events set out above, with the appropriate treatment and control, are set out in Table 13 below. Controls are described further in section 9.

Table 6: Risk assessment summary

	Description of Risk Event			Applicant controls	Risk rating	Acceptability with controls (conditions on instrument)	Resulting Regulatory Controls
	Emission	**Source**	**Pathway/ Receptor (Impact)**				
1.	Tailings seepage	Tailings deposition	Increasing groundwater mounding and increasing salinity of groundwater impacting on vegetation health	Groundwater Seepage Recovery Management Plan using series of seepage recovery bores	Moderate consequence Possible likelihood **Medium Risk**	Acceptable subject to Applicant and regulatory controls	Works Approval • Construction of the embankments for Stage 6 to be in accord with the Scopes of Works, (Coffey 2019). Licence • Existing groundwater monitoring conditions to be retained. • Monthly accounting of water balance over TSF1 and TSF2 to be completed and reported on a quarterly basis to the CEO. • Updated commitments relating to groundwater recovery to be included.

9. Regulatory controls

The risks are set out in the assessment in section 8 and the controls are detailed in this section. DWER will determine controls having regard to the adequacy of controls proposed by the Applicant. The conditions of the Works Approval and Licence will be set to give effect to the determined regulatory controls.

9.1 Works Approval controls

9.1.1 Infrastructure and equipment

The embankment raise will be required to be installed as per the drawings in the Scope of Works for TSF1 (Coffey 2019). Construction compliance documents will be required to be submitted to the CEO within 60 days of completion of construction, demonstrating how the construction works complied with the conditions of the Works Approval.

9.1.2 Monitoring requirements

No monitoring requirements will be specified under the Works Approval.

9.2 Licence controls

9.2.1 Specified actions

Reporting of the monthly water balance for TSF1 will be required to be submitted the CEO on a quarterly basis, detailing the amount of seepage recovered from toe drains. Additionally, the Applicant will be required to report on the total water pumped from all recovery bores and the amount recovered from decant return as percentage of the slurry water discharged.

An improvement condition will be added to the Licence to characterise the risk posed to wildlife by cyanide discharge in tailings supernatant. This condition was originally to be included in the licence after the Stage 5 lift for TSF1 but has yet to be implemented.

9.2.2 Monitoring requirements

Monitoring of groundwater in the vicinity of both TSF's is currently undertaken under existing Licence condition 3.4.1. The existing limits prescribed for standing water levels, total dissolved solids and pH will be maintained.

The groundwater quality parameters for analysis will be revised, with selenium added and other parameters added where necessary. This condition was originally to be included in the licence after the Stage 5 lift for TSF1 but has yet to be implemented.

10. Applicant's comments

The Applicant was provided with the draft Decision Report and draft issued Works Approval on 7/02/2020. The Applicant replied on 10/02/2020 with no comments and waiving the remaining draft period.

11. Conclusion

This assessment of the risks of activities on the Premises has been undertaken with due consideration of a number of factors, including the documents and policies specified in this Decision Report (summarised in Appendix 1).

This assessment was also informed by a site inspection by DWER officers on 22 November 2020.

Based on this assessment, it has been determined that the Works Approval will be granted subject to conditions commensurate with the determined controls and necessary for administration and reporting requirements.

Tim Gentle

Digitally signed by Tim Gentle
Date: 2020.02.11 17:06:04 +08'00'

Tim Gentle
Manager – Resource Industries
Delegated Officer
under section 20 of the *Environmental Protection Act 1986*

Appendix 1: Key documents

	Document title	In text ref	Availability
1.	Licence L6498/195/11 – Northern Star Jundee	L6498/195/11	accessed at www.der.wa.gov.au
2.	Email from Abraham van Niekerk, Northern Star Resources Limited – 10/09/2019 containing attached: • Works Approval Application – Northern Star Resources Limited; • 2019 TSF1 Stage 6 Raise Scope of Works.	Works Approval application	DWER records (DWERDT198751)
3.	JUNDEE GROUNDWATER RECOVERY SEEPAGE MANAGEMENT, Northern Star Resources Limited, 18/05/2017	GRSMP	DWER records (DWERDT238369)
4.	Tailings Storage Facilities 2018 Calendar Year Audit and Review – Coffey Services Australia Pty Ltd, 10 May 2019	TSF Audit	DWER records (DWERDT238371)
5.	Email from Jan De Lange, Department of Mines, Industry Regulation and Safety – 7/01/2020	DMIRS Reply	DWER records (DWERDT243604)
6.	DER, July 2015. *Guidance Statement: Regulatory principles.* Department of Environment Regulation, Perth.	DER 2015a	accessed at www.dwer.wa.gov.au
7.	DER, November 2016. *Guidance Statement: Risk Assessments*. Department of Environment Regulation, Perth.	DER 2016b	
8.	DER, November 2016. *Guidance Statement: Decision Making*. Department of Environment Regulation, Perth.	DER 2016c	

Appendix 2: Summary of applicant's comments on risk assessment and draft conditions

Condition	Summary of Licence Holder comment	DWER response
N/A	No comments	N/A

Attachment 1: Issued Works Approval W6311/2019/1