Government of Western Australia
Department of Water and Environmental Regulation

Decision Report

Application for Works Approval

Division 3, Part V *Environmental Protection Act 1986*

Works Approval Number	W6284/2019/1
Applicant	Robe River Mining Co. Pty Ltd
ACN	008 694 246
File Number	DER2019/000437
Premises	Mesa A/ Warramboo Iron Ore Mine ML248SA L08/177
Date of Report	**8 September 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
ANZECC	Australian and New Zealand Environment and Conservation Council
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
AS 1940- 2004	Australian Standard 1940- 2004. The Storage and Handling of flammable and combustible liquids
ASLP	Australian Standard Leaching Procedure
BWT	Below water table
Category/ Categories/ Cat.	Categories of Prescribed Premises as set out in Schedule 1 of the EP Regulations
CCOPCs	chemical constituents of potential concern
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)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Cth)

GL	gigalitres
hyporheic	Means the region of sediment beneath and adjacent to a stream containing a mixture of local and regional groundwater and stream water
HV	Heavy vehicles
m^3	cubic metres
mbgl	Metres below ground level
Minister	the Minister responsible for the EP Act and associated regulations
MS	Ministerial Statement
mtpa	million tonnes per annum
NEPM	National Environmental Protection Measure
NEPM ASC	*National Environmental Protection (Assessment of Site Contamination) Measure 1999*
Noise Regulations	*Environmental Protection (Noise) Regulations 1997* (WA)
Occupier	has the same meaning given to that term under the EP Act.
OWS	Oily Water Separator
PM	Particulate Matter
PM_{10}	used to describe particulate matter that is smaller than 10 microns (µm) in diameter
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
Revised Licence	the amended Licence issued under Part V, Division 3 of the EP Act following the finalisation of this Review.
Risk Event	As described in *Guidance Statement: Risk Assessment*
TLO	Train load out
TRH	Total Recoverable Hydrocarbons
UDR	*Environmental Protection (Unauthorised Discharges) Regulations 2004* (WA)
$\mu g/m^3$	micrograms per cubic metre
µg/L	micrograms per litre
WFSF	waste fines storage facility

2. Purpose and scope of assessment

Robe River Mining Co. Pty Limited (the Applicant) is proposing to construct and commission iron ore processing facilities, dewatering discharge infrastructure, infrastructure to deposit iron ore tailings (waste fines) into mine out pits, landfill and vehicle refuelling facilities to support the Mesa A/Warramboo Iron Ore Mine.

Ore processing
Existing facilities at Mesa A are proposed to be modified for processing of below water table ore from Warramboo, Mesa B and Mesa C to sustain production at 35 million tonnes per annum (Mtpa). Existing facilities include primary and secondary sizers.

Run of Mine (ROM) ore from Warramboo, Mesa B and Mesa C will be hauled to the existing Mesa A processing facilities and processed through the existing primary and secondary crushing facilities to produce high grade product. The below water table (BWT) ore requires a scrubbing and screening process to break down and remove clay pods (inherent in the deposits) and to achieve the required alumina and silica targets for the Robe Valley product.

The existing train load out (TLO) conveyor will become two separate conveyors with a transfer station added to facilitate tie-in to the new wet processing facilities. Secondary crushed material will be directed to the new wet processing facilities via a surge bin. The surge bin will have a capacity of approximately 600 m^3 (approximately 15 minutes of feed per scrubbing stream) to control and maintain a stable feed to the wet plant during brief upstream surges or interruptions. The surge bin will distribute ore between the two outlet hoppers and discharge via apron feeders onto scrubber feed conveyors. The scrubber feed conveyors will transport the ore to two scrubbing and screening streams. Each stream includes the following:

- A scrubber feed chute;
- A scrubber assembly (sized to process a nominal 1,848 tonnes/hour);
- A double deck banana type scalping screen;
- Two single deck banana type product screens;
- Screen oversize chutes;
- Screen underflow hoppers; and
- Slurry pump and piping systems.

Underflow material from the scalping screen will be pumped to the product screens. From the product screens it will be pumped to a thickener facility. The thickener will recover process water for reuse in the process. A flocculant mixing plant is proposed to add flocculant to the thickener to accelerate the settlement of solids from the process water. The mixing plant will include a flocculant silo (with two months nominal storage capacity), mixing tank, flocculant storage tank and flocculant dosing pumps located in a separate concrete bunded area. Final product will be conveyed and stacked onto the existing TLO stockpiles for loading onto trains and railing to the Cape Lambert process plant for further processing before export.

Mobile crushing and screening plants are also proposed to provide material for use in construction and will be regulated via the existing Part V licence.

WFSF (Dewater discharge and tailings deposition)
Processing below water table ore will create iron ore waste fines (tailings). Fines are to be deposited to new in-pit WFSF; the previously mined Pits 1/2 and Pit 3 of the Warramboo deposit. The storage capacity of Pit 1/2 is approximately 19.2 million tonnes and the capacity of Pit 3 is approximately 13.8 million tonnes. No confining embankments are proposed as the remnant

walls will form the perimeter of the storage areas. No new areas will be disturbed for tailings storage, however new areas will be disturbed for the tailings pipelines, access corridors and other process related infrastructure. The tailings deposition spigot installation and operation will be staged as follows:

- Pit 1/2 deposition point 1, 3 and 4 only;
- Pit 1/2 all deposition points (final number and location to be confirmed based on operation of the earlier stages); and
- Pit 3 all deposition points (final number and location to be confirmed based on operation of the Pit 1/2 deposition points).

Deposition into Pit 1/2 from points 1, 3 and 4 is scheduled to commence in early 2021 (Figure 1). Deposition from these points is expected to provide approximately 4.5 years of storage, which may allow deferral of construction of the additional deposition points.

Tailings will be delivered from the Mesa A wet plant to Pit 1/2 and Pit 3 via a distribution pipeline adjacent to the existing mine access road. The pipeline will be in a fully bunded corridor to the pits and divide into two separate distribution lines (each in a bunded corridor) around the perimeter of Pit 1/2 and Pit 3.

Prior to tailings deposition, Pit 1/2 will be used for Below Water Table (BWT) dewatering storage. Approximately 3 GL of water is expected to be in Pit 1/2 when deposition commences. Pontoon mounted pumps anchored to the remnant wall at the western pit extent will be used to control the water level and remove water to the discharge point.

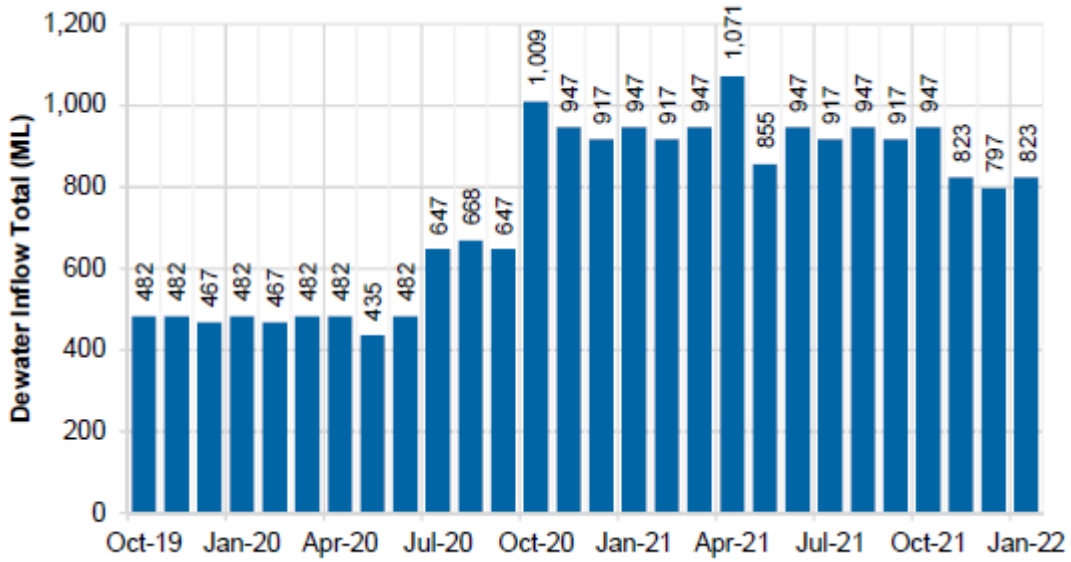


Figure 1: Estimated dewatering discharge inflows to Pit 1/2 prior to tails deposition (GHD 2019)

During tailings deposition, supernatant water will be decanted from Pit 1/2 via pontoon mounted pumps located at the north-western extent of Pit 1/2 and a transfer pipeline. Decant water will be transferred to Pit 3 where it can be water quality tested to ensure that it meets the Applicant's set limits for chloride content in saleable iron ore. If it meets these limits it can be reused in the Processing Plant. If chloride concentrations are an issue for the produce quality, the Applicant will investigate a Reverse Osmosis Plant to be implemented to treat the decant water to the required specification so that it can be reused within the Processing Plant.

Once Pit 1/2 has reached capacity (approximately end of 2026), the waste fines will be deposited into Pit 3. Pit 3 supernatant will be decanted using pumps installed at the northern extent of the Pit 3.

A 0.5m deep 20m wide spillway will be constructed at the north western end of Pit 1/2 (natural low point of the Pit edge). The spillway invert level will be at RL 54.5 m. A perimeter bund will also be constructed around Pit 1/2.

Pit 1/2 supernatant pond
Pit 1/2 supernatant pond modelling conducted by the Applicant shows that supernatant volume will increase due to the transfer of dewatering from Pit 1/2 and the accumulation of rainfall and runoff. Tailings deposition is scheduled to commence in July 2021, and the pond volume will increase as a result. In December 2021, decant removal recommences and this decant is discharged into Pit 3. In early 2022, dewatering flows are expected to cease and the supernatant pond volume is also expected to decrease. From mid-2022, the volume of the pond is expected to be stable, assisted by the incorporation of a minimum threshold depth of 1.5m in the decant pump operations. Tailings deposition is scheduled to cease in mid to late 2026 and the pond volume is expected to decrease as a result.

The maximum pond level for the 90% confidence interval is approximately RL53m. This is expected to maintain a 1.5m freeboard to the emergency spillway level (RL 54.5m). This is expected to accommodate a 1:100 year 72-hour rainfall event. A perimeter flood diversion bund will also be constructed around Pit 1/2. Overspill from the perimeter bund will flow into Pit 4.

Pit 3 supernatant pond
Pit 3 supernatant pond modelling shows that a small increase in volume will occur once tailings deposition commences due to the accumulation of rainfall and runoff. There will also be an increase in volume once decant inflow from Pit 1/2 commences in December 2021. The Pit 3 pond level will reach the maximum level in late 2024. Monitoring of pond performance and water quality will be undertaken during the operation of Pit 1/2 storage to refine the water balance model and to forecast expected volume, level and water quality over time. The monitoring and forecasting will inform the development of a future water management solution outside of Pit 1/2 and Pit 3. The model assumes that 14.8 ML/ day of Pit 1/2 decant water is discharged into Pit 3. The supernatant pond volume decreases after late 2024 and Pit 3 will be almost completely dewatered by the time tailings deposition is scheduled to commence in 2027. It is expected that by almost dewatering Pit 3, the subaerial deposition of tailings should be maximised, increasing tailings consolidation and the stored density. From early 2027, pond levels will increase with tailings deposition. Tailings production is scheduled to cease in 2030 (base case) and 2029 (sensitivity case).

The maximum pond level for the 90% confidence interval is approximately RL 49m, which maintains a 1.5m freeboard to the lowest edge level (RL 50.5m). A freeboard of 1.5m is expected to accommodate a 1:100 year 72- hour rainfall event. A perimeter bund will also be constructed around Pit 3.

Decant water from Pit 1/2 and Pit 3 will be transferred to the existing Turkeys nest via the decant water pipeline.

Dewatering discharge
Initially dewatered water is proposed to be discharged to Pit 1/2 for a period preceding deposition of waste fines to Pit 1/2.

A new discharge point is proposed to be located at Mesa A to discharge up to 7 GL of surplus water to Warramboo Creek annually. Surplus water will be delivered to the creek via a new pipeline at a maximum discharge rate of 290 L/s.

Landfill facilities
Wastes are currently disposed of at the Pannawonica Deepdale landfill, however, this is a 120km round trip so a new waste dump landfill facility is proposed to be located at Mesa A to dispose of approximately 1,000 tonnes of inert and putrescible waste annually. The facility will not accept putrescible waste generated on site, however it will accept wooden packaging and pallets. The facility will be located within an area being progressively backfilled with mineral waste. Waste will be covered as required and to at least 200mm at final landform.

Heavy Vehicle Refuelling Facility
A heavy vehicle refuelling facility (HVRF) is proposed to support the mining fleet. The facility will include the following:

- Road train/ tanker unloading system to supply fuel to the facility;
- Two self bunded 200kL fuel storage tanks;
- Heavy vehicle refuelling bays with a fuel delivery pump, heavy vehicle fuel arm and bunds as per *Australian Standard (AS) 1940- 2004: The storage and handling of flammable and combustible liquids*;
- Spillage drive in collection sump with drying pad; and
- Hydro- cyclone oily water collection and treatment discharging to an evaporation pond.

The HVRF will be located near the ore processing facilities with direct access via the proposed haul road. Additional temporary fuel facilities will be required for construction including 2 110kL fuel storage tanks located in laydown areas adjacent to construction work areas. The total proposed fuel storage capacity is 620kL which is below the Category 73 threshold. The existing fuel storage capacity on the site is 440kL. Once the HVRF is constructed, the cumulative capacity (1060kL) will exceed the Category 73 threshold.

The road tanker unloading pad, heavy vehicle refuelling bays and pump station bunded area will be graded such that water will be directed into a drive in collection sump. A drying pad adjacent to the collection sump will allow contaminated solids removed from the sump to dry prior to disposal. Water from the collection sump will overflow into a sump pit and then be transferred to the hydro-cyclone OWS. The OWS is designed to treat water to achieve an effluent TRH concentration of less than 15 mg/L. A section of the pipeline which transfers oily water from the fuel pumps to the OWS is proposed to be underground. The oily water pipe will be contained in a ‘pipe in pipe’ design with appropriate inspection pits. Treated oily water will be used for dust suppression.

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
Mesa A/ Warramboo Iron Ore Mine Works Approval Application	9/8/2019
Detailed Design Report (Appendix to Warramboo Tailings Storage Supporting Document)	

3. Background

Table 3 lists the prescribed premises categories that have been applied for in this works approval. The existing licence L8234/2008/2 includes Category 12 and Category 54.

Table 3: Prescribed Premises Categories applied for

Classification of Premises	Description	*Approved Premises production or design capacity or throughput*
Category 5	Processing or beneficiation of metallic or non-metallic ore: premises on which — (a) metallic or non-metallic ore is crushed, ground, milled or otherwise processed; or (b) tailings from metallic or non-metallic ore are reprocessed; or (c) tailings or residue from metallic or non-metallic ore are discharged into a containment cell or dam.	35,000,000 tonnes per annual period
Category 6	Mine dewatering: premises on which water is extracted and discharged into the environment to allow mining of ore	7,000,000 tonnes per annual period
Category 64	Class II putrescible landfill site: premises (other than clean fill premises) on which waste of a type permitted for disposal for this category of prescribed premises, in accordance with the Landfill Waste Classification and Waste Definitions 1996 is accepted for burial	1,000 tonnes per annual period
Category 73	Bulk storage of chemicals etc.: premises on which acids, alkalis or chemicals that - a) contain at least one carbon to carbon bond; and b) are liquid at STP (standard temperature and pressure) are stored	620 m^3 in aggregate (below threshold currently)
Category 12[*1]	Screening etc. of material: premises (other than premises within category 5 or 8) on which material extracted from the ground is screened, crushed, ground, milled, sized or separated	10,000,000 tonnes per year
Category 54[*2]	Sewage facility: premises — a) on which sewage is treated (excluding septic tanks); or b) from which treated sewage is discharged onto land or into waters	341 cubic metres per day

*1*2 denote existing L8234/2008/2 categories

4. Overview of Premises

4.1 Operational aspects

The Applicant operates the existing Mesa A/ Warramboo Iron Ore Mine located approximately 43km west of Pannawonica in the Robe Valley on State Agreement Mining Lease ML248SA. The location of the mine is shown in Figure 2. The Mesa A/ Warramboo Mine includes above water table mining from the Mesa A and Warramboo deposits, ore processing in central processing facilities at approximately 35 Mtpa and supporting infrastructure. The prescribed premises boundary is shown in Figure 3.

