Decision Report

Application for works approval

Division 3, Part V *Environmental Protection Act 1986*

Works approval number	W6322/2019/1
Applicant	IB Operations Pty Ltd
ACN	165 513 557
File number	DER2019/000575
Premises	Iron Bridge Magnetite Project Mining Tenements M45/1226, L45/293, L45/294, L45/359, L45/360, L45/361, L45/364 and L45/367 MARBLE BAR WA 6760
Date of report	24 April 2020
Status of report	Final

Definitions

Table 1: Definitions

Term	Definition
AEP	annual exceedance probability
AER	Annual Environmental Report
AMD	Acid Mine Drainage
ANC	Acid Neutralising Capacity
Applicant	IB Operations Pty Ltd
BGM	Bituminous Geomembrane
CEO	means Chief Executive Officer. CEO for the purposes of notification means: Director General Department administering the *Environmental Protection Act 1986* Locked Bag 10 Joondalup DC WA 6919 info@dwer.wa.gov.au
COS	Coarse Ore Stockpile
CCIR	Critical Containment Infrastructure Report
Critical Containment Infrastructure Report	means a report to satisfy the CEO that works of critical containment infrastructure have been constructed in accordance with the works approval.
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.
discharge	has the same meaning given to that term under the EP Act.
DMIRS	Department of Mines, Industry Regulation and Safety
DRL	Dry Rejects Landform
emission	has the same meaning given to that term under the EP Act.
EP Act	*Environmental Protection Act 1986* (WA)
EP Regulations	*Environmental Protection Regulations 1987* (WA)
EPA	Environmental Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Cth)

Term	Definition
g/t	Grams per tonne
GL/a	Gigalitres per annum
HPGR	high pressure grinding roll
km	kilometres
km^2	Kilometres squared
LEAF	Leaching Environmental Assessment Framework
LOM	Life of Mine
m	metre
m/s	metres per second
m^3	meters cubed
m^3/day	meters cubed per day
mg/L	milligrams per litre
mm	millimetre
Mt	million tonnes
Mtpa	million tonnes per annum
mbgl	Metres below ground level
mbrp	metres below reference point, where ‘reference point’ is from where the measurement is taken from at the bore which is generally the top of the (bore) casing.
MP	Mining Proposal
MS	Ministerial Statement
NAF	Non-Acid Forming
OPF	Ore Processing Facility
PAF	Potentially Acid Forming
Project	Iron Bridge Magnetite Project
PSD	Particle Size Distribution
RL	Relative level
ROM	Run of Mine

Term	Definition
RWP	Return Water Pond
SG	Specific Gravity
t/a	Tonnes per annum
time limited operations	refers to the operation of the infrastructure and equipment identified under this works approval that is authorised for that purpose, subject to the relevant conditions.
TDS	total dissolved solids
TSF	Tailings Storage Facility
µm	micrometres
works approval	refers to this document, which evidences the grant of the works approval by the CEO under section 54 of the EP Act, subject to the conditions.
WWTP	Wastewater Treatment Plant
XRD	X-ray diffraction

Overview of premises

Classification of premises

IB Operations Pty Ltd (the Applicant) operates the Iron Bridge Magnetite Project (the Project) under licence L8845/2014/1. The licence L8845/2014/1 licences Stage 1 of the operation and incorporates the following prescribed activities:

- North Star ore processing facility (Category 5);
- Power station (Category 52); and
- Wastewater Treatment Plant (WWTP) and irrigation field (Category 54).

The Project will process up to 72 million tonnes per annum (Mtpa) of magnetite ore, producing up to 25 Mtpa (wet) of ore concentrate. This Works Approval assessment, W6322/2019/1, is for part of Stage 2 of the Project for mining above the water table. The assessment includes the following proposed prescribed activities:

- Ore Processing Facility (OPF); Category 5 – proposed to replace the facility licensed under Licence L8845/2014/1; and
- Tailings Storage Facility (TSF): Category 5.

Classification of Premises	Description	Premises design capacity
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.	25 Mtpa (wet) design

Description of proposed activity

Ore Processing Facility

The OPF will produce up to 25 Mtpa (wet) of concentrate, 31.9 Mtpa (wet) of tailings and 10.6 Mtpa of dry rejects. The water use is expected to be 24.5 gigalitres per annum (GL/a) sourced from the Canning Basin borefield and comprising; mine dewatering, return water from the Port Hedland port facility, project bores and water recovered from tailings. Figure 1 shows the location of the Premises (Figure 1).

As part of Stage 1, all dewater will be used onsite, hence category 6 (mine dewatering) is not triggered given there is no discharge to the environment.

Ore will be mined and trucked to the Run of Mine (ROM) pad, then fed through the primary and secondary crushing circuit to a Coarse Ore Stockpile (COS). The ore from the COS will then fed through a tertiary crushing circuit consisting of High Pressure Grinding Rolls (HPGRs) and screens, and then dry magnetic separation to discard silica and non-magnetic materials.

Dry primary grinding grinds the ore using HPGRs in closed circuit with air classification. Rejects from the dry magnetic separation are transferred to the Dry Rejects Landform (DRL) located adjacent to the OPF. This is followed by a wet plant, which includes three stages of magnetic separation, secondary and tertiary fine grinding and two stages of hydro separation.

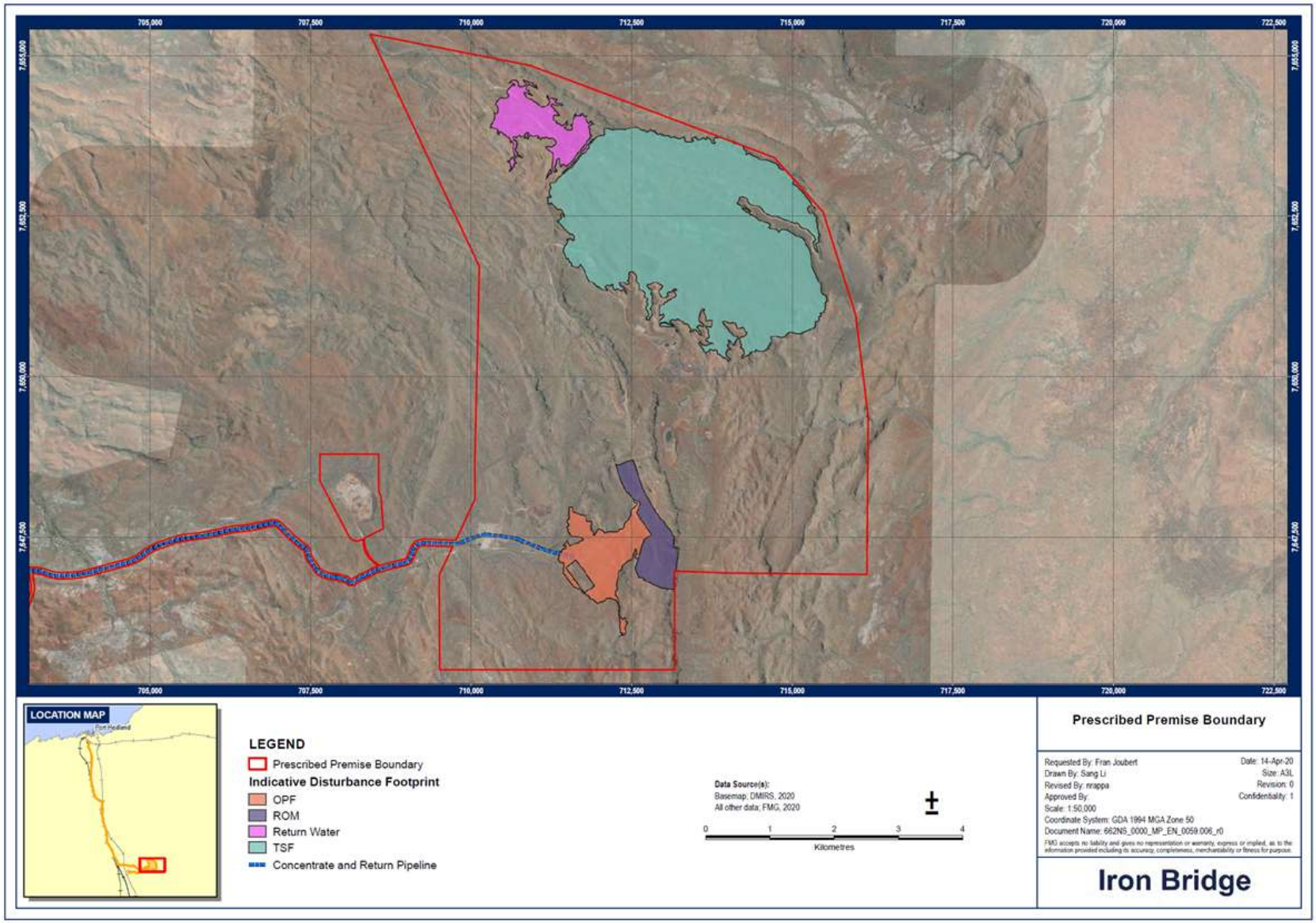

Figure 1: Map of Prescribed Premises

Tailings Storage Facility

The valley fill TSF will include the following key components:

- Embankment Walls
- Tailings storage area
- Distribution pipeline and spigots
- Spillway
- Pontoon mounted recovery pump station
- Return Water Pond (RWP)
- Access roads.