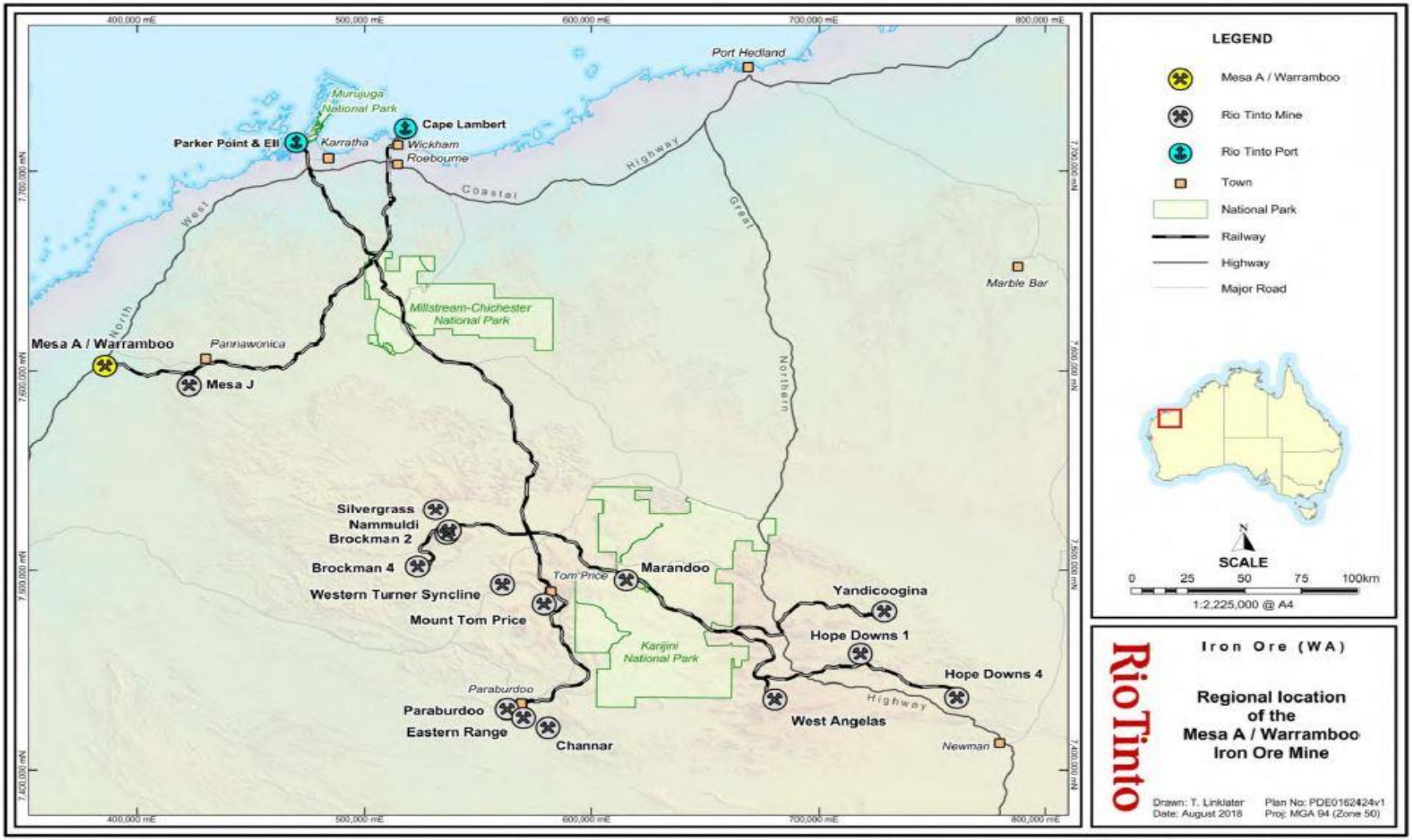


Figure 2: Location of the Mesa A/ Warramboo Mine

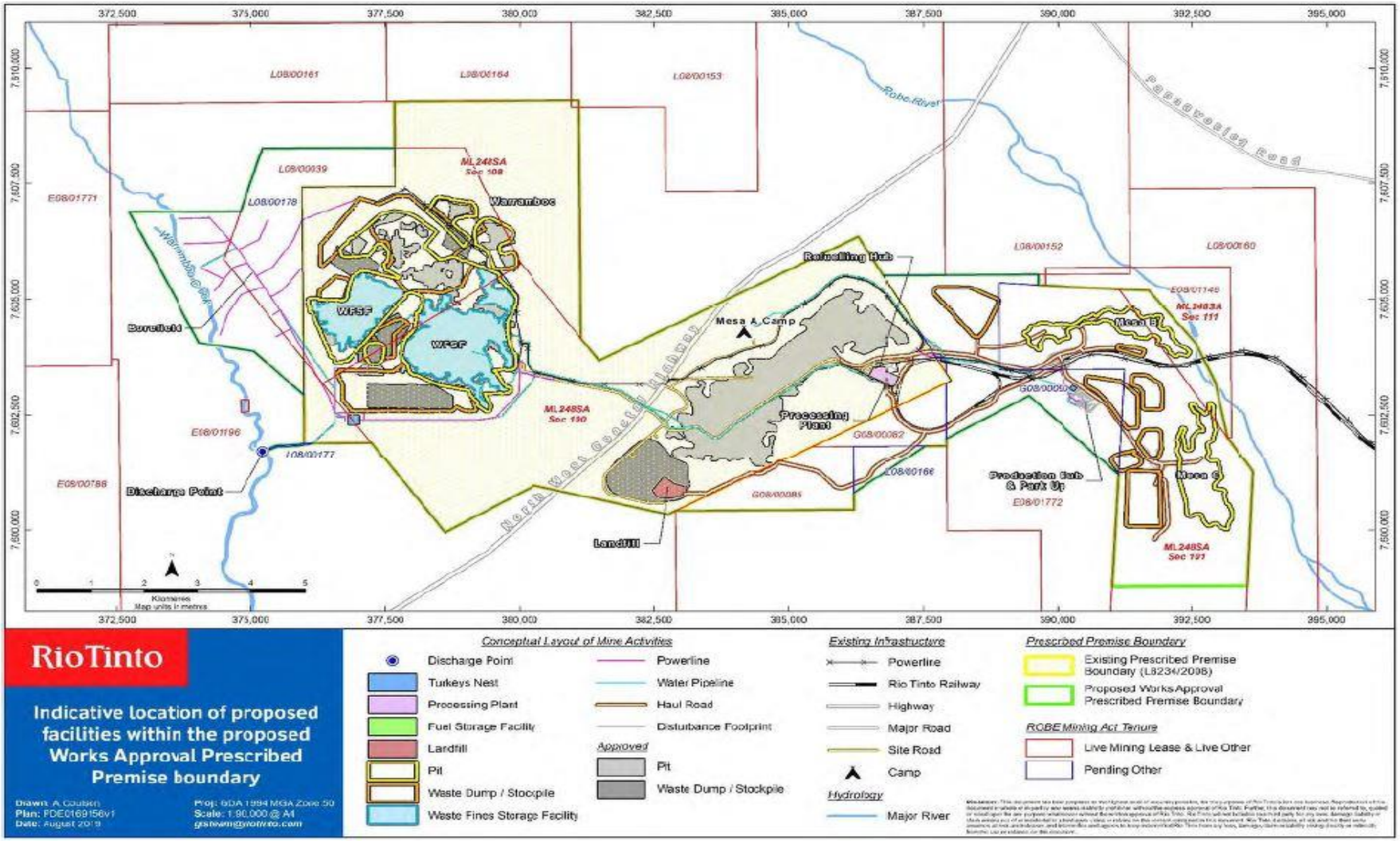


Figure 3: Prescribed Premises Boundary Mesa A/ Warramboo

4.2 Infrastructure

Table 4 lists infrastructure associated with each prescribed premises category.

Table 4: Mesa A/ Warramboo Iron Ore Mine Facility Category 5, 6, 64 and 73 infrastructure

	Infrastructure	Site Plan Reference
	Prescribed Activity Category 5	
Mesa A processing facilities to be modified to allow for below water table processing of ore to sustain production at 35Mtpa. Below water table processing will generate iron ore waste fines that are to be deposited to a new in-pit WFSF (previously mined Pits 1&2 and Pit 3) at Warramboo.		
1	New transfer point to divert ore from the existing TLO feed conveyor	Schedule 1: Maps of the works approval
2	Surge bin to maintain a stable feed to the wet plant during brief upstream surges or interruptions	
3	Wet scrubbing and screening to break down and remove clays	
4	A second new transfer point to return wet material to the TLO feed conveyor	
5	A sample station for monitoring material properties of the product	
6	A waste fines thickener facility to recover waste for reuse in the process	
7	In-pit Pit 1/2 and Pit 3 tailings and decant pipelines	
8	0.5m deep 20m wide in-pit Pit 1/2 Spillway	
9	Perimeter bund Pit 1/2 and Pit 3	
10	Supernatant pond levels managed by transferring excess water by a pontoon-mounted pump system.	
11	In-pit Pit 1/2 and Pit 3 groundwater monitoring bores already installed for monitoring: • MB13WARR003 • MB13WARR012 • MB13WARR013 • MB13WARR016 • MB17WARR0008 • MB19WARR0001	
12	Conveyors for transportation of ore between facilities	
13	Flocculant mixing plant	
	Prescribed Premises Category 6	
Up to 7 GL/a of surplus water extracted from below water table mining will be discharged to Warramboo Creek.		
1	Dewatering discharge point	Schedule 1: Maps of the works approval
2	Flow meter at the discharge point to record the discharge volume	
3	Rip rap apron at the discharge point and rip rap protection within the portion of the creek bed deemed susceptible to erosion	

	Infrastructure	Site Plan Reference
	Prescribed Premises Category 64	
New waste dump landfill facility to dispose of up to 1,000 tonnes of clean fill, Inert Type 1 waste (including conveyor belts, screen mats, concrete rubble and steel products), Inert Type 2 waste (including tyres and plastics) and Putrescible waste (wooden packaging and pallets only).		
1	Waste dump landfill facility	Schedule 1: Maps of the works approval
2	Subsequent landfill facilities	Within Prescribed Premises Boundary
	Prescribed Premises Category 73	
Refuelling Hub to support the mining fleet		
1	Road train / tanker unloading to supply fuel to the HVRF	Schedule 1: Maps of the works approval
2	2 x 200 kL fuel storage tanks	
3	Heavy vehicle refuelling bays with delivery pump and fuel arm to suit the HV fleet and associated bunds as per *Australian Standard 1940-2004 (AS 1940-2004): The storage and handling of flammable and combustible liquids*	
4	Spillage drive-in collection sump with drying pad	
5	Oily water collection and treatment, discharging to an evaporation pond	

The design of the proposed processing facilities proposed for Mesa A (also referred to as the Mesa A Hub) is shown in Figure 4.

the in-pit WFSF (Pit 1/2 and Pit 3), dewatering and discharge point pipelines at Mesa A/Warramboo is depicted in Figure 5.

Dewatering water is proposed to be discharged to Pit 1 / 2 for a period of approximately 18 preceding deposition of waste fines. The supernatant volume/level in Pit 1 / 2 is expected to decrease when discharge of dewatering water from the borefield to Warramboo Creek commences until waste fines deposition occurs (once tailing deposition commences, the proposed discharge to Warramboo Creek will cease). A significant increase in supernatant volume/level is then expected due to waste fines deposition and dewatering discharge into Pit 1 / 2 (as well as the accumulation of rainfall and runoff) until decant commences in December 2021 (discharging into Pit 3), and dewatering inflows cease in early 2022.

Once decant commences and discharge ceases, a significant decrease in supernatant volume/level in Pit 1 / 2 is expected. From mid-2022, a relatively constant supernatant volume/level are expected to be maintained. No decant will go to Warramboo Creek, only dewatering water direct form the borefield.

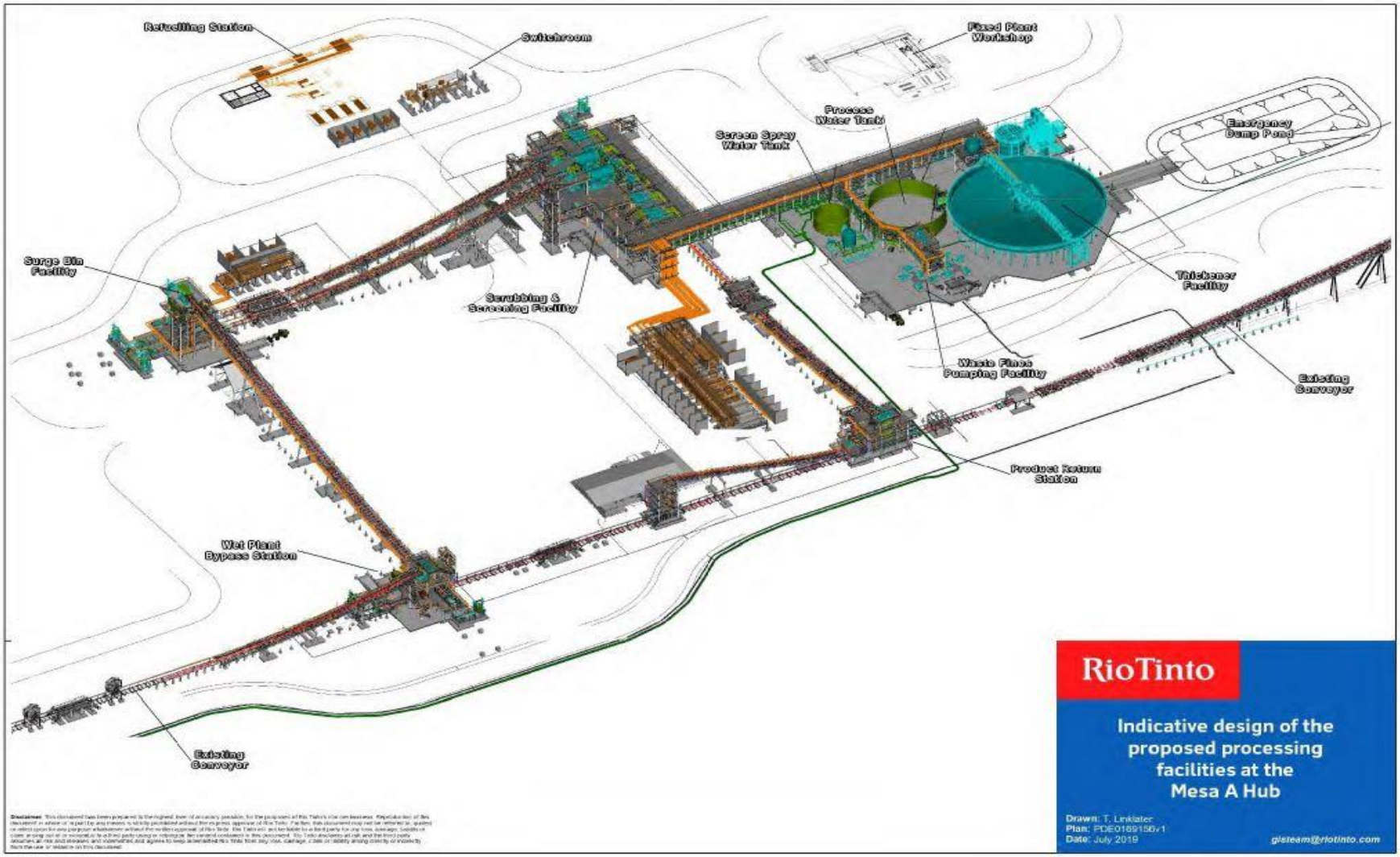


Figure 4: Design of the proposed processing facilities at Mesa A/Warramboo

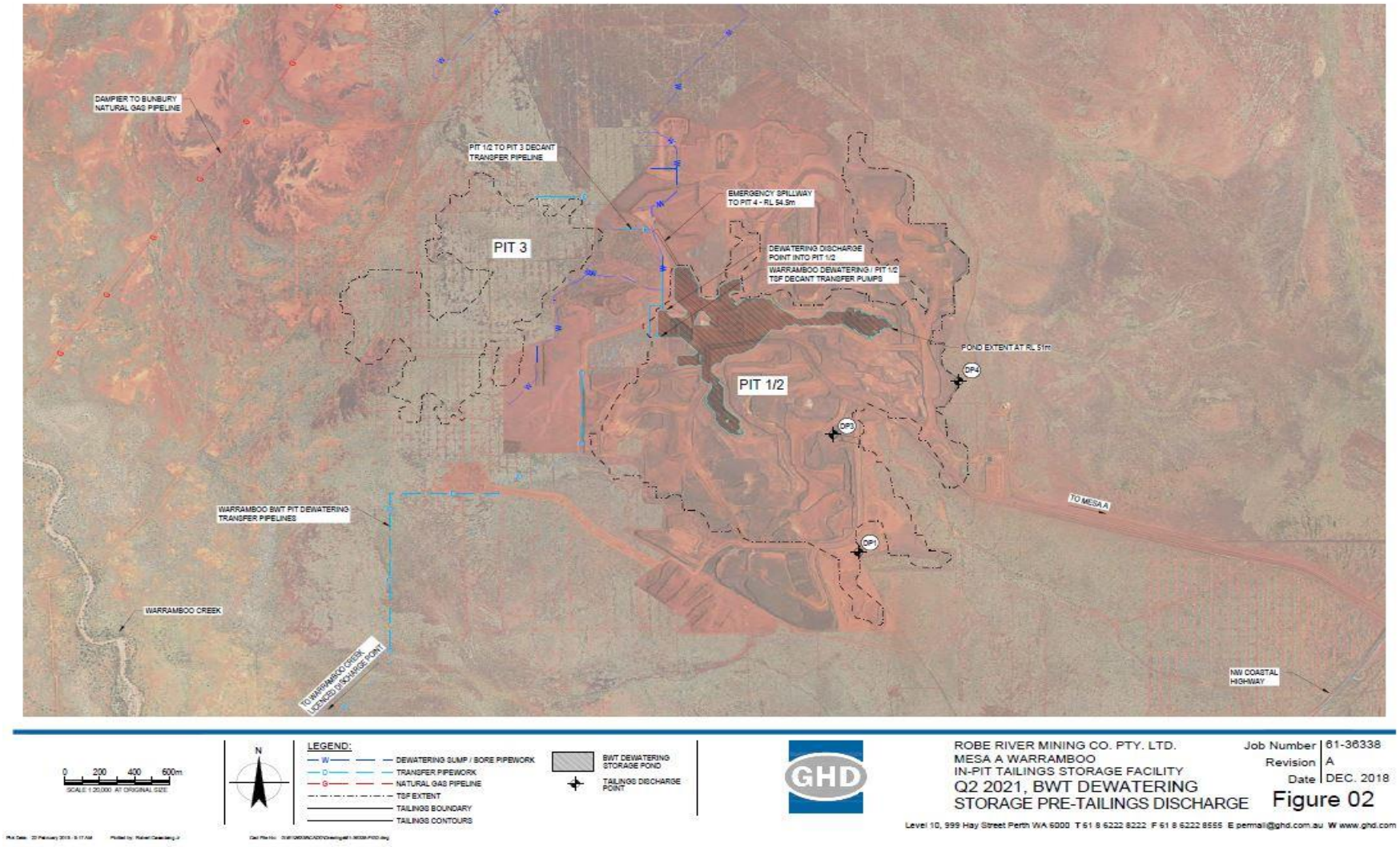


Figure 5: In-pit WFSF (Pit 1/2 and Pit 3), dewatering and discharge point pipelines at Mesa A/Warramboo

4.3 Construction, Commissioning, and time limited operations

Construction is proposed to be in two stages:

- Stage 1 construction will comprise the landfill and dewatering discharge point and is proposed to commence in 2020; and
- Stage 2 construction comprises the ore processing facilities, associated infrastructure for the in- pit WFSF at Warramboo (including pipelines) and the fuel storage and refueling facilities.

Commissioning of the ore processing facilities will be in six stages. Stages 1, 2 and 3 are not expected to result in emissions or discharges. Emissions and discharges are expected during Stages 4, 5 and 6:

- Stage 1 is construction verification which involves verifying the construction has been completed as per the design intent;
- Stage 2 is pre-commissioning which includes functional testing of equipment;
- Stage 3 is no-load commissioning which includes dynamic testing of operating systems without process materials;
- Stage 4 is load commissioning in which the equipment is run with feedstock and incremental load tuning is performed;
- Stage 5 is care custody and control in which operations and maintenance teams rectify any operating issues and aim to achieve stable equipment performance; and
- Stage 6 is performance verification in which the production rate is increased until the design throughput for the equipment is reached.

4.4 Exclusions to the premises

This Part V assessment does not assess the safety risks associated with the operation of the WFSF which are regulated under the *Mines Safety and Inspection Act 1994*.

Mining operations, including waste rock disposal, are not part of the Part V assessment.

Risk events regulated under the Part IV approval (refer section 5.1 following) are not duplicated in this assessment where already conditioned by the Ministerial Statement.

5. Legislative context

Table 5 summarises approvals relevant to the assessment.

Table 5: Relevant approvals and tenure

Legislation	Number	Subsidiary	Approval
EP Act Part IV	Ministerial Statement 1112	Robe River Mining Co. Ltd	Proposal may be implemented
EP Act S51E	Permit to Clear Native Vegetation CPS 6689		Clearing of up to 800 hectares (ha) of native vegetation on ML248SA
Rights in Water and Irrigation Act 1914	GWL 162500		Abstraction of 3.000.000 kL groundwater per annum from the Warramboo borefield for the purposes of conservation, dust suppression, earthworks, construction, exploratory drilling, general campsite use, mineral ore processing, maintenance, potable water and other mining

Legislation	Number	Subsidiary	Approval
	Amendment to GWL162500		purposes Submitted to allow for an increase in abstraction to 15,000,000 kL per annum for mine dewatering and water supply for ore processing Groundwater abstraction volumes will continue to be managed via GWL 162500 and associated Groundwater Operating Strategy and amendments as required
Iron Ore (Robe River) Agreement Act 1964	State Agreement Mineral Lease ML248SA		Location of proposed processing waste fines storage, fuel storage and refuelling and landfill facility subject to the Iron Ore (Robe River) Agreement Act 1964

5.1 Part IV of the EP Act

The Mesa A/Warramboo Iron Ore Mine is subject to Ministerial Statement (MS)1112, published 22 August 2019. The following matters have been assessed and are regulated by conditions in the Ministerial Statement and have not been replicated in the works approval. As such the matters are not considered in this decision report.

MS1112 conditions the requirement for various Management Plans. Where these Management Plans regulate impacts on receptors from activities associated with the Mesa A Project, the receptor has not been considered further in this assessment.

Management Plans and relevant MS 1112 Conditions relevant to this assessment are:

- Mesa A Troglofauna Management Plan;
- Condition 7 Flora and Vegetation – Sand Sheet Vegetation (Robe Valley) PEC;
- Condition 8 Flora and Vegetation – Priority Flora;
- Condition 9 Terrestrial Fauna Habitat – Conservation Significant Fauna species: Ghost Bat and Northern Quoll; and
- Condition11 Inland Waters; maintain groundwater levels to ensure no impact on riparian vegetation of the Robe River as a result of groundwater abstraction and/or dewatering associated with implementation of the proposal.

5.2 Other relevant approvals

5.2.1 Federal Legislation

Environment Protection and Biodiversity Conservation Act 1999 (Cth)

The Applicant's proposal was determined to be a controlled action under the *Environment Protection and Biodiversity Conservation* (EPBC) *Act 1999* in February 2017 as it was considered likely to have a significant impact on Threatened species and communities listed as Matters of National Environmental Significance (MNES). It was assessed under an accredited assessment between the Commonwealth and Western Australian State Governments (Reference Number EPBC 2016/743).

Four species of elevated conservation significance listed under the EPBC Act 1999 were recorded during biological surveys of the proposal area:

1) The Northern Quoll (*Dasyurus hallucatus*)- listed as Endangered; and

2) The Pilbara Leaf- nosed Bat (*Rhinonicterus aurantia*), Ghost Bat (*Macroderma gigas*) and Pilbara Olive Python (*Liasis olivaceus barroni*) - listed as Vulnerable.

5.3 Part V of the EP Act

5.3.1 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: Setting Conditions (October 2015);*
- *Guidance Statement: Environmental Siting (November 2016);*
- *Guidance Statement: Risk Assessments (February 2017);*
- *Guidance Statement: Decision Making (June 2019);* and
- *Guideline: Industry Regulation Guide to Licensing (June 2019)*.

5.3.2 Works approval and licence history

Table 6 summarises the works approval and licence history for the premises.

Table 6: Works approval and licence history

Instrument	Issued	Nature and extent of works approval, licence or amendment
L8234/2008/1	31/07/2008	The Licence was issued for the operation of the wastewater treatment plant (WWTP) for the construction camp
L8388/2009/1	28/01/2010	The Licence was issued for the Mesa A Warramboo Mine Development (Category 5)
L8388/2009/1	09/11/2012	The Licence was revoked and conditions were merged with L8234/2008/1
L8234/2008/1	6/12/2012	The Licence was amended to include the following conditions relating to the operation of the ore processing plant (Category 5): • Inclusion of definitions; • Conditions 1 and 2 for the construction of the crushing and screening plant including the submission of compliance documentation; • Stormwater management condition and total petroleum hydrocarbon discharge of 30mg/L; • Liquid chemical storage conditions; and • Alignment of the Annual Environmental Report and Annual Audit Compliance Report reporting dates.
L8234/2008/2	18/07/2013	The Licence was amended to add Category 54 (WWTP)
W5872/2015/1	17/09/2015	A works approval was issued for the installation of a sequence batch reactor WWTP to replace the plant installed in 2008
L8234/2008/2	25/08/2016	The Licence was amended to authorise the operation of WWTP1, constructed under W5872/2015/1. Minor administrative amendments were made to term definitions and removal of previous conditions relating to targets, stormwater management and liquid chemical storage
W6284/2019/1	8/09/2020	The works approval was issued for the construction, commissioning and time limited operations of iron ore processing facilities (Category 5), dewatering discharge (Category 6), a landfill facility (Category 64) and a heavy vehicle refueling facility (Category 73)

5.3.3 Clearing

An existing Native Vegetation Clearing Permit (CPS 6689) granted by DMIRS under Section 51E of the EP Act allows for the clearing of up to 800 ha on ML248SA. Any clearing that is not considered approved by the Ministerial Statement will be managed using CPS 6689 and subsequent amendments as required.

6. Consultation

Stakeholder consultation is shown in Table 7.

Table 7: Stakeholder consultation

Method	Comments received
Direct interest stakeholders (DMIRS and Shire of Ashburton) notified 21/11/19	No comments were received
Application advertised on DWER website (25/11/2019)	No comments were received

7. Location and siting

The premises is located within the 220,480 ha Yarraloola pastoral station (N049500).

The premises is entirely within the Fortescue Botanical Province of the Eremaean Botanical Province defined by Beard (1975). The vegetation of the Province is typical of arid landscapes dominated by Acacia with occasional Eucalypts over spinifex (*Triodia*) hummock grasslands.

The premises is located within the Hamersley and Roebourne sub- regions of the Pilbara Biogeographic Region (PIL) recognised by the Interim Biogeographic Regionalisation of Australia (IBRA). The premises is characterised by mountainous Proterozoic sedimentary ranges and prominent scarps dissected by a series of gorges with *Eucalyptus leucophloia* over *Triodia* hummock grasses and plateaus with Mulga (*Acacia aneura*) low woodland over bunch grasses.

7.1 Residential Premises

The closest known residential receptors are located in the Pannawonica township, located 38km from the mine site. The township of Pannawonica is not considered a receptor for this assessment, given the large separation distance.

7.2 Groundwater / Surface water

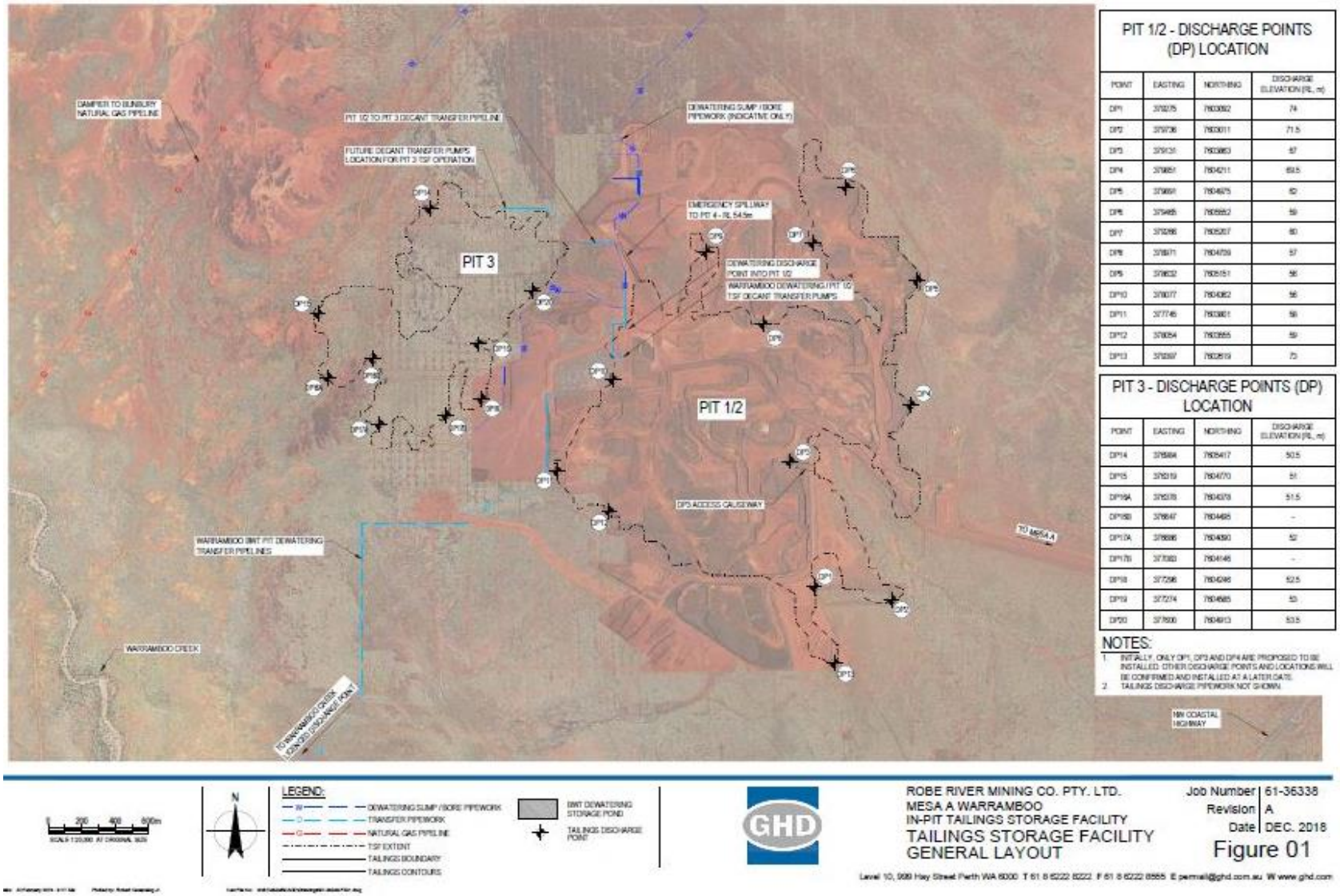
7.2.1 Surface waters

The Mesa A/Warramboo Iron Mine is located on a natural catchment divide between the Robe River catchment (approximately 7,500 square km) and the coastal catchment (approximately 4,557 square km). Significant water courses in the region include the Robe River, Warramboo Creek, Jimmawarruda Creek, Bungaroo Creek and Mungarathoona Creek. Rivers and creeks are ephemeral and surface water flow is typically seasonal depending on significant rainfall events. The Robe River is the most significant system in the region covering a linear distance of 260km. The Robe River catchment generally drains east to west through the high relief areas of the Hamersley Ranges onto the more gently sloping coastal plain before discharging into the Indian Ocean. Surface water flow typically only occurs following significant rainfall events. The Robe River passes adjacent to the east and intersects the eastern boundary of the proposed Prescribed Premises.

The permanency of the Robe River pools is controlled by rainfall events. The alluvial aquifer is recharged by rainfall events resulting in elevated groundwater levels which replenish the pools. During dry periods groundwater within the alluvial aquifer is reduced resulting in shallower pools.

Only groundwater fed pools persist during prolonged dry periods representing the only permanent surface water source in the region.

Warramboo Creek (catchment area approximately 685 square km) drains from its headwaters approximately 50km south of the Warramboo deposit to the north north-west, discharging across the scrubland of the coastal plain (refer to Figure 6). Warramboo Creek intersects the western portion of the proposed Prescribed Premises, passing adjacent to the west of the Warramboo deposit. The proposed discharge point will intersect Warramboo Creek.



PIT 1/2 - DISCHARGE POINTS (DP) LOCATION

POINT	EASTING	NORTHING	DISCHARGE ELEVATION (RL, m)
DP1	378275	7803062	74
DP2	378736	7803011	71.5
DP3	379131	7803063	67
DP4	379657	7804211	69.5
DP5	379691	7804675	62
DP6	379465	7805662	59
DP7	379286	7805207	60
DP8	378871	7804759	57
DP9	378632	7805151	56
DP10	378077	7804062	56
DP11	377745	7803861	56
DP12	378054	7803955	59
DP13	378397	7803519	73

PIT 3 - DISCHARGE POINTS (DP) LOCATION

POINT	EASTING	NORTHING	DISCHARGE ELEVATION (RL, m)
DP14	378884	7805417	50.5
DP15	378519	7804770	51
DP16A	378378	7804378	51.5
DP16B	378647	7804485	-
DP17A	378886	7804580	52
DP17B	377303	7804146	-
DP18	377298	7804246	52.5
DP19	377274	7804585	53
DP20	377600	7804913	53.5

NOTES:
1. INITIALLY, ONLY DP1, DP3 AND DP4 ARE PROPOSED TO BE INSTALLED. OTHER DISCHARGE POINTS AND LOCATIONS WILL BE CONFIRMED AND INSTALLED AT A LATER DATE.
2. TAILINGS DISCHARGE PIPEWORK NOT SHOWN.

Figure 6: Location of proposed Mesa A/Warramboo WFSF (Pits 1 /2 and 3). Warramboo Creek shown bottom left (GHD 2019)

7.2.2 Groundwater

The groundwater resource at the Premises consists of two primary aquifer units; the Channel Iron Deposit aquifer (formed by pisolite infill of the Robe River paleochannel) which overlies the Yarraloola Conglomerate aquifer. These aquifers are overlain by Quaternary alluvium and colluvium and underlain by the basement Ashburton Formation.

Groundwater flow is inferred from east to west with a gradient of 0.01. Recharge to the aquifers is primarily from rainfall and indirectly from stream flow during periods of high flow (GHD 2019)

The distances to groundwater and local water sources are detailed in Table 8.

Table 8: Groundwater and water sources

Groundwater and water sources	Distance from Premises	Environmental value
Pannawonica Water Reserve	Within the premises boundary	Pannawonica town water supply
Robe River	Intersects the eastern boundary of the premises	Flow occurs once a year following significant rainfall events. Permanent pools are maintained in the River upstream of the premises.
Warramboo Creek	Intersects the western portion of the premises	Ephemeral- flows dependent on occurrence of rainfall events
Groundwater	15-20 mbgl typically; 7 mbgl has been recorded on the coastal plain to the north (Warramboo Creek) and 25 mbgl has been recorded to the south	Warramboo groundwater quality is considered fresh to brackish (dependent on location) with: • Neutral pH; • TDS concentration 8-7000 mg/L; • Chloride concentrations ranging from 48- 3170 mg/L; and • Nitrate concentrations ranging from 0.05- 130 mg/L.

7.2.3 Groundwater quality

Baseline groundwater quality data from six bores located close to the proposed Mesa A WFSF area are presented in Table 10.

The bore construction used for the MB13WARR bores has been reviewed by DWER and is considered not ideal for monitoring seepage from a TSF or a similar mine waste retention structure. The slotted intervals in bores MB13WARR03, 12 and 13 are considered too long, which means that it will be difficult to interpret the results from any monitoring undertaken. Slotted intervals of monitoring bores should be no longer than about 6 metres. Rather than constructing long slotted intervals, it is preferable to construct a nest of bores monitoring near the water table, about half way down in the aquifer, and one near the base. The most important monitoring interval is near the water table.

The slotted interval of bore MB13WARR16 is considered too deep below the water table and is unlikely to detect anything meaningful. Also, it appears that MB13WARR013 is within the waste dump footprint.

Table 9: Baseline groundwater quality at Mesa A.

Sample Point	MB13WARR003	MB13WARR012	MB13WARR013	MB13WARR016	MB17WARR0008	WB19WARR0001
Sample Date	7/09/2013	13/12/2015	7/09/2013	1/10/2017	23/09/2017	8/05/2019
Alkalinity **CaCO3 (mg/L)**	300	316	260	344	299	292
EC LAB (uS/cm)	1,900	2,110	880	No data	1,570	3,990
pH (pH Units)	7.6	7.58	7.6	No data	8.18	7.12
TDS (mg/L)	1,100	1,340	530	788	866	2,410
TSS (mg/L)		11		<5	233	< 5
ALUMINIUM (mg/L)	<0.005	<0.01	0.01	<0.005	<0.01	< 0.01
ANTIMONY (mg/L)	<0.001	<0.001	<0.001	No data	<0.001	No data
ARSENIC (mg/L)	<0.001	0.0	0.0	0.0	<0.001	< 0.001
BARIUM (mg/L)	0.02	0.39	0.06	0.32	0.01	0.05
BERYLLIUM (mg/L)	<0.001	<0.001	<0.001	No data	<0.001	< 0.001
BORON (mg/L)	0.6	0.65	0.58	0.92	0.54	1.07
BROMIDE (mg/L)	1.7	1.87	0.53		0.95	No data
CADMIUM (mg/L)	<0.0001	<0.0001	0.0	<0.00005	<0.0001	< 0.0001
CALCIUM (mg/L)	68	82	69	87	67	140
CHLORIDE (mg/L)	400	513	110	264	316	1,020
CHROMIUM (mg/L)	<0.001	<0.001	0.0	0.0	<0.001	0.0
COBALT (mg/L)	0.0	0.02	0.0	0.0	0.0	No data
COPPER (mg/L)	0.0	<0.001	0.01	No data	0.0	0.02
FLUORIDE (mg/L)	No data	0.6	No data	No data	0.6	0.6
IRON (mg/L)	0.06	1.82	0.06	0.19	0.06	0.26
LEAD (mg/L)	<0.001	<0.001	0.0	<0.0001	<0.001	< 0.001
MAGNESIUM (mg/L)	56	70	27	41	54	102
MANGANESE (mg/L)	0.11	1.79	0.04	1.81	0.06	0.04

Sample Point	MB13WARR003	MB13WARR012	MB13WARR013	MB13WARR016	MB17WARR0008	WB19WARR0001
MERCURY (mg/L)	<0.00005	<0.0001	<0.00005	<0.00004	<0.0001	< 0.00004
MOLYBDENUM (mg/L)	<0.001	0.0	0.0	0.0	<0.001	< 0.001
NICKEL (mg/L)	0.0	0.02	0.01	0.0	0.0	0.01
NITRATE (mg/L)	0.69		27	23.4	2.3	13
NITRITE (mg/L)	<0.05	No data	<0.05	No data	No data	
AMMONIA (mg/L)	No data	No data	No data	0.01	No data	0.04
NITRATE N (mg/L)	No data	0.01	No data	5.28	0.52	2.94
NITRITE N (mg/L)	No data	<0.01	No data	0.12	<0.01	0.01
TOTAL PHOSPHORUS (mg/L)	No data	0.02	No data	<0.02	0.04	No data
POTASSIUM (mg/L)	9.9	14	9.3	7	11	9
SELENIUM (mg/L)	<0.002	<0.01	<0.002	0.0	<0.01	< 0.01
SILICON (mg/L)	6.4	14.6	29	7.7	7.34	
SILVER (mg/L)	<0.001	<0.001	<0.001		<0.001	< 0.001
SODIUM (mg/L)	230	294	64	164	164	509
STRONTIUM (mg/L)	0.71	1.14	0.49	0.71	0.64	
SULPHATE (mg/L)	74	68	19	32	75	239
TIN (mg/L)	<0.001	<0.001	<0.001		<0.001	< 0.001
VANADIUM (mg/L)	<0.001	<0.01	0.01	0.0	<0.01	0.11
ZINC (mg/L)	0.03	0.01	0.04	0.02	0.02	

Note: some parameters were not analysed or no data provided.

7.3 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 10 which 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 10: Environmental values

Specified ecosystems	Distance from the Premises
Riparian vegetation of the Robe River and Warramboo Creek- *Eucalyptus camaldulensis* and *Eucalyptus vitrix*	Within the premises boundary (but not expected to occur near the proposed locations of any prescribed activities).
Priority Flora of the Robe Valley Region • *Abutilon* sp. Onslow Priority 1 • *Triodia* sp. Robe River Priority 3 • *Goodenia nuda* Priority 4 • *Rhynchosia bungarensis* Priority 4	
Breakaways and gullies habitat that provides the following: • denning, shelter and foraging habitat for the Northern quoll (*Dasyurus hallucatus*) • nocturnal roosting and foraging habitat for the Pilbara Leaf- nosed Bat (*Rhinonicteris aurantia*) and the Ghost Bat (Macroderma gigas) • breeding, shelter and foraging habitat for the Pilbara Olive Python (*Liasis olivaceus barroni*)- particularly areas close to the semi- permanent and ephemeral pools of the Robe River	
Robe Valley Pisolitic Hills	
Sand Sheet Vegetation (Robe Valley)- Priority 3 PEC	
Robe Valley Mesas	
Subterranean invertebrate community of pisolitic hills in the Pilbara	
Subterranean invertebrate community of mesas in the Robe Valley Region	
Hyporheic invertebrate taxa in Warramboo Creek (recorded upstream of the mine) including: • 3 stygobite species • Anostracan species (*Branchinella* or *Streptocephalus*?) Not conservation significant except for a possible *Branchinella* species.	

7.4 Soil type

Table 11 details soil types and characteristics relevant to the assessment.

Table 11: Soil and sub-soil characteristics

Groundwater and water sources	Environmental Value
Soil type classification	Sandy clay loam to medium clay. Depth is highly variable ranging from <0.1m on the talus slopes of the outcropping mesas to deeper clay soils in the valleys Clay soils are generally lower permeability and naturally susceptible to surface runoff Alluvial sands occur along ephemeral creek lines.
Acid sulfate soil risk	No known risk

8. Tailings characterisation and seepage modelling

8.1 Tailings characterisation

Test work was completed on 23 pilot tailings samples from Mesa B and C in 2018. No data is currently available for Mesa A tailings samples. The results of the test work on the Mesa B and C samples are shown in Table 12 below.

Table 12: Tailings characterisation

Parameter	**Result**
Particle size distribution	32% sand 31% silt 37% clay
Specific gravity solids	3.7
Stored dry density	Subaqueous discharge- 0.82 t/m^3 Upper limit beach drying- 1.9 t/m^3
Hydraulic conductivity	<1 x 10^{-5} m/ day (for >200 kPa effective stress) – 10^{-4} m/ day (for 10 kPa effective stress)
Slurry feed solids concentration	Average 42% (range 33- 45%)
Chemical Parameters	**Result (tailings leachate average)**
pH	7.73
EC (uS/cm)	84
TDS (mg/L)	55
Na (mg/L)	9
K (mg/L)	0.7
Ca (mg/L)	6
Mg (mg/L)	0.8
Cl (mg/L)	10
SO4 (mg/L)	6
As (mg/L)	0.0012
Cd* (mg/L)	0.0001
Cr (mg/L)	0.009
Cu (mg/L)	0.0063
Fe (mg/L)	12.3

Chemical Parameters	Result
Al (mg/L)	12.4
Pb (mg/L)	0.003
Ni (mg/L)	0.005
Zn (mg/L)	0.0299

*detection limit reached on all samples

Stage 1 static AMD tests were conducted on the 23 samples to determine acid neutralising capacity (ANC), net acid producing potential (NAPP) and net acid generation (NAG). The results are shown in Table 13.

Table 13: Stage 1 AMD test results

Parameter	Result
Acid neutralising capacity (ANC)	Low to medium
Net acid producing potential (NAPP)	Non-acid producing
Net acid generation (NAG)	Low risk

The Australian Standard Leaching Procedure (ASLP) was undertaken to assess the potential for the tailings to produce metalliferous or saline drainage. Deionised water was used as the leaching solution to simulate rainfall infiltration. The results were compared with the ANZECC Guidelines for 95% protection of freshwater aquatic ecosystem species. The concentrations of Aluminium (Al), Chromium (Cr), Copper (Cu), Lead (Pb), Nickel (Ni), Silver (Ag) and Zinc (Zn) exceeded the corresponding default guideline values (Table 13). The concentration of Al exceeded the trigger value by two orders of magnitude.

8.2 Seepage modelling

There is a positive hydraulic gradient from Pit 1/2 to Pit 3 and therefore seepage from Pit 1/2 to Pit 3 is expected. The Pit 1/2 floor level is entirely above the groundwater level and the Pit 3 floor is partly above and partly below the groundwater level. The difference in pit levels indicates that seepage from Pit 1/2 to Pit 3 is likely through the pit walls and/ or through the pit foundation.

2D seepage modelling was conducted under five stages using the RocScience Slide 7.0 design package. The 5 stages are as follows:

1. Initial filling;
2. Pit 3 is mined and dewatered to the basement level. The water level of Pit 1/2 is assumed to be at the floor level (e.g. tailings deposition commenced);
3. Pit 1/2 - approximately 2m deep supernatant pond, Pit 3 dewatering ceased and the pit (15m below ground) is filled with water to ground level;
4. Pit 1/2 is reaching/ has reached full capacity of tailings and the decant level is approximately 5m below the pit edge. Pit 3 is as per the previous stage;
5. Pit 1/2 is as per the previous stage, Pit 3 is receiving tailings and the decant pond level is raised to 5m below the average pit floor level; and
6. Pit 1/2 is as above. Pit 3 has reached full tailings capacity. The decant pond level is 0.5m below the pit edge (maximum level).

The results of the seepage modelling are shown in Table 14.

Table 14: Seepage modelling results

Seepage stage	Water level in Pit 1/2	Water level in Pit 3	Seepage rate from Pit 1/2 to Pit 3 (m^3/ day)	Groundwater inflow to Pit 3 (m^3/ day)	Total seepage rate to Pit 3 (m^3/ day)
1	RL 44m	Fully dewatered	3,333	1,023	4,356
2	RL 46m	Dewatering ceased- RL 35m	4,976	0	4.976
3	RL 50.5m	As above	8,112	0	8,112
4	As above	RL 45m	3,029	-1,820	1,299
5	As above	RL 50m	291	-2,913	-2,622

8.3 DWER technical review

Given that Pit 3 has been mined below the water table, tailings deposition into this Pit and decant flow from Pit 1/ 2 (as identified above) may come into contact with groundwater under anoxic conditions, particularly towards the end of mine life, dependent on local groundwater abstraction rates.

The applicant has also requested the option of depositing mine dewater (surplus water) from Warramboo groundwater abstraction to Pit 1/ 2. This option, combined with the lack of decant return from the Warramboo WFSF (Pits 1/2 and Pit 3) is likely to result in the tailings being stored under saturated conditions, analogous to being stored in anoxic conditions.

Previous geochemical leach testing of iron ore mine waste under anoxic conditions indicates that there is potential for leaching of soluble arsenic and manganese due to the changed iron oxy-hydroxide conditions (Watson, *et al* 2016). The ASLP testing on Mesa B and Mesa C waste samples (referred to in section 8.1 above) were conducted under oxidative conditions and do not address the geochemical environment that storage of Mesa A tailings with no decant return and dewater storage, is likely to encounter.

9. Risk assessment

9.1 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 18.

The identification of the sources, pathways and receptors to determine Risk Events are set out in

Table 15 and Table 16 below.

Table 15: 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, earthworks and infrastructure Vehicle movements on unsealed access roads	Dust	A public road passes through the premises	Air / wind dispersion	Health/amenity	No	Large distance to sensitive receptors. Short term construction period of approximately 18 months. Applicant has committed to the following measures: • Clearing will be managed to ensure that areas are only cleared as required; • Areas cleared only as required to reduce open areas; • Rehabilitation to occur as construction completed; • Water trucks, control of vehicle movements / restricted speeds; and • Vegetation condition monitoring and dust monitoring (Sand Sheet Vegetation Community) as per MS 1112.
			Vegetation onsite Sand Sheet Vegetation (Robe Valley) Priority Ecological Community	Air / wind dispersion	Deposition on vegetation affecting photosynthesis Increased sedimentation in stormwater	No	

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		**Potential emissions**	**Potential receptors**	**Potential pathway**	**Potential adverse impacts**		
		Hydrocarbons from fuel storage and refuelling spillage	Nearby creeks, tributaries, vegetation and soils and groundwater	Direct discharge and infiltration	Soil and groundwater contamination and decline in vegetation health	No	Applicant has committed to the following measures: • Hydrocarbon facilities designed in accordance with *Australian Standard 1940- 2004: Storage and handling of flammable and combustible liquids;* • Refuelling to occur on a concrete hardstand or compacted lined earth pad. A drop tray will be used for in- field refuelling; • Fuel storage tanks will be above ground and self-bunded; • Secondary containment will be installed to ensure any spills are contained; and • Spill kits will be provided.

Table 16: Identification of emissions, pathway and receptors during commissioning and operation

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		**Potential emissions**	**Potential receptors**	**Potential pathway**	**Potential adverse impacts**		
Ore Processing and tailings discharge	Operation of new transfer point, surge bin, wet scrubbing and screening, second new transfer point, sample station, waste fines thickening facility and conveyors	Dust	Public road passes through the premises.	Air dispersion	Health/amenity	No	Large distance to sensitive receptors. Applicant has committed to the following measures: • Surge bins equipped with an insertable type dust collector at the top of the bin structure; and • Load points from the surge bin onto each conveyor include skirts and covers to reduce spillage and dust suppression sprays. These have been included in the Design and construction / installation requirements of the works approval.

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		
							Robe Valley Mine Operations Dust Management Plan current. TSFs are approximately 4.5 km from highway and tailings will have a high moisture content.
			Vegetation communities of elevated conservation significance located within and adjacent to the Premises. **The Sand Sheet Vegetation** (Robe Valley) PEC is located within the Premises, 200 m from the processing facilities.	Air dispersion	Decline in vegetation health	No	The modifications to the processing infrastructure will include: • New transfer point to divert ore from the existing TLO feed conveyor; • Surge bin to maintain a stable feed to the wet plant during brief upstream surges or interruptions; • Wet scrubbing and screening to break down and remove clays; • A second new transfer point to return wet material to the TLO feed conveyor; • A sample station for monitoring material properties of the product; and • A waste fines thickener facility to recover waste for reuse in the process. As the additional ore to be processed is below water table, the ore should be wet so significant dust emissions are not expected. Ministerial Statement 1112, condition 7 requires no direct impact to the **Sand Sheet Vegetation** (Robe Valley)
		Contaminated or sediment laden stormwater	Soils, groundwater, vegetation	Direct discharge and infiltration	Deterioration of surface water quality in tributaries, creeks, Robe River Riparian vegetation of the Robe River is more than 4.8km	No	The depth to groundwater is more than 10mbgl. Applicant has committed to the following measures: • Rainfall run-off from the processing facility is directed into an area that is bounded by access roads. Any sedimentation is then retained in this area. • Diversion bunds and drains in place to direct surface water flows around the facilities:

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		
					away from the processing facilities.		• Drainage from the concrete hardstand will be retained on site and directed to sedimentation ponds/silt traps; • All washdown from the Processing Plant (which includes potentially contaminated water) will be captured and directed to drive in sumps. Water will be recovered and reused in processing; • Sediment in the washdown water will be contained and collected from sumps and placed onto adjacent impermeable drying pads before being appropriate disposal; • An emergency dump pond has been included in the design, to capture thickener discharge in an emergency discharge if required. The emergency dump pond capacity is 5.9 ML, equivalent to 70% of the thickener capacity allowing for 0.5 m freeboard. These controls will be included in the design and construction requirements of the works approval.
		Hydrocarbon spills	Soils, vegetation and groundwater	Direct discharge	Soil and groundwater contamination, vegetation health decline	No	The Applicant proposes the following controls: • Hydrocarbon facilities designed in accordance with *Australian Standard 1940- 2004: Storage and handling of flammable and combustible liquids;* • Concrete hardstand where there is potential for hydrocarbon contaminated surface water; • Refuelling to occur on a hardstand with a drip tray used for in-field refuelling; • Spill kits provided; and • Potentially contaminated water will be collected and directed to the oily water collection and treatment system. Depth to groundwater is >10m and riparian vegetation of the Robe River is more than 4.8km away.
	Leaks from the discharge of waste fines (**tailings**) to	Leaks and spills of the pipeline carrying tailings	Soils, vegetation, groundwater	Direct discharge	Contamination of soils and groundwater and	Yes	See Section 9.4

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		
	in-pit Pit 1/2 and Pit 3 Discharge of waste fines Pit 1/2 decant water to Pit 3	(waste fines) from the Mesa A processing plant to the Warramboo Pit 1/2 and Pit 3. Tailings containing flocculant, elevated chemicals, chloride and TDS.			decline in vegetation		
		Leaks and spills of the pipeline carrying decanted waste from the Pit 1/2 and Pit 3 for storage	Soils, vegetation, groundwater	Direct discharge	Contamination of soils and groundwater and decline in vegetation	Yes	
		Overtopping of tailings from Pit 1/2 (spillway to pit 4)	Soils, vegetation, groundwater Warramboo Creek	Direct discharge	Surface and groundwater contamination and decline in vegetation	Yes	See Section 9.6
		Seepage of tailings through the Pit 1/2 and Pit 3 containing elevated metal(loids) concentrations, elevated nitrate and chloride concentrations, and flocculant residue	Groundwater	Seepage	Alteration of current good quality ground water	Yes	See section 9.7
			Hyporheic fauna and	Infiltration through creek with discharge	Changes to fauna in creek bed	No	EPA Report 1640 assessed hyporheic fauna upstream of Warramboo and in the vicinity. It was determined that there were no species to be impacted that were not present elsewhere as a result of creek discharge. Hence some impact would be expected and will occur downstream of Warramboo.

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		
		Dust lift off	Sand Sheet Vegetation (Robe Valley) Priority Ecological Community	Air/ windborne dispersion	Decline in vegetation health	No	The WFSF will be accepting both mine dewatering water and waste fines so unlikely to generate dust emissions. Ministerial Statement 1112, condition 7 requires no direct impact to the Sand Sheet Vegetation (Robe Valley) Priority Ecological Community as a result of implementation of the proposal, other than existing and authorised disturbance and shall minimise indirect impacts due to the proposal as far as practicable to the Sand Sheet Vegetation (Robe Valley) Priority Ecological Community so that the biological diversity and ecological integrity of the Priority Ecological Community are maintained.
	Below water table dewater (from bores and in-pit sumps) discharged to **WFSF Pit 1/2** for approx.15 months (before tailings deposition) and tailings decant.	Water affected with elevated metal(loids) concentrations, elevated nitrates (from blasting)	Groundwater quality	Seepage from pits to groundwater.	Alteration of groundwater quality Release of metalloids	Yes	See Section 9.5
			Deep rooted vegetation	Seepage	Impacts to deep rooted vegetation on the premises	No	No irreversible damage to riparian vegetation in Warramboo Creek as a result of dewatering, abstraction and surplus water discharge is regulated via MS 112 Condition 11 Inland Waters.
	Transfer of mine dewatering water to WFSF and Warramboo Creek	Pipeline ruptures resulting in discharge of brackish water with trace soluble metal(loid)s; potentially elevated nitrates concentration.	Onsite vegetation, erosion, seepage and impact on vegetation	Direct discharge and/ or seepage	Deterioration in soils and inundation of vegetation	No	No irreversible damage to riparian vegetation in Warramboo Creek as a result of dewatering, abstraction and surplus water discharge is regulated via MS 112 Condition 11 Inland Waters. Windrows will be designed and for the majority of the proposed pipeline routes, a windrow will only be constructed on one side of the pipeline. The pipelines will run alongside access roads.

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		**Potential emissions**	**Potential receptors**	**Potential pathway**	**Potential adverse impacts**		
Dewatering discharge (Category 6)	Direct Discharge of dewatering water from bores and in-pit sumps to **Warramboo Creek** (for approx. 12 months). Will occur while dewater discharge to WFSF Pit 1 /2 is also occurring. *Once deposition of waste fines commences into WFSF Pit 1/2 the discharge to Warramboo Creek will cease.*	Poor water quality Raw pit water from operational pit (with no tailings decant) slightly brackish mine dewatering water elevated with nitrates, metal(loids), into Warramboo Creek	Warramboo Creek water quality, creek bed, seepage to aquifer	Direct discharge	Alteration of creek water chemistry	Yes	See Section 9.8 While the discharge to Waramboo Creek has been endorsed by Part IV, category 6 *Mine Dewatering* is regulated by Part V. Part V will require the volume and monitoring of water quality parameters in the works approval future licence to ensure discharge water is adequately managed. .
Landfill facilities	Operation of the landfill facilities	Dust	The township of Pannawonica is approximately 38km east	Air/ wind dispersion	Health and amenity	No	Large distance to sensitive receptors. Applicant has committed to the following measures: • Areas cleared only as required to reduce open areas; • Weather forecasts will be monitored, with activities that have the potential to generate high dust levels restricted if adverse weather; • Waste covered so waste is not left exposed; and • Regular inspections. These have been included in the in the Design and construction / installation and time limited operational requirements of the works approval.
			Conservation significance vegetation including priority ecological community (PEC)	Air/ wind dispersion	Decline in vegetation health	No	
		Odour	The township of Pannawonica is approximately	Air/ wind dispersion	Health and amenity	No	Large distance to sensitive receptors. Applicant has committed to the following measures:

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		
			38km east				• Maximum of 1,000 tonnes per annual period deposited; • Accept approved types of waste (putrescible wastes in waste dump landfills will be wooden only (not odorous); • Signage; • Waste covered so that no waste is left exposed; and • Regular inspections. These have been included in the in the Design and construction / installation and operational requirements of the works approval.
		Windblown wastes	Native fauna - Foraging animals/ pests	Air dispersion	Increase in feral fauna attracted to putrescible waste	No	Applicant has committed to the following measures: • Collection areas to be in place to facilitate waste management; • Recycling in place; • Non-recyclable materials will be disposed of at the landfills; • Maximum of 1,000 tonnes per annual period deposited; • Only accept approved types of waste; • to be fenced to an appropriate height, gated and locked to contain windblown waste and exclude scavenging animals; • Fencing surrounding the perimeter of putrescible landfill facilities will be regularly inspected for damage and cleared of waste; • Signage that clearly defines what waste is accepted; and • Waste covered so that no waste is left exposed. These have been included in the Design and construction / installation and time limited operational requirements of the works approval.

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		
		Seepage of landfills leachate	Soils, groundwater, vegetation (riparian vegetation of Warramboo Creek- more than 7.1km from the landfill facility)	Infiltration through soil to groundwater Uptake via roots	Soil contamination (nutrients, heavy metals) Deterioration of groundwater quality Decline in the health of groundwater dependent vegetation	No	Soils are sandy clay loam to medium clay and lower permeability and depth to groundwater is 15 – 20 mbgl so migration of landfill leachate to groundwater is not expected. Landfills are also no accepting highly contaminated wastes and are generally small in waste quantities. Applicant has committed to the following measures: • The facilities will only accept approved waste types; • The facilities will be located more than 100m from a permanent or perennial watercourse; • The height difference between the waste and the highest seasonal and expected post mining ground water level is at least 3m; • Bunding will divert water away from landfill facility; and • A sump will collect any surface water that has come into contact with waste. These have been included in the in the Design and construction / installation and time limited operational requirements of the works approval.
HVRF	Operation of facility Vehicle refuelling	Hydrocarbon spills Leaks from hoses/ pipelines	Soil	Infiltration through soil to groundwater Potentially contaminated stormwater if not contained	Groundwater contamination	No	The Applicant has the following measures in place to manage the HVRF: • The distance to groundwater will be >10m and the distance to surface water will be >2km; • Fuel storage tanks will be designed and constructed to *AS 1940-2004: The storage and handling of flammable and combustible liquids*; • Fuel storage tanks above ground and self bunded; • Concrete hardstand will be installed under hydrocarbon storage and refuelling facilities where there is potential for hydrocarbon spills; • Bunding / secondary containment will be installed at all hydrocarbon storage facilities to ensure any spills are contained;

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		
							• Vehicle refuelling to occur over concrete hardstand; • Concrete collection slabs to be installed under all areas at the refuelling facilities where there is the potential for hydrocarbons to be spilled; • Potentially contaminated surface water to be collected in sumps and directed to the OWS and TRH concentrations of <15mg/L to be achieved for dust suppression; and • Spill response equipment available. These infrastructure design requirements and standard time limited operational requirements will be conditioned on the works approval.

9.2 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 17 below.

Table 17: 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 18 below.

Table 18: 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.

9.3 Acceptability and treatment of Risk Event

DWER will determine the acceptability and treatment of Risk Events in accordance with the Risk treatment Table 19 below:

Table 19: 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.

9.4 Risk Assessment – Leaks and spills from the tailings and decant water pipelines

9.4.1 Description of pipelines leaks and spills

An unexpected spillage or discharge may result from a leak or burst in pipeline that transfers the tailings from the processing plant to Pit 1/2 and/or Pit 3, or in the pipeline that transfers decant water from the Pit 1/2 and/or Pit 3 for storage.

9.4.2 Identification and general characterisation of emission

Waste fines have elevated concentrations of metal(loid)s in solution. Decant water from waste fines also has elevated concentrations of metal(loid)s. Refer to section 8.17.3 for tailings characterisation.

9.4.3 Description of potential adverse impact from the emission

A spill of waste fines or decant water from a pipeline failure may result in damage to vegetation and contamination of soils and potentially groundwater depending on the location of the failure.

9.4.4 Criteria for assessment

Ecological investigation levels in NEPM ASC 1999.

9.4.5 Applicant controls

This assessment has reviewed the controls set out in Table 20 below.

Table 20: Applicant's proposed controls for leaks and spills from the tailings and decant water pipelines

Site infrastructure	Description	Operation details
In-pit Pit 1/2 and Pit 3 waste fines and decant pipelines	• Windrows included in design and, for the majority of the proposed pipeline routes, a windrow will only be constructed on one side of the pipeline. The pipelines will run alongside access roads; • Tailings will be delivered from the Mesa A wet plant to the Warramboo pits via a distribution pipeline located adjacent to the existing mine access road. The pipeline will be in a fully bunded corridor to the Warramboo pit area; • The location of this pipeline is within the disturbed operational area of the Mesa A/Warramboo pit area; • Pipeline to be in a fully bunded corridor to contain spills; • Pressure/flow gauges will be included to identify a pipeline burst; • Low points in the pipeline will include scour valves and containment sumps to drain the pipe if required; • Drains will be located at low points across the operations (approximately every 1 km); • Scour valves and sumps will be installed at low points within the bunded corridor to allow for draining of the pipeline prior to inspection. • Scour pit storage will be enough to drain the line at that specific portion with some small excess capacity. • Pits sized for 15 minutes of the design flow (515m^3) with some additional storage capacity; and • Flowmeters will be installed at the discharge point of the wet plant pumps and the booster station pumps (providing methods for leak detection). The line will be fitted with pressure transmitters at both pump stations and at the burst disc locations which will provide feedback for any discharge irregularities. Pumps will be interlocked with these instruments. Bolted connections will be included in the pipeline to allow for disconnection and internal inspection.	• Maintenance and inspection program for both pipelines to ensure they are in good condition and to provide early warning of need for replacement; and • Pipelines to be inspected daily with detailed inspections occurring once per week.

9.4.6 Consequence

If leaks and spills from the tailings and decant water pipelines occurs, then the Delegated Officer has determined that the impact of contamination of soils and/or impacts to vegetation will have low level on-site impacts, minimal off-site impacts local scale. Therefore, the Delegated Officer considers the consequence of pipelines leaks and spills to be **minor**.

9.4.7 Likelihood of Risk Event

The Delegated Officer has determined that the likelihood of leaks and spills from the tailings and decant water pipelines being released to vegetation and soils will probably not occur in most circumstances. Therefore, the Delegated Officer considers the likelihood of leaks and spills from pipelines impacting on vegetation and soils to be **unlikely**.

9.4.8 Overall rating of leaks and spills from pipelines

The Delegated Officer has compared the consequence and likelihood ratings described above with the risk rating matrix Table 17 and determined that the overall rating for the risk of and leaks and spills from pipelines is **medium**.

9.5 Risk Assessment – Seepage from the discharge of mine dewater (from bores and in-pit sumps) and tailings decant to WFSF

9.5.1 Description of discharge of mine dewater to WFSF

Surplus mine dewater is planned to be discharged to Pit 1/ 2 for a period of 15 months prior to tailings (waste fines) deposition. Subsequently, decant water from tailings deposition at Pit 1/2 is planned to be discharged to the adjacent Pit 3 to ensure adequate freeboard is maintained in Pit 1/ 2. Decant water from tailings in the pits is not to be discharged directly to Warramboo Creek.

9.5.2 Identification and general characterisation of emission

Baseline groundwater quality in the vicinity of the Mesa A WFSF is summarised in Table 9. It is of brackish salinity, with trace soluble metal(loid)s. It is likely the mine dewater will contain elevated nitrates from explosives residue.

Tailings decant will be of brackish salinity with likely elevated arsenic, antimony and manganese concentrations in solution. The decant will also have potentially elevated nitrates due to explosives residue from blasted ore migrating into waste fines. Taking mine dewater from a reducing environment (below water table) and mixing with a mined-out pit (oxidative environment) may result in some metal(loid)s also being mobilised. Tailings decant may also contain flocculant.

Mine dewater accumulated in Pit 1/2 will mix with waste fines when deposition starts. This combination is likely to create anoxic conditions for tailings (waste fines) storage, creating an environment favourable for arsenic and manganese leaching.

9.5.3 Description of potential adverse impact from the emission Risk Assessment – Dewater discharge to WFSF Pit 1/2 and Decant to Pit 3

Given the permeability of the open pits at the WFSF (hydraulic conductivities of 10^{-5} m/s) and the expectation that seepage (drainage) from Pit 1/2 will migrate to daylight in Pit 3 it is also possible that mine dewater and decant may seep to groundwater.

9.5.4 Applicant controls

The Applicant has committed to refining the water balance over the WFSF, investigating the potential for decant recovery (and treatment) back to the Mesa A wet plant for re-use, and groundwater monitoring.

9.5.5 Consequence

The consequence of mine dewater and tailings decant impacting on receptors is a mid level impact to an onsite receptor, therefore **moderate.**

9.5.6 Likelihood

Given the likely though not validated groundwater pathways at the WFSF, and considering the complexity of determining at which point the WFSF will cease to act as a groundwater sink due to tailings deposition/ changing local groundwater abstraction rates, means this likelihood is a preliminary rating; and is considered **possible**.

9.5.7 Overall rating

The overall rating for impacts to receptors from mine dewater and decant discharge seepage to the WFSF is **medium.**

9.6 Risk Assessment – Overtopping of tailings from Pit 1/2 spillway

9.6.1 Description of overtopping of WFSF

Overtopping occurs when the level of decant water, tailings and stormwater in the waste fines storage facility exceeds the top edge level. Overtopping can be caused by a number of factors including poor management practice, insufficient freeboard being maintained and large rainfall events.

9.6.2 Identification and general characterisation of emission

Emission is tailings including decant water causing adverse impacts to surface and groundwater, vegetation. The tailings characterisation indicated that concentrations of Aluminium (Al), Chromium (Cr), Copper (Cu), Lead (Pb), Nickel (Ni), Silver (Ag) and Zinc (Zn) exceeded the ANZECC guideline values for water quality for protection of 95% of freshwater aquatic ecosystem species. The decant water is likely to also contain elevated nitrate concentrations due to residue from explosives.

9.6.3 Description of potential adverse impact from the emission

Potential to inundate and smother onsite vegetation, and soil and groundwater contamination.

9.6.4 Criteria for assessment

Ecological investigation levels in NEPM ASC 1999.

9.6.5 Applicant controls

This assessment has reviewed the controls set out in Table 21 below.

Table 21: Applicant's proposed controls for overtopping of WFSF

Site infrastructure	Description	Operation details
WFSF	• Pit 1/ 2 has been designed with a spillway to overflow to Pit 4 • Decant pumps will be appropriately sized to maintain decant pond level within acceptable limits in accordance with the water balance; • Regular reviews of WFSF performance and predictions of capacity during operations; • Monitoring of pond water and evaporation seepage rates will be assessed to validate the water balance and to determine the future decant water method (may include licensed discharge); • Trigger Action Response Plan (TARP) has been developed in the Operating Manual for decant pond scenarios and early intervention actions for higher pond levels; • The maximum pond level 53 mRL; • Maintaining a freeboard of 1.5 m to the emergency spillway level (54.5mRL); and • Operational freeboard is adequate to store a 1:100 year, 72-hour rainfall event.	• Freeboard adequate to store the 1:100 year 72-hour rainfall event (freeboard of 1.5 m to the emergency spillway level (54.5mRL)).

9.6.6 Consequence

If overtopping of the WFSF occurs, then the Delegated Officer has determined that the impact will have mid-level onsite impacts. Therefore, the consequence of overtopping of the in-pit

WFSF is **moderate**.

9.6.7 Likelihood of Risk Event

Given the presence of an emergency spillway on Pit 1/ 2 to Pit 4, the likelihood of a tailings release from overtopping impacting on vegetation is only a consideration for overtopping from Pit 3. The Delegated Officer considers the likelihood of this event to be **rare.**

9.6.8 Overall rating of overtopping of WFSF

The Delegated Officer has compared the consequence and likelihood ratings described above with the risk rating matrix Table 17 and determined that the overall rating for the risk of overtopping is **medium**.

9.7 Risk Assessment - Seepage from tailings in WFSFs to groundwater

9.7.1 Description of seepage from the WFSF

Waste fines will be deposited to the Mesa A WFSF at a solids content of approximately 40% (refer Table 12 in section 8.1.) There is a positive hydraulic gradient from Pit 1/2 to Pit 3 as Pit 3 has been mined to a much lower level than Pit 1/ 2, and seepage flow from Pit 1/2 to Pit 3 is expected. GHD (2019) forecast that the majority of seepage would occur through the walls of the Pit 1/ 2. The floor of Pit 1/2 is above the surrounding groundwater level and therefore only seepage out is expected. Part of the floor of Pit 3 is above the surrounding groundwater level and part is below. When the Pit 3 pond level is low, seepage of groundwater into Pit 3 is expected and as Pit 3 fills, seepage from Pit 3 is expected.

At this stage there is planned no decant return to the processing plant and hence the tailings will be kept in a saturated state with maximum head. Decant from Pit 1/ 2 will be pumped to Pit 3 (pre waste fines deposition to Pit 3) to ensure minimum freeboard levels in Pit 1/ 2 are available.

9.7.2 Identification and general characterisation of emission

Limited leachate testwork on the tailings has been completed (ASLP testing on Mesa B and C waste fines) so it is not possible to confidently determine which contaminants will leach into seepage at this time. Given the deposition of waste fines into a pit which is planned to be used for mine dewater storage (Pits 1/2 and Pit 3) and the use of Pit 3 which is mined below the water table, the tailings will be deposited into an anoxic environment. Testwork on similar iron ore wastes in anoxic environments suggests that mobilisation of soluble arsenic and manganese at concentrations of concern is possible (Watson *et al* 2016). Refer to section 8.3 for further explanation.

9.7.3 Description of potential adverse impact from the emission

Seepage from the Mesa A WFSF may alter groundwater quality. The groundwater at Warramboo is generally of good quality with metals and trace element concentrations usually at or below limits of detection. Tailings discharge are likely to deteriorate groundwater quality.

9.7.4 Criteria for assessment

Relevant water quality criteria are the ANZECC default guideline values for 95% protection of freshwater aquatic ecosystems.

9.7.5 Applicant controls

This assessment has reviewed the controls set out in Table 22 below.

Table 22: Applicant's proposed controls for seepage from the WFSF

Site infrastructure	Description	Operation details
WFSF	• Groundwater monitoring bores already installed to monitor for seepage: ➢ MB13WARR003; ➢ MB13WARR012; ➢ MB13WARR013; ➢ MB13WARR016; ➢ MB17WARR0008; and ➢ MB19WARR0001. Bore logs provided and baseline data. Bores installed are deep with slots not near the water table.	• Model to be refined as further monitoring and tailings solids and liquor characterisation information becomes available. • Water quality monitoring during commissioning and time limited operations; • Some seepage may be captured by process water bores (however, these bores are not purpose built seepage recovery bores) and recirculated in processing during operations; • Prior to water levels in Pit 3 reaching the maximum operating level, additional monitoring of water, seepage rates and evaporation will be undertaken to validate the water balance model and to determine the future decant water management strategy; and • Regular monitoring and characterisation of tailings solids and liquor once the decant pond commences operation.

9.7.6 Consequence

If seepage flows from the WFSF are able to migrate to adjacent creeks (Warramboo Creek), then the impacts to groundwater may result in mid-level onsite impacts. Therefore, the Delegated Officer considers the consequence of seepage of the WFSF to be **moderate**.

9.7.7 Likelihood of Risk Event

In the absence of site specific tailings composition and behaviour and confirmation of pathways from the WFSF, the Delegated Officer considers the likelihood of seepage from the WFSF to be **possible**. It is noted from bore logs provided for the 6 installed bores that the bore slots are deep. DWER therefore considers interpretation of monitoring results will be difficult for seepage, and one bore is located in the future waste rock dump footprint.

9.7.8 Overall rating of seepage from the WFSF

The Delegated Officer has compared the consequence and likelihood ratings described above with the risk rating matrix Table 17 and determined that the overall rating for the risk of seepage from the WFSF is **medium**. Four new monitoring bores are required between the inpit TSF and Warramboo Creek to allow better establishment of background data and to monitor seepage.

9.8 Risk Assessment - Direct Discharge of dewater to Warramboo creek

9.8.1 Description of pit dewatering discharge to Warramboo Creek

Surplus dewatering water from bores and in-pit sumps, will be discharge to a new point at Warramboo Creek. The maximum rate of discharge will be 290 litres per second (L/s) to a maximum of 7GL per annual period.

9.8.2 Identification and general characterisation of emission

Surface water samples collected from Warramboo Creek after rainfall events show the water to be fresh with neutral pH, reflecting rainwater. Raw pit water from the operational pit (with no tailings decant) is slightly brackish with elevated nitrates and metal(loids).

9.8.3 Description of potential adverse impact from the emission

The introduction of approximately 7 GL/year of dewater to the creek is likely to change creek water chemistry.

9.8.4 Criteria for assessment

Relevant water quality criteria are the ANZECC default guideline values for 95% protection of freshwater aquatic ecosystems.

9.8.5 Applicant measures

Water quality sampling will be established at the discharge point. Discharge volumes to Warramboo Creek will not exceed 7 GL per annual period via the dewatering discharge point.

9.8.6 Consequence

The impacts of discharge of 7GL of bore and pit dewatering may result in a low level of offsite impacts. Therefore, the Delegated Officer considers the consequence of seepage of the WFSF to be **moderate**.

9.8.7 Likelihood of Risk Event

The Delegated Officer considers the likelihood of deterioration of creek water quality from bore and pit dewatering discharge to be **possible**.

9.8.8 Overall rating of seepage from the WFSF

The Delegated Officer has compared the consequence and likelihood ratings described above with the risk rating matrix Table 17 and determined that the overall rating is **medium**.

9.9 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 23 below. Controls are described further in section 11.

Table 23: Risk assessment summary

	Description of Risk Event			**Applicant controls**	**Risk rating**	**Acceptability with controls (conditions on instrument)**
	Emission	**Source**	**Pathway/ Receptor (Impact)**			
1.	Leaks and spills from tailings and decant water pipelines	Waste fines from the processing plant and/or decant water from the WFSF	Direct discharge potentially impacting groundwater and flora and fauna	Pipeline bunding, pressure/flow gauges, sumps, maintenance and inspections	Minor consequence Unlikely likelihood **Medium Risk**	Acceptable subject to Applicant controls conditioned and regulatory controls.
2.	Mine dewater and decant seeping from WFSF and impacting on downstream surface water receptors	Direct discharge of mine dewater and decant to the WFSF	Direct discharge to pits and then migration via groundwater pathways	Revision of the WFSF water balance to evaluate whether decant can be returned to the Mesa A wet plant for reuse.	Moderate consequence Possible likelihood **Medium risk**	Potentially acceptable with additional regulatory controls.

	Description of Risk Event			Applicant controls	Risk rating	Acceptability with controls (conditions on instrument)
	Emission	**Source**	**Pathway/ Receptor (Impact)**			
3.	Overtopping of the WFSF containing tailings	Waste fines (tailings) deposition to the WFSF	Spill over the top edge level potentially impacting surface and groundwater, flora and fauna	Supernatant water quality monitoring, maintaining decant pond water size, water balance, freeboard	Moderate consequence Rare likelihood **Medium Risk**	Acceptable subject to Applicant controls conditioned and regulatory controls
4.	Seepage of tailings	Tailings deposition to the WFSF	Seepage through WFSF into groundwater causing groundwater quality deterioration.	Water quality monitoring (bores), validation of water balance, monitoring characteristics of tailings solids and liquids	Moderate consequence Possible likelihood **Medium risk**	Acceptable subject to Applicant controls conditioned and regulatory controls (**additional bores required**)
5.	Dewater from bores and in-pit sumps directly discharged to Warramboo Creek	Dewater from active mining pit and bores	Direct discharge to Warramboo Creek. Alternation of existing environment, erosion of creekbed.	Monitoring of discharge volume and quality. Erosion controls to be implemented in Warramboo Creek. Pipeline controls.	Moderate consequence Possible likelihood **Medium risk**	Acceptable subject to Applicant controls conditioned and additional regulatory controls (monitoring of discharge).

10. Regulatory controls

10.1 Works Approval controls

10.1.1 Construction infrastructure and equipment requirements and time limited operational requirements

Design requirements have been included for processing plant, dewatering pipeline and discharge point, landfill facilities and HVRF as per the Applicant's commitments.

Standard time limited operational requirements have been included for the Processing Plant, landfills and HVRF.

The following requirements have also been put into place for time limited operations:

- The discharge of mine dewatering water to Warramboo Creek; and
- Supernatant water to be decanted from Pit 1/2 to Pit 3 to maintain freeboard in Pit 1/2.

10.1.2 Leaks and spills from tailings and decant water pipelines

The works approval requires:

- Pipelines from Mesa A wet plant to Warramboo WFSF to be in a fully bunded corridor to contain spills;

- Pressure/flow gauges installed at both ends of the tailings delivery pipeline and decant pipeline from Pit 1/2 to Pit 3 to identify a pipe burst; and
- Low points in the pipeline will include scour valves and containment sumps to allow containment of the pipe's contents if necessary to drain the pipe for maintenance.

Grounds: risks associated with leaks and spills from pipelines have been assessed as medium (section 9.4.8). Requirements are derived from the controls outlined by the Applicant.

Compliance reports are required to be submitted to confirm the infrastructure has been put in place and design commitments met prior to operation.

10.1.3 Overtopping of the WFSF

The works approval requires:

- Installation of the emergency spillway on Pit 1/ 2 to Pit 4 at level 54.5mRL;
- Freeboard adequate to store the 1:100 year 72-hour rainfall event; and
- Installation of a supernatant (decant) pond pontoon-mounted pump system on Pit 1/2.

Grounds: risks associated with overtopping of the WFSF have been assessed as medium (section 9.6.8). Requirements are derived from the controls outlined by the Applicant.

Compliance reports are required to be submitted to confirm the infrastructure has been put in place and design commitments met prior to operation.

10.1.4 Direct discharge of mine dewater and waste fines decant to WFSF

The works approval will require:

- During time limited operations monitoring of the water quality of tailings supernatant and fines; and
- Refinement of the water balance over the WFSF to ensure groundwater levels in the vicinity of the WFSF are managed over the operational life of the WFSF and that the option of recycling decant water to the Mesa A wet plant is fully evaluated and implemented if feasible.

Grounds: risks associated with direct discharge of mine dewater and decant to the WFSF have been assessed as medium (section 9.5.7). Requirements are derived from additional studies required to refine the assessment and the risk posed by the direct discharge of tailings.

10.1.5 Seepage from WFSF

The works approval requires:

- Installation of a supernatant pond pontoon-mounted pump system at Pit 1/2 and operation during time limited operations;
- Additional groundwater monitoring bores installed in the vicinity of the WFSF. Initial monitoring to occur prior to deposition and then during time limited operations; and
- Further leach tests of the waste fines to be conducted during time limited operations to improve the estimate of the extent that metals/contaminants in waste fines may be mobilised into the leachate under the anoxic conditions expected at the WFSF.

Compliance reports are required to be submitted to confirm the infrastructure has been put in place and design commitments met prior to operation.

Grounds: The slotted interval of bore MB13WARR16 is considered too far below the water table and is unlikely to detect meaningful data for seepage. It also appears that MB13WARR013 is within the waste dump footprint so will therefore be lost.

10.1.6 Monitoring requirements

The works approval requires the following monitoring regimes:

- Baseline monitoring of SWL and water quality at the newly constructed groundwater monitoring bores, and monthly monitoring during time limited operations, with comparison of the results to ANZECC Guidelines 95% protection of freshwater aquatic ecosystems;
- Test for tailings flocculant by product (acrylamide) in groundwater and tailings;
- Monthly monitoring of groundwater quality around Mesa A WFSF;
- Quarterly monitoring of Tailings fines and supernatant; and
- Monitoring of mine dewatering water discharged to Warramboo Creek - once during commissioning and then monthly (if discharging), with a comparison to the ANZECC Guidelines 95% protection of freshwater aquatic ecosystems.

Grounds: Monitoring of ambient groundwater levels and quality is required to determine if SWL is changing indicating seepage from the WFSF or water quality is deteriorating. Comparison to the ANZECC 95% protection of freshwater aquatic ecosystems and to the baseline groundwater water is required. Flocculant used in tailings can migrate to groundwater.

Monitoring of the waste fines and supernatant water is required to indicate potential changes in water quality that may result in downstream impacts.

10.1.7 Inspections

The works approval requires the following inspection regimes:

- Waste fines delivery pipelines;
- Waste fines decant water return pipelines;
- WFSF embankments;
- Freeboard; and
- Pit 3 Process Water Dam.

Grounds: Visual inspections of containment infrastructure and pipelines are required during commissioning and time limited operations and the Applicant is required to keep records of visual monitoring undertaken (but is not required to report this on an annual basis but is required to record the information in their books).

10.1.8 Monitoring reports

The works approval requires the following reports be submitted:

- Environmental Compliance Report demonstrating that the infrastructure has been installed as committed to and as per the required Infrastructure and equipment requirements table, with no material defects;
- Environmental Commissioning Report providing a summary of the commissioning activities with timeframes, material processed, product produced, waste fines deposited and mine dewatering water discharged, summary of monitoring results obtained and environmental performance; and
- Time limited operations report providing iron ore processed, product produced, waste fines deposited, waste fines density (solid vs water content), the WFSF and associated ponds water balance, summary of monitoring results obtained and environmental performance.

Grounds: Reporting requirements are necessary for the administration of the works approval, validating ongoing acceptability of the operations and for validation against design criteria.

11. Applicant's comments

The Applicant was provided with a draft Decision Report and draft issued Works Approval on 19 June 2020. The Applicant formally responded on 7 August 2020. A summary of the Applicant's comments are summarised, along with DWER's response, in Appendix 2.

A second 21-day draft of the documents was subsequently sent to the Applicant on 27 August 2020. The applicant responded on 1 September 2020 requesting clarification of one referencing condition but otherwise waiving the remaining review period for the instrument to be issued.

12. 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).

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.

Alana Kidd

Digitally signed by Alana Kidd
Date: 2020.09.08 11:52:22 +08'00'

Alana Kidd
Manager, Resource Industries
Regulatory Services
Delegated Officer
under section 20 of the *Environmental Protection Act 1986*

Appendix 1: Key documents

	Document title	In text ref	Availability
1.	Works Approval Application	N/A	DWER records (DWERDT188273)
2.	GHD (2019) Appendix to Works Approval Application- Detailed Design Report Warramboo Tailings Storage Supporting Document	GHD 2019	DWER records (DWERDT188278)
3.	Ministerial Statement 1112	N/A	accessed at http://www.epa.wa.gov.au/sites/default/files/1MINSTAT/1640%20Statement%201112%20for%20publishing.pdf
4.	DER, October 2015. *Guidance Statement: Setting conditions.* Department of Environment Regulation, Perth.	N/A	accessed at www.dwer.wa.gov.au
5.	DER, February 2017. *Guidance Statement: Risk Assessments*. Department of Environment Regulation, Perth.	N/A	
6.	DER, June 2019. *Guidance Statement: Decision Making*. Department of Environment Regulation, Perth.	N/A	
7.	DWER, June 2019. Guideline: Industry Regulation Guide to Licensing. Department of Water and Environmental Regulation, Perth	N/A	
8.	Email titled "RE: [External] W6284/2019/1 Mesa A/Warramboo Iron Ore Mine Additional Information" and associated attachments dated 12/05/2020 11:24am and authored by Rio Tinto	N/A	DWER records (A1893016)
9.	Eberhard, S.M., Halse, S.A. and Humphreys, W.F., 2005. Stygofauna in the Pilbara region, north-west Western Australia: a review. *Journal of the Royal Society of Western Australia*, **88**,167-176.	Eberhard *et al*., 2005	The paper is available from web site https://www.rswa.org.au/publications/Journal/88(4)/vol88pt4eberhardetal167-176.pdf.
10.	Green, R, Linklater, C, Lee, S, Terrusi, L & Glasson, K (2019), 'Rio Tinto's framework for evaluating risks from low sulfur waste rock', in AB Fourie & M Tibbett (eds), *Proceedings of the 13th International Conference on Mine Closure*, Australian Centre for	Green, R *et al* 2019	https://papers.acg.uwa.edu.au/p/1915_68_Green/

	Geomechanics, Perth, pp. 855-870		
11.	Watson A., Linklater, C., & Chapman, J., (2016) Backfilled Pits – Laboratory-scale Tests for Assessing Impacts on Groundwater Quality	Watson *et al* 2016	https://www.srkexploration.com/sites/default/files/file/AWatson_BackfilledPits_2016_0.pdf
12.	WRM (2018) *Warramboo Project: Baseline Aquatic Ecosystem Survey Wet Season Sampling*, April 2018	WRM 2018	Appendix to the Mesa A Hub Environmental Review Document (ERD) available at www.epa.gov.wa.au
13.	WRM (2017) *Mesa B and C Project Baseline Aquatic Ecosystem Survey Wet Season Sampling* May 2016	WRM 2017	Appendix to the Mesa A Hub ERD available at www.epa.gov.wa.au
14.	Younger, P.L. and Wolkersdorfer, C., 2004. Mining Impacts on the Fresh Water Environment: Guidelines for Catchment Scale Management. Publication of the ERMITE (Environmental Regulation of Mine Waters in the European Union) Consortium.	Appendix 1 in Younger and Wolkersdorfer, 2004	The publication is available from web site https://s3.amazonaws.com/academia.edu.documents/43779300/ERMITE_guidelines_MW_E_Jl.pdf?response-content-disposition=inline%3B%20filename%3DMining_Impacts_on_the_Fresh_Water_Enviro.pdf&X-Amz-Algorithm=AWS4-HMAC-SHA256&X-Amz-Credential=AKIAIWOWYYGZ2Y53UL3A%2F20191217%2Fus-east-1%2Fs3%2Faws4_request&X-Amz-Date=20191217T022045Z&X-Amz-Expires=3600&X-Amz-SignedHeaders=host&X-Amz-Signature=ab7474189df7625d6f209c4a17082cda6156a3a246292f7c9ed76aaa76afa95a
15.	Email titled “Mesa A / Warramboo Iron ore Mine - W6284/2019/1 Works Approval Draft Review” and associated attachments dated 10/08/2020 and authored by Rio Tinto.	N/A	A19213192, A1921337

Appendix 2: Summary of applicant's comments on risk assessment and draft conditions – first 21 day period.

Condition	Summary of Licence Holder comment	DWER response
Condition 3	The in-pit WFSF will be totally contained within the previously mined pits. The Condition refers to construction of a tailing's impoundment starter. No confining starter embankments are proposed as outlined in the application. The remnant pit walls will form the perimeter of the storage area. The Project will comply with the DMIRS '*Code of Practice – Tailings storage facilities in Western Australia*' and an Annual Audit Report will be submitted to DMIRS. In accordance with DMIRS requirements, an operating manual will be compiled on completion of the final detailed design and prior to tailings deposition commencing. The Licensee requests that the condition is deleted. As the facility is an inpit WFSF there will be no tailing storage embankments constructed. Additionally, this condition adds duplication as the facility is constructed and operated in accordance with DMIRS guidelines.	Condition 3 referred to the TSF construction being supervised by an engineer for the tailings impoundment starter. This has been removed. Conditions 3 and 4 were general advice conditions provided to DWER by DMIRS but are not applicable to an in-pit TSF. Given the Project is subject to a State Agreement Act (SAA), the Mining Act is not applicable hence DWER sought advice from DMIRS. Advice from DMIRS was general and not specific, this has since been clarified and these conditions subsequently removed given this is an in-pit TSF.
Condition 4	The Licensee requests that the condition is deleted. Refer to commentary regarding Condition 3.	Condition 4 referred to the safety of the embankment being documented by an engineer. This has also been removed, as outlined above as this was suggested by DMIRS given the SAA.
Condition 5. Table 3 Groundwater bores around TSF	The six monitoring bores listed in the Works Approval Application are existing bores. These have been drilled by a licensed driller, using appropriate drilling equipment/technique. The bores have been constructed as per the National Uniform Drillers Licensing Committee's '*Minimum Construction Requirements for Water Bores in Australia*', the DMIRS's '*Guidelines for the Protection of Surface and Ground Water Resources*' and Rio Tinto's Standard Headworks for Hydro Guidelines (RTIO-PDE-0089729).	DWER assumed the bores referenced in the works approval application had not been constructed as supporting documentation and figures had bore locations as 'indicative'. Baseline data and bore logs have since been provided by the Applicant for the 6 bores. DWER has updated the assessment to capture this information.

Condition	Summary of Licence Holder comment	DWER response
	The bore logs are provided in Attachment 2 as evidence. A groundwater monitoring bore location map is provided in Attachment 3. The Licensee requests that the condition is deleted as the proposed monitoring bores have already been constructed.	The requirement to install these bores has also been removed from table 1 of the works approval. For MB13WARR bores to monitor seepage from the Mesa A in pit TSF, DWER considers the slotted intervals in bores MB13WARR03, 12 and 13 are too long. This will make it difficult to interpret sample results taken from these bores for detecting seepage from the in pit TSF towards Waramboo Creek. These slotted intervals should be no longer than 6 metres. DWER has updated information provided by the Applicant in the decision report and the risk assessment and determined that additional bores are required to better monitor seepage. Table 3 has been amended (now Condition 3) – four new monitoring bores are required to adequately monitor for seepage. The indicative location of the new monitoring bores are depicted in Figure 15. Existing bores are also in Figure 15. It is a requirement that a nest of monitoring bores be constructed near the water table, about half way down in the aquifer, and one near the base. The most important monitoring interval is near the water table and this will therefore prove valuable for seepage (not at depth well below the water table). It also appears that MB13WARR013 is within the waste dump footprint which means that this monitoring point will be lost. This has been captured in the risk assessment.
Condition 6	The Licensee requests that the condition is deleted Refer to commentary regarding Condition 5.	As outlined above, with the provision of bore logs and baseline data, the information the assessment and risk has been updated/reviewed.

Condition	Summary of Licence Holder comment	DWER response
		This condition (now Condition 4) has been updated for the works approval holder to submit bore construction compliance documentation and baseline data for the four new bores (not the six already installed). Four new monitoring bores are required as per updated risk assessment and commentary above.
Condition 7	As per Condition 5 and 6 commentary the bores have already been constructed. The Licensee has been monitoring groundwater levels and groundwater quality at the Warramboo borefield since 2007. A summary of the Warramboo background groundwater quality data was provided in the Mesa A Warramboo In-Pit Tailings Storage Facility Supporting Document for Works Approval Application, Table 4-1 (Appendix 1), and a full summary of monitoring data is provided in excel format in Attachments 4. Request that this condition is deleted as bores are already constructed and groundwater monitoring is required by Condition 12.	Previous Condition 7 (now Condition 5) requires baseline data form bores to be installed to be provided within 60 days of construction. Condition 5 has therefore been updated as per the commentary above for baseline data for the four new bores to be provided. The six bores listed are already installed and baseline data has been provided. This has all been updated in the decision report.
Condition 13	Additional field surveys for hyporheic fauna species, further seepage assessments and revision of the conceptual site model are not considered warranted for this Works Approval. The Licensee does not consider Warramboo Creek (and the hyporheic species) a potential receptor. The Warramboo Creek is an ephemeral, well-defined and incised creek flowing northwards towards to the coastline. The creek starts to meander 4 kms north-west of the Warramboo deposit, becoming less-defined, branching out into multiple shallow, small drainage lines. These drainage lines are not visible downstream of this area. The Warramboo Creek, flows on average, three times a year, generating a fresh water lens in the saturated zone along the creek line. The creek is a losing stream at all times with no base flows ever observed. Please see Attachment 7 which shows the conceptual cross sections indicating aquifers, boundaries and components of the water balance.	Condition 13 required additional studies on the hyporheic zone downstream of Warramboo Creek. Upon further consideration of the EPA Report which accompanies MS 1112 and following discussions with DWER's EPA Services, it was identified that the risk to aquatic fauna was considered by the EPA under Part IV of the *Environmental Protection Act 1986*. Page 30 Mesa A revised proposal Report 1640 states '*the EPA considers that impacts to surface water quality and groundwater quality arising from the discharge of surplus water to Warramboo Creek, and the discharge of waste fines at Warramboo, are not so significant to require a condition and can be adequately managed by the DWER under the requirements of Part V of the EP Act'.*

Condition	Summary of Licence Holder comment	DWER response
	The potential impacts to hyporheic fauna from WFSF seepage has been assessed through the *Environmental Protection Act 1986* (EP Act) Part IV Assessment process completed by the Environmental Protection Authority (EPA) in 2019. Baseline aquatic and subterranean sampling has previously been comprehensively completed for the area. The EPA completed an assessment of the Mesa A Hub Revised Proposal (Assessment No. 2107) and issued Ministerial Statement (1112) on 21 August 2019. The EPA considered the proposal is unlikely to have a significant impact on aquatic fauna. Impacts to aquatic fauna, including invertebrates, were assessed as part of the Mesa A Hub Revised Proposal assessment. The EPA noted no aquatic fauna species are restricted to impact areas and concluded that it is unlikely that the proposal will have a significant impact on aquatic fauna. Baseline aquatic fauna sampling has been completed to support the Mesa A Hub Revised Proposal (Assessment No. 2107), specifically: • Wet season sampling was conducted in 2016; • Wet and dry season sampling was conducted in 2018; and • Wet and dry season sampling was conducted in 2019 (report is currently in draft). Five phases of aquatic fauna sampling have been completed for the Warramboo Creek, these surveys included sampling for hyporheic fauna and have included downstream sites (refer to figure provided in Attachment 5). The most recent study, 2019 Draft Aquatic Fauna report (in prep), identified that potential exposed sites had higher percentages of clay substrates than reference sites. Though clay is a highly porous sediment and can hold a lot of water, the pores within the fine sediments are so small that water moves slowly through them, making clay a poorly conductive sediment (i.e. low hydraulic conductivity), and therefore a poor habitat for hyporheic fauna. The	The EPA considered that, whilst it was accepted there would be some impact to the species within the hyporheic zone of Warramboo Creek, this was considered acceptable and was unlikely to impact the hyporheic species as a whole. DWER has therefore removed the requirement for a field survey of hyporheic fauna species within Waramboo Creek and notes water quality monitoring will remain to monitor water quality and volume. The surface water quality monitoring condition is considered sufficient to provide early identification of any changes to the water quality of the creek. ..

Condition	Summary of Licence Holder comment	DWER response
	sites referred to as 'exposed sites' are those downstream of the discharge point (sites with DS in the name in the figure in Attachment 5). The Licensee requests that the condition is deleted. This condition duplicates the baseline aquatic fauna survey work completed and assessed as part of the Environmental Impact Assessment of the proposal under Part IV of the EP Act.	
Condition 14	Groundwater modelling for the WFSF has been completed (DHI, 2018) (refer to Attachment 6a and 6b). Seepage assessments completed for the WFSF have indicated that seepage will not reach Warramboo Creek and therefore there is no pathway for WFSF seepage (source) to impact on hyporheic species (receptor). DHI (2018) undertook the Warramboo TSF Seepage Study to support the approval process. Modelling was undertaken to assess the potential for changes to water quality as a result of seepage from the tailings storage facility. Modelling of seepage predicts that it will be confined to a small proportion of the available subterranean habitat (less than 2% of the habitat provided by the Yarraloola Conglomerate) and is unlikely to have a significant impact on the ecological integrity of the habitat or the diversity of species. The ERD (RTIO, 2018) stated that monitoring of groundwater levels and riparian vegetation will be undertaken to ensure that changes to ground water and vegetation health are identified and that drawdown is consistent with modelled predictions. Management measures, if required will be implemented following EPA approval of the Environmental Management Plan required by Condition 5 (Ministerial Statement 1112). The Licensee has drilled an extensive monitoring bore network, and has been monitoring regional groundwater since 2007, defining with high resolution, the geology and hydrogeology in the Warramboo flats. Pre-mining water levels are illustrated in Attachment 7, Figure 1 and further evidence is provided in the monitoring bore logs (Attachment 8a – 8c).	Condition 14 referred to submission of a field assessment to determine hypoheic fauna downstream in Warramboo Creek prior to discharge.. This condition has been removed as per the comment relating to former condition 13 above. A revised conceptual groundwater model for seepage, was required by previous condition 15 – this has been addressed below for Condition 15. Rio has mistakenly referred to Condition 14 here, instead of 15.

Condition	Summary of Licence Holder comment	DWER response
	Groundwater, in the absence of the mining activities, flows from south-east to north-west, almost parallel to the creek line. Water depths range from 20 to 5 meters below the incised low flow channel up to the point where the creek is not identifiable within the Warramboo flats. Subsequently, groundwater does not discharge, at any time, into the creek bed or the sub-layer containing alluvial beneath the creek. The alluvial layer ranges from 17 meters below ground level (bgl) west of the future WFSF down to 5 meters bgl where the creek meanders. The water table is consistently below this layer. Furthermore, thick clays are present between the alluvial and the main water bearing horizon, the Yarraloola aquifer, which indicates a partial disconnect. During Life of Mine (LOM), a network of bores will be pumping for dewatering, water supply and potable water activities generating a combined cone of abstraction. Pumping activities are expected to extend until 2037. The groundwater gradient during LOM will be directed towards to the three borefields, intercepting any potential seepage originating from the WFSF. See Attachment 7 Figure 4. At closure, groundwater will recover after 2037 to its initial gradient, without interaction with the alluvial layer. Conceptual cross-sections presented in Attachment 7, Figure 2 and 3 illustrate this disconnect. The closure strategy for the Mesa A Hub remains as described in the April 2018 Mine Closure Plan (MCP). The closure strategy considers the following (as summarised from the Mesa A Hub MCP): • AWT pits at Mesa A and Warramboo: backfill (partial) to minimise ex-pit landforms; measures to restrict inadvertent public access; rehabilitation of final surface (pit walls to remain); • BWT pits at Warramboo: opportunistic backfill to suppress the formation of pit lakes; rehabilitation of final surface (pit walls to remain); • In-Pit Waste Dumps: reshaping according to design criteria and material type; rehabilitation of final surface; • Free Standing Waste Dumps: construction according to	

Condition	Summary of Licence Holder comment	DWER response
	design criteria; reshaping of final landform according to design criteria and material type; application of topsoil/subsoil; rip and seed using native species; • Free Standing Waste Dumps (to be reclaimed at closure): depending on volume of material, rehabilitation as per free standing dumps; and • WFSF (at Warramboo): capping with 2m inert material; rehabilitation final landform surface; shallow ripping where possible. The modelling completed has assumed all pits will be backfilled. The DHI report (Attachment 6a, Figure 4-30 within the report) illustrates the difference between operations and closure, with the plume dissipating to negligible values within a few kilometres from the pits. Further work will be completed as part of the next MCP revision to further understand the seepage potential at closure. The Licensee requests that the condition is deleted.	
Condition 15	An extensive assessment of environmental impacts related to surplus water management and discharge to Warramboo Creek was completed through the EP Act Part IV approval process which included an assessment of impacts related to seepage. The EPA report stated that that seepage from WFSF at Warramboo is unlikely to extend beyond the cone of depression from the Warramboo borefield. The potential impacts resulting from WSFS WFSF seepage, and therefore requirements of this condition have already been addressed through the EPA Part IV EP Act assessment process and the additional work completed to support the Works Approval Application. With respect to groundwater pathways, the transport of seepage from the WFSF has been modelled using chloride as a proxy of solutes that may seep from the facility. The modelling indicates that the increase in chloride concentration due to the WFSF will not extend beyond the cone of depression and that the majority of the increase in chloride concentration will remain within the pit area and is not expected to reach water supply bores or environmental receptors. Further, the	Condition 15 required the works approval holder to develop a revised conceptual site model for seepage flows form the WFSF, identifying groundwater pathways that may result in impacts on downstream surface water receptors. An updated groundwater model had been completed by the applicant and has since been provided and this condition has been removed. The risk assessment has been updated and DWER notes that the applicant has committed to monitoring groundwater quality around the in pit TSF to monitor seepage (condition 20 works approval).

Condition	Summary of Licence Holder comment	DWER response
	effects of naturally occurring areas of higher chloride concentration to the west of Warramboo make chloride concentrations in the study area likely to be relatively insensitive to the WFSF chloride concentrations. * Chloride was chosen as a suitable analyte for the modelling of groundwater quality for several reasons, namely that the groundwater at Warramboo is of the Na-Mg-Cl type *and generally of good quality with metals and trace element concentrations usually at or below limits of detection*, Total Dissolved Solids (TDS) was found to be dominated by chloride concentrations and to follow similar distribution patterns to chloride across the site, and chloride is generally a conservative solute. The Licensee requests that the condition is deleted.	
Condition 16	The Licensee requests that this condition is deleted, refer to condition 13, 14 and 15. The conceptual model developed to support the application will guide the development of additional groundwater monitoring and triggers for the Warramboo WFSF if required based on monitoring collected during operations. We do not think it is necessary to develop trigger values for arsenic, antimony or manganese at this stage because we believe redox conditions in the aquifer are arguably anoxic and most likely could be described as sub-oxic. While anoxic conditions may develop at the bottom of the pit filled with tailings, we believe the presence of nitrate in tailings water inhibits the development of reducing conditions by controlling the redox conditions at redox (pe) values above zero. Further evidence is provided in Attachment 6b. Modelling completed shows that chloride does not increase in water stored within the pits. The Licensee will test this hypothesis following DWER's recommendations by conducting column tests as outlined in Watson et al 2016. Should the release of arsenic, antimony or manganese materialise in column tests planned for Warramboo waste materials, the seepage monitoring program (Condition 25) will be revised accordingly. This may consider among others the development of trigger values for the constituents of potential concern (COPC) that	Condition 16 related to condition 15 and the requirement to develop site triggers for arsenic, antimony and manganese in groundwater. This condition has been removed. Additional tailings geochemical testing is to be conducted (condition 27) to further characterise the emission at source. If required, additional groundwater monitoring requirements may be added at a later date following that testing.

Condition	Summary of Licence Holder comment	DWER response
	may be identified in the column testing of Warramboo waste materials. Based on the analysis completed to support the application and lack of environmental receptors, we believe the risk is low. We will commit to completing the additional baseline monitoring and column testing however we believe at this stage the development of the groundwater plan and site triggers levels is not warranted. The Licensee requests that the condition is deleted. The monitoring required by Condition 12 is sufficient to manage this risk.	
Condition 17	Refer to condition 15 and 16. The Licensee requests that the condition is deleted.	Condition 17 referred to the groundwater and management plan from previous conditions 14 to 16 which have been deleted. Condition 17 is therefore no longer applicable and has been removed.
Condition 20. Table 4	To complete all stages of commissioning for an ore processing plant and WFSF it takes up to 18 months. As per the application we have committed to provide a construction compliance report prior to commissioning. An updated construction, commissioning and operation schedule is provided in Attachment 9.	The applicant requested updates to the commissioning schedule as DWER had requested clarification on the commissioning schedule proposed (applicant had requested 18 months). Following a meeting with the applicant on the 30 July, DWER clarified commissioning timeframes and time limited operation under the works approval. The applicant provided an updated schedule which has been updated in Table 4 (now Condition 13).
Condition 21	Reference to the spigot location specific discharge points is prescriptive and does not allow for the operation of the WFSF through the implementation of an operating manual in line with DMIRS requirements. An operating manual will be compiled on completion of the final detailed design and prior to tailings deposition commencing. Waste fine deposition can be from one or more spigots depending on the WFSF stage and will be altered during operation to achieve maximum storage. The Licensee requests that Table 5 is amended to address deposition for the spigots as required based on the WFSF	Condition 21 specified the discharge points for waste fines discharge to the in pit TSF during commissioning and time limited operations. The applicant's request has been considered and the Table 5 (now Condition 14) updated accordingly for discharge to Pit 1/2 *via one or more discharge points from spigots located around the pit perimeter.*

Condition	Summary of Licence Holder comment	DWER response
	deposition strategy / operating manual. The Licensee requests the following amendments: All text in ***Discharge Point*** column is deleted and replaced with *Discharge to pit 1 / 2 and 3 will be via one or more discharge points from spigots located around the pit perimeter*	
Condition 24 Table 7	In line with changes proposed to other conditions in the draft Works Approval, the Licensee requests amendments to Table 7. The proposed changes are related to the following: *WFSF Pit 1 / 2 and Pit 3* - During the train loadout process the decant pumping system in pit 1/2 will be operational but not turned on, remove the requirement to be active. *Dewatering pipeline and discharge point* - The abstraction rate and discharge rate is monitored in order to demonstrate compliance with the rates in Schedule 1 of MS 1112 - The flow meter at the discharge point and water balance infrastructure will enable the Licensee to demonstrate whether there has been a loss/failure of the pipeline. Additionally, it is not expected that dewatering and discharge will be constant, occurring daily. Therefore, it is requested that daily is removed from the condition. - Daily scouring inspections are not considered necessary, the discharge outlet has been designed with erosion control protection (rip rap apron) to withstand the maximum discharge rate of 290 L/s. - Potential impacts have also been addressed through MS Condition 11-1(3), which requires that the proponent shall ensure that there is no irreversible impact to the health of riparian vegetation of Warramboo Creek as a result of surplus water discharge associated with implementation of the proposal. The Licensee is requesting that any repairs be conducted within 14 days to allow time to mobilise the required equipment within this	Previous Condition 24 (Table 7) related to all site infrastructure and equipment. Table 7 therefore requires updating to reflect all other changes outlined above. DWER has updated Table 7 (now condition 19) with the additional information provided as below: - Figure numbers updated; - Decant pump requirement amended; - Dewatering pipeline and discharge inspection frequency changed to daily during discharge; and - Repairs amended to 14 days.

Condition	Summary of Licence Holder comment	DWER response
	timeframe. The Licensee requests the following amendments: - Figure references are checked throughout. WFSF Pit 1 / 2 and Pit 3 - Delete ***active or reword to operational*** Dewatering pipeline and discharge point - The operation currently utilises online equipment monitors that monitor the whole plant/system 24/7 and is set with alarms which allow shutdown from the control room. Therefore, it is requested that ***daily*** is removed from the condition and the condition is deleted or as a minimum monthly inspections are required. - Delete ***Inspect the discharge outlet daily for excessive scouring*** - Amend … ***and make good repairs within 14 days of recording the maintenance request***.	
Condition 25. Table 8	The Licensee requests the following amendments to Table 8: - A note is included stating that in-field non-NATA accredited analysis be permitted for EC - Waste fines Deposited in the WFSF o Sample Location – process plant o Frequency – one sample during commissioning phase and quarterly during time limited operations. - Dewatering water discharged to pit…***delete monitoring requirement*** Approval to discharge dewatering groundwater into pits has been provided through Ministerial Statement 1112, therefore pit dewatering discharge sampling conditions in the Works Approval are not considered warranted given lack of sensitive environmental receptor that could be impacted. All compliance monitoring required by the GWOS (and required under Part IV) will be complied with on the commencement of dewatering.	Previous condition 25 (Table 8) refers to all monitoring required during commissioning and time limited operations. DWER has reviewed the monitoring requirements and considered the additional information provided by the Applicant (as outlined above). There was text missing for monitoring requirements to allow *in field monitoring* for some parameters. DWER has updated Table 8 (now condition 20) as below: - EC measurement amended (in field non NATA) accredited analysis permitted); - Dewatering monitoring updated for in field sampling; - Tailings sampling and location amended; and - Dewatering discharge amended (for sampling to occur while discharge is occurring).

Condition	Summary of Licence Holder comment	DWER response
	- Dewatering water discharged to Warramboo Creek o Sample Location – water quality sampling will be established at the discharge point. o Frequency – Once during commissioning, monthly during time limited operations, only if discharge is occurring.	DWER has also added acrylamide to the monitoring suite to be able to establish if this chemical (used in flocculant) is present in samples. DWER's risk-based approach and the precautionary principle means that once data is collected - where no impact or detection can be demonstrated, monitoring can be updated to reflect the risk.
Condition 29 Table 9	The Licensee requests that this condition is deleted. The operation currently utilises online equipment monitors that monitor the whole plant/system 24/7 and is set with alarms which allow shutdown from the control room. The WFSF has freeboard level indicators and telemetry which allow remote checks. The pipeline is also bunded and adding additional secondary containment. Given the level of existing online and real-time monitoring occurring, four hourly inspections are not considered warranted.	Table 9 refers to the inspection schedule of infrastructure and had previously listed 4-hourly. In accordance with DMIRS guidelines "*Guide to Departmental requirements for the management and closure of tailings storage facilities (TSFs)*" inspections should be conducted "normally twice per production shift". The Applicant had committed to comply with the DMIRS TSF guidelines, so this had been added as a control. DWER has amended the condition to daily in Table 9 as requested by the applicant (now Condition 23).
Condition 31 (f) and (g)	Using the ANZECC guidelines for freshwater ecosystems (95% species protection) is not practical given the naturally elevated background levels of some analytes. <u>Groundwater</u> Natural background concentrations of some analytes (including boron, total nitrogen, nitrate and NOx) in the groundwater exceed the ANZECC guidelines for freshwater ecosystems (95% species protection). However, all analytes are below the ANZECC guidelines for livestock drinking water quality. <u>Surface water</u> Total nitrogen, total phosphorus, aluminium, chromium, copper, nitrate and zinc concentrations in Warramboo Creek were generally elevated	Previous Condition 31 referred to monitoring requirements for time limited operation. This is now Condition 25. DWER acknowledges that in some monitoring bores, parameters like Nitrogen exceed ANZECC 95% protection for freshwater ecosystems. DWER has used the updated groundwater data recently provided by the applicant, from monitoring bores MB13WARR003, 012, 013, 016, MB17WARR0008 and WB19WARR0001 as baseline data, and updated the risk assessment accordingly.

Condition	Summary of Licence Holder comment	DWER response
	compared with the ANZECC guidelines for freshwater ecosystems (95% species protection). Waste fines The results *of leachate analysis on waste fines samples* indicate that concentrations of aluminium, chromium, copper, lead and zinc exceed the ANZECC guidelines for freshwater. The Licensee requests the following amendments: - Review reference to conditions 9 and 12. - The Licensee requests that the parameters are compared against ANZECC guidelines for livestock drinking water quality.	DWER considers ANZECC 95% to be the most appropriate comparison parameter for the level of disturbance in the area, not livestock drinking water quality. Where baseline data is not available, monitoring should establish background information. ANZECC 95% remains as comparison parameter. Reference conditions have been also updated through the document to refence the correct condition.
Condition 33	The incorrect conditions have been referenced. Additionally, in line with changes proposed to other conditions in the draft Works Approval, the Licensee requests conditions referenced to be revised.	Previous Condition 33 (now Condition 27) outlines maintaining accurate and auditable books in line with works approval conditions. With changes to conditions, the references in this updated condition have now been updated to reflect the correct conditions.
Schedule 2: Monitoring	The Licensee requests several changes to the parameters, locations and frequencies to reflect site operations whilst meeting the intent of the Works Approval. The Licensee requests the following amendments: - EC updated such that In-field non-NATA accredited analysis be permitted. - Delete requirement to monitor prior to the commencement of commissioning.	Schedule 2 outlines all monitoring requirements under the works approval. This has been updated to reflect changes detailed above for monitoring.

Attachment 1: Issued Works Approval W6284/2019/1