Tailings from wet magnetic separators will be combined with overflow from the hydro separator thickeners in three tailings thickeners prior to being pumped via a 7 km slurry pipeline to the TSF. Tailings will be thickened from 62% to 65% solids. Flocculent (1270 t/a added at 40 g/t) and coagulant (110 t/a added to reduce the amount of residual flocculent in the process water) will be added to the tailings to aid in the sedimentation of suspended solids.

The TSF has been designed for storage of approximately 560 Mt of tailings and at 20 years Life of Mine (LOM) will be approximately 68 m high. The estimated composition of tailings is 18% Fe and 52% SiO_2, containing 19.4 GL/a water. The TSF will be constructed using down-stream methods in seven staged lifts, with an eighth stage contingency lift of 6.5 m providing an additional 4 years of storage, if required. The TSF catchment is 13.5 km^2.

This works approval assessment is for Stage 1 of the TSF. Stage 1 construction of the TSF embankment will be approximately 27 m high. Embankments will be made from local borrow, mine waste rock and plant dry rejects, and include a bituminous geomembrane (BGM) liner. All decant and runoff water collecting on the tailings beach will be conveyed via gravity decant structures (single decant for Stage 1A) constructed on the upstream face of the main TSF embankment. These decant structures direct water into outfall pipes constructed through the embankments to a RWP directly downstream of the TSF. The TSF main embankment decant structures drain water using inverted box culverts with segmented stoplogs on top. There are no additional construction or preparation works proposed on the lateral embankments or top of the TSF (besides for tailings discharge infrastructure) with tailings to flow into and down the existing valley.

Stage 1 of the TSF has been divided into Stage 1A (Figure 2) and Stage 1B (Figure 3), subdividing the TSF valley into a larger, northern arm (Stage 1A) and a smaller, southern arm (Stage 1B) by the construction of a small (8 m) sacrificial bund which will be overtopped as part of Stage 1B deposition. Stage 1A deposition will provide approximately 16 months of storage capacity. During this time, other infrastructure will be constructed to complete Stage 1. Stage 1B provides approximately 8 months of storage capacity, allowing approximately 2 years for completion of Stage 1 prior to requiring the next lift.

Discharge into Stage 1 will be down-valley discharge on a rotational basis from two discharge points/spigots at the head of tributary creek valleys at the eastern end of the TSF area. Further discharge points are proposed for future stages. Permeability in the TSF embankment area ranges from 10^{-6} to 10^{-7} m/s. It is approximately 4.5 km from spigots to the decant system.

TSF freeboard will be designed for a 1:100 annual exceedance probability (AEP) 72 hour rainfall event in addition to the normal operating (decant) pond depth of 400 mm, with the exception of Stage 1A which spills at the sacrificial bund. Spillway capacity for all stages is designed for a minimum 1:100,000 AEP (critical duration) rainfall event, apart from Stage 1B which is designed for a 1:1,000 AEP.

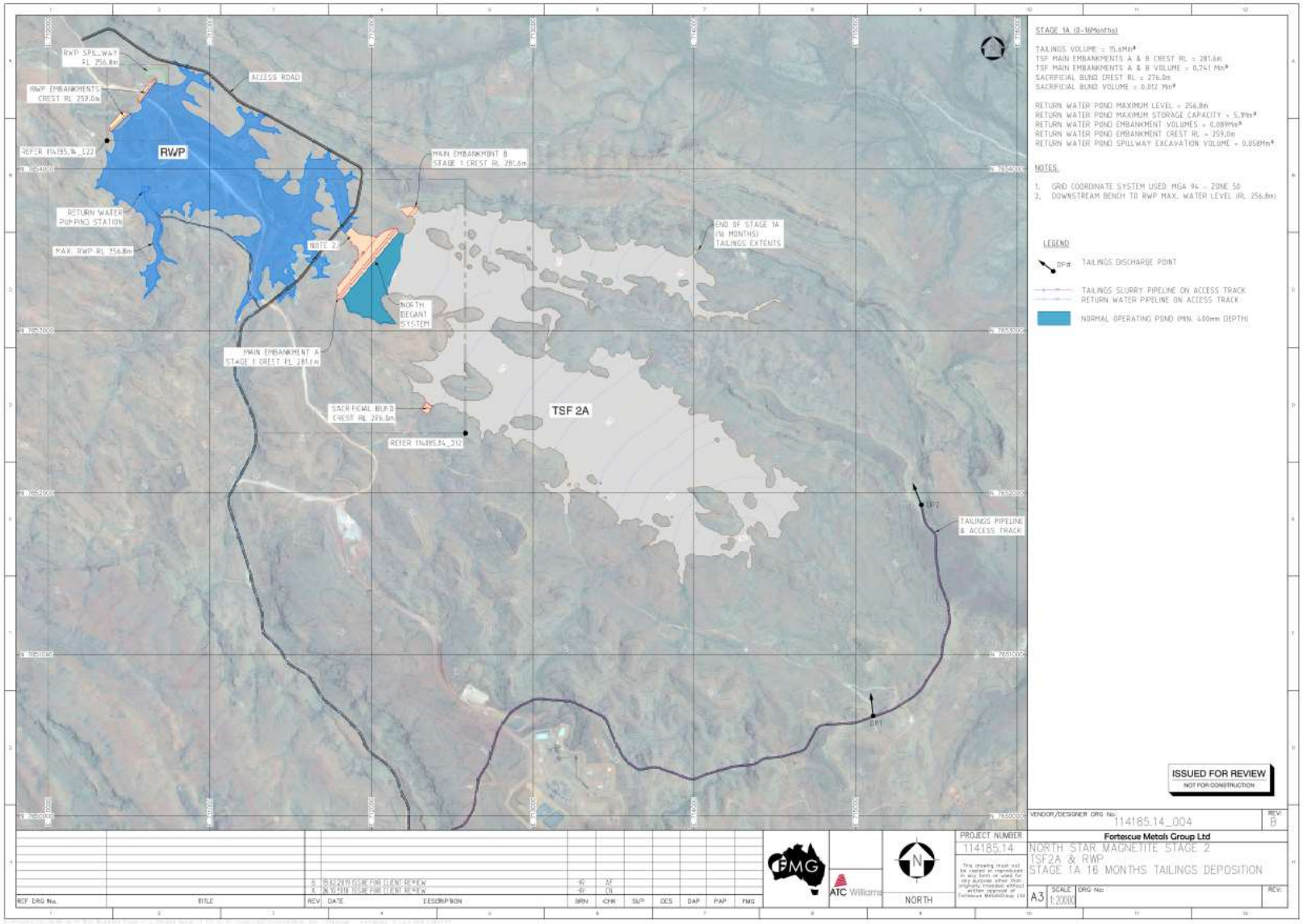

Figure 2: Map of TSF Stage 1A and RWP

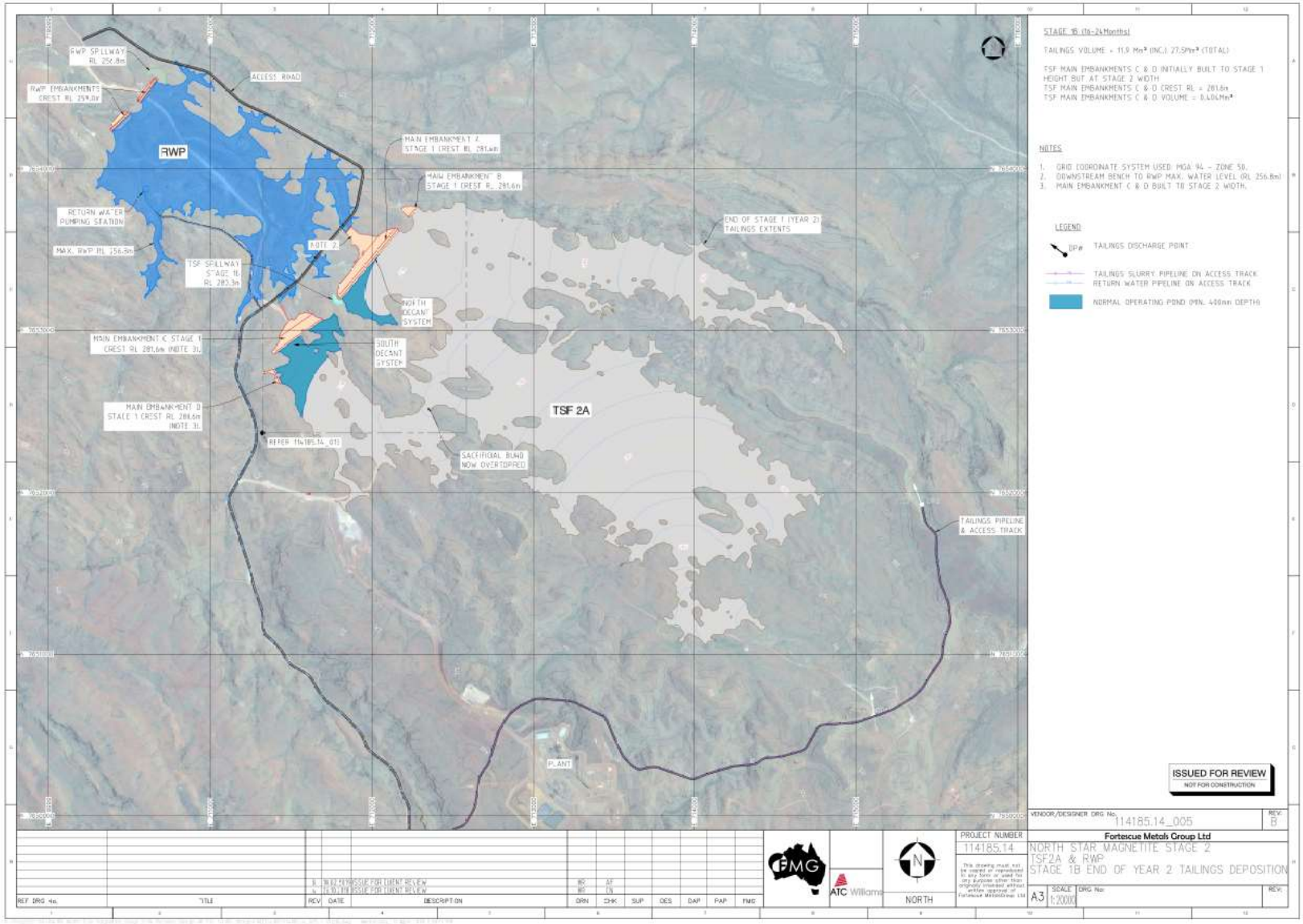

Figure 3: Map of TSF Stage 1B and RWP

Return water pond

Decant and runoff water in the TSF will be conveyed through the TSF embankment to the RWP, once tailings deposition is further advanced. The catchment area for the RWP is 7.1 km^2.

Confinement for accumulated water in the RWP will be achieved by the construction of small embankments (16 m and 9.5 m high respectively) approximately 1.5 km downstream of the TSF embankment. These RWP embankments will be constructed using local borrow, mine waste rock and plant dry rejects, and includes a BGM liner, and will be constructed to full height during the initial construction works.

The return water pumping system will consist of a pontoon-mounted pumping station located within a channel excavated to access the central part of the RWP area from its southern perimeter. All water in the RWP will be pumped to process water ponds and re-used within the OPF only.

Permeability at the RWP embankments is 2 x 10^{-5} m/s (high permeability) to a depth of 20 mbgl. A grout curtain at the upstream toe of the embankment, which ties in to the BGM liner, will be installed to manage seepage as water will pond against the upstream lower portions of the RWP south embankment. The grout curtain is expected to lower permeability to around 3 x 10^{-6} m/s between 15 to 20 mbgl, and expected to lower further to 2x10^{-7} m/s beyond 20 mbgl. The RWP base is unlined.

Pipeline

Processed and concentrated ore will be mixed with water to create a slurry and then pumped via pipeline to Port Hedland. The pipeline route is approximately 135 km long and runs along the existing mine access road and Fortescue Minerals Group (FMG) rail corridor to Port Hedland. At the port (subject of a separate works approval), the slurry will be dewatered to approximately 10% moisture and the decant water returned to the mine via the return water pipeline, to be re-used in the OPF.

The pipelines will be buried to a depth of approximately 1.5 mbgl with minimum 600 mm of cover. Pressure monitoring stations will be established along the pipelines capable of detecting corrosion to maintain safe operation, and sumps installed near inspection and break points. Construction and operation of the pipeline is regulated by the Department of Mines, Industry Regulation and Safety (DMIRS). The applicant has advised that the pipeline will be included in an upcoming Mining Proposal to DMIRS.

Proposed timeframes

Project phase	**Proposed dates**	
Commencement of works	Q2 2020	
Commencement of commissioning	Q4 2020	
Time limited operations (commence)	Q2 2021	
Prescribed Activity	**Timeframe**	**Assessed as part of this works approval**
OPF	20 years	Yes
TSF Stage 1A	16 (commending during time limited operations)	Yes
TSF Stage 1B	8 Months	Yes
TSF Stage 1 (total)	2 years	Yes
TSF Stage 7 (complete)	20 years	No
RWP	20 years	Yes

Environmental siting

The distances to residential and other sensitive receptors are detailed in **Table 2**.

Table 2: Receptors and distance from activity boundary

Sensitive receptors	Distance from Prescribed Activity
Residential Premises	There are no residential receptors within a 30 km radius of the Premises
Other mining areas	Atlas Iron Limited – Abydos Ore Project – 7 km north east BHP Billiton Iron Ore Pty Ltd - Turner Camp – 16 km south west Altura Lithium Operations Pty Ltd - Pilgangoora Lithium Project – 21 km north west Wodgina Lithium Pty Ltd - Wodgina Operations – 32 km west
Chinnamon Creek	Crossing from the north into the proposed TSF area within the premises boundary and flows down the valley TSF (Figure 4)
Turner River	Approximately 20 km downstream and west of the activity

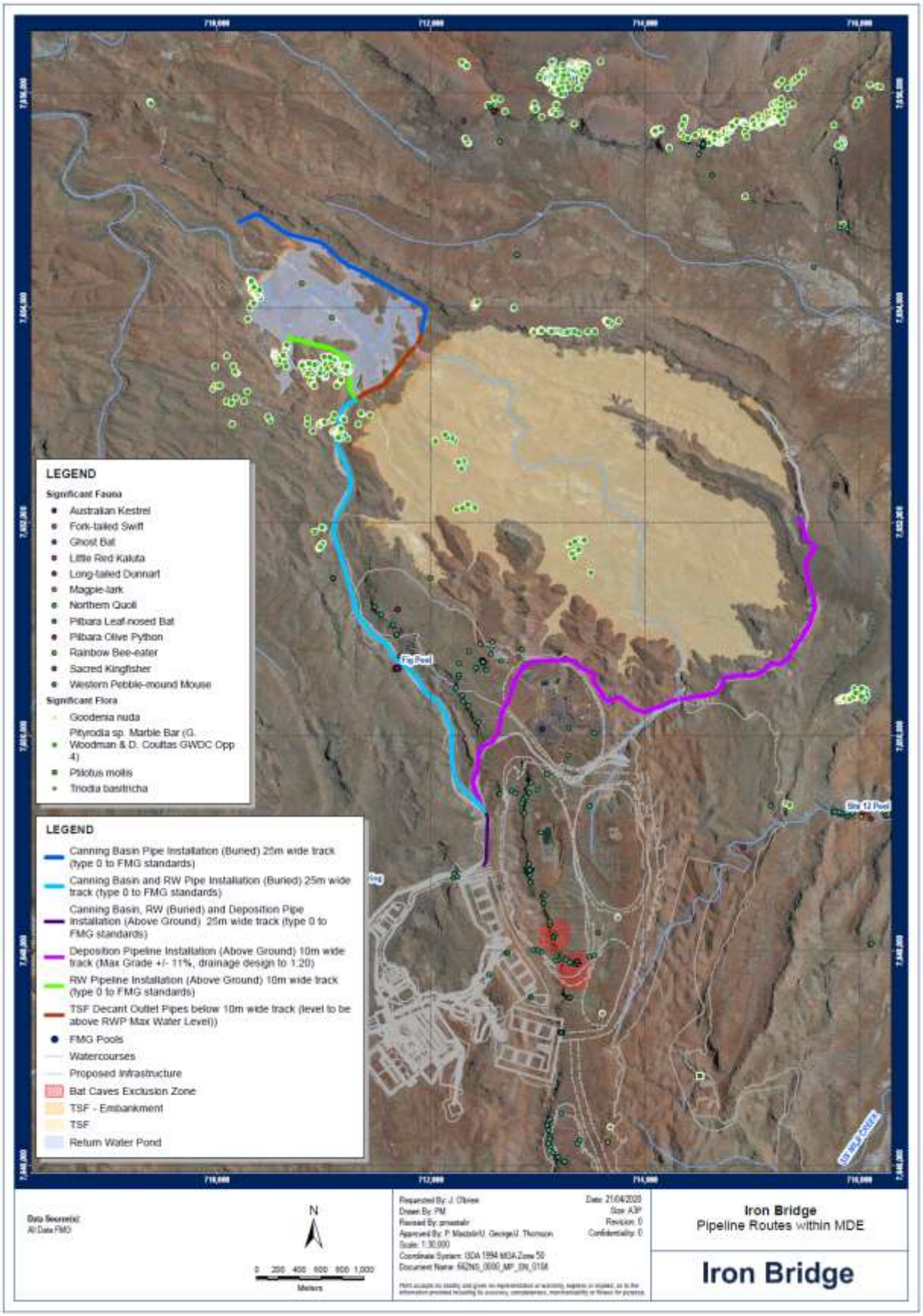

Figure 4: Map of TSF and RWP pipelines, sensitive receptors and specified ecosystems in the immediate area

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 3**. **Table 3** also identifies the distances to other relevant ecosystem values which do not fit the definition of a specified ecosystem.

Table 3: Environmental values

Specified ecosystems	Distance from the Premises
Ramsar Sites in Western Australia	Eighty Mile Beach approximately 160 km to the north east of the Premises
Important wetlands – Western Australia	De Grey River approximately 95 km north east of the Premises Leslie (Port Hedland) Saltfields System approximately 100 km north of the Premises Fortescue Marshes approximately 110 km south of the Premises
RIWI Act Pilbara Groundwater Area	Premises is within the Area
RIWI Act Pilbara Surface Water Area	Premises is within the Area
Department of Biodiversity, Conservation and Attractions Managed Lands and Waters	Mungaroona Range Nature Reserve approximately 70 km south west of the Premises
Threatened Ecological Communities and Priority Ecological Communities	Survey work did not record any Threatened Ecological Communities (TECs) or Priority Ecological Communities (PECs) within the proposal's development envelopes (Source: Environmental Protection Authority [EPA] Report 1514). Nearest PECs are as follows: • Priority 1, Four plant assemblages of the Wona Land System approximately 90 km south and 125 km south west of the Premises • Priority 1, Freshwater claypans downstream of the Fortescue Marsh - Goodiadarrie Hills on Mulga Downs Station (Koodjeepindarranna Pool and GnoonaPool – South) approximately 110 km south west of the Premises • Priority 3, Eighty Mile Land System approximately 125 km north of the Premises, And therefore not a sensitive receptor to the proposed activities.

Specified ecosystems	Distance from the Premises
Biological component	**Distance from the Premises**
Threatened or Priority Flora	No Threatened has been reported within the premises boundary or within 3 km of the proposed activity (information from the Department mapping database) – not considered sensitive receptors to the proposed activities. Priority 1 listed flora, Pityrodia sp. Marble Bar, are in the area and managed via the Part IV EPA process (Source: EPA Report 1514). Shown in Figure 4
Threatened or Priority Fauna	Pilbara Leaf-nosed Bat, Northern Quoll and Pilbara Olive Python are found in the area (Source: EPA Report 1514). Shown in Figure 4
Other relevant ecosystem values	**Distance from the Premises**
Site 12 Pool	Located outside the eastern boundary of the Prescribed Premises, four individuals of the Pilbara Olive Python recorded which is an unusually high number of individuals for this species and suggests that this pool is particularly important habitat for this species (Source: EPA Report 1514). Shown in Figure 4
Cave 13	Located toward the southern boundary of the Prescribed Premises. Cave 13 is a maternal roost cave for a large colony of approximately 200-250 individuals of Pilbara Leaf-nosed Bat and is located within the Mine Development Envelope. All natural known roost caves in the Pilbara region are habitat critical to the viability of the Pilbara Leaf-nosed Bat and a Mine Exclusion Zone of 100 m from the predicted lateral extent of Cave 13 has been imposed (Source: EPA Report 1514). Shown in Figure 4

The distances to groundwater and water sources are shown in **Table 4**.

Table 4: Groundwater and water sources

Groundwater and water sources	Distance from Premises	Environmental value
Major watercourses/ waterbodies	The Turner River is approximately 20 km downstream and west of the proposed activities. Two main ephemeral drainage lines are located within the Prescribed Premises: • Chinnamon Creek is located within the area required for the TSF, which ultimately flows into the Turner River. Shown in Figure 4. • An unnamed creek which roughly travels parallel to the mine access road and flows into the Turner River.	The Project lies on the catchment boundary of Turner River and Strelley River.

Groundwater and water sources	Distance from Premises	Environmental value
Unnamed ephemeral Creeks which flow into the Turner River.	Numerous creek lines cross the Project area.	Drainage lines in the region are ephemeral in nature and generally only flow for short durations following rainfall events. Intermittent flows normally occur during the wet season with long periods without flows during the dry season.
Groundwater	Groundwater in the valley floor area of the TSF occurs at depths typically ranging from 2.3 m to 6.6 m with an inferred hydraulic gradient of 1:100 towards the north-west.	Groundwater salinity within the exploration and production bores is relatively low (fresh) to brackish ranging between 300 mg/L and 3,500 mg/L.

The area experiences a dry desert climate, with hot dry summers and mild winters. Temperatures are generally high and mean annual rainfall is 394 mm. Evaporation rates are expected to be approximately 9 mm per day.

Legislative context and other approvals

The relevant approvals for this works approval are outlined in Table 4 below.

Table 4: Relevant approvals

Legislation	Approval identification Number(s)	Description
Mining Act 1978	Reg ID 84768	Under assessment; approval for the construction of the TSF and RWP embankments is expected by 30 April 2020. Future Mining Proposals and Mining Proposal amendments will include the assessment of deposition of tailings into the TSF, and the concentrate slurry and return water pipeline from Port Hedland port.
Environmental Protection Act 1986 (EP Act) Part IV	Ministerial Statement 993 (MS 993)	The proposed activities are within the Development Envelope. Conditions predominately relate to surveys and management plans to protect priority fauna within the Mine Development Envelope.
Environment Protection and Biodiversity Conservation Act 1999 (Cth)	Decision Notice EPBC 2012/6689	The Project was a controlled action for impacts to listed threatened species and communities (sections 18 &18A of the EPBC Act), approved with conditions on 5 February 2015.
EP Act Part V (Clearing)	CPS 5427/5 CPS 6106/2 CPS 6236/2	In addition, clearing permit exemption applies under MS 993.
Rights in Water and Irrigation Act 1914	GWL179289 CAW203155(1)	Applicant is not applying for further licences or permits – a valid licence/permit applies.
Dangerous Goods Licence	N/A	Yet to be acquired

Part IV of the EP Act

The EPA report (Assessment 1946) assessed impacts from an open cut iron ore mine (above ground), tailings storage facility, waste rock dump and borefield (located in the Canning Basin, 160 km north-east of the mine area), water pipeline infrastructure, and a slurry pipeline connecting the mine to facilities in Port Hedland. The EPA report considered the proposal mine life of 45 years to generate up to 15 Mtpa of product. The proposal abstraction was 14 GL/a of water from the confined Wallal Aquifer located within the Canning Basin borefield.

The EPA considered the following key environmental factors in their assessment:

- Flora and Vegetation;
- Terrestrial Fauna;
- Subterranean Fauna;
- Hydrological Processes and Inland Waters Environmental Quality; and
- Offsets – integrating factor.

Ministerial Statement (MS) 993 was set based on the outcome of the assessment of the above factors. Conditions within MS 993 involve management of the mine, borefield and linear infrastructure to avoid rare and priority flora species, fauna species and threatened ecological communities, and to rescue fauna trapped in trenches associated with the construction of the linear infrastructure. Conditions also relate to ensuring no detrimental impact to the water quality or hydrological regime of Site 12 Pool, which is Pilbara Olive Python habitat.

Several attachments to MS 993 exist and Attachment 2 (approved on 8 March 2019) relates to the increase in abstraction from the borefield from 14 GL/a up to 20 GL/a. This increase allowed for augmented ore production from 15 Mtpa to 25 Mtpa. An Acid Mine Drainage (AMD) Plan will also be developed.

Therefore, management of impacts from clearing on flora/vegetation and fauna, and from groundwater abstraction are not discussed in this assessment. General impacts to vegetation relating to dust emissions, groundwater impacts related to tailings storage, and management of contaminated stormwater will be discussed, as these were not considered to be key environmental factors requiring evaluation by the EPA.

Part V of the EP Act

The overarching legislative framework of this assessment is the EP Act and EP Regulations. The guidance statements which inform this assessment are listed in Appendix 1. The works approval and licence history for the site are listed below in **Table 5**.

The application for a works approval was submitted by the applicant under Division 3 Part V of the EP Act on 22 October 2019. The application was advertised in the West Australian and the Department's website on 21 January 2020 for 23 days. No submissions were received.

The application was referred to DMIRS and the Shire of East Pilbara on 17 January 2020, with no objections to the application.

Communication from DMIRS indicates the Mining Proposal (MP) for the construction of the TSF and RWP is yet to be approved. It is also apparent that tailings are not included in the MP as the generation of these will be from below the water table and it is expected that there will be Potentially Acid Forming (PAF) materials with significant PAF/AMD risks for the Project. DMIRS has advised they are awaiting further information on this prior to a new MP being submitted.

Key Findings:

1. **The Mining Proposal is not yet endorsed by DMIRS.**
2. **DMIRS expect PAF and AMD risks for the Project.**
3. **The works approval application is at variance to DMIRS concerns, and should the design, emissions, or risk to receptors change, an updated Part V approval will be required.**

Table 5: Works approval and licence history

Instrument	Issued	Nature and extent of works approval, licence or amendment
L8845/2014/1	08/06/2015	New Licence
L8845/2014/1	07/01/2016	Amendment to add category 5
L8845/2014/1	02/06/2016	Amendment to increase category 5, add category 54 and decrease category 5 throughput.
L8845/2014/1	24/05/2017	Amendment Notice 1 for Category 54 activities during care and maintenance, general stormwater management and administrative changes.
L8845/2014/1	03/10/2018	Amendment Notice 2 to amend the TSF inspection requirements.
L8845/2014/1	13/02/2020	Amendment 3 to include a temporary 45 m^3/day WWTP.
W6315/2019/1	24/03/2020	Works Approval for a new WWTP, irrigation field, used tyre storage facility, waste transfer station, bulk fuel storage facility and landfill facility.
W6322/2019/1	24/04/2020	This assessment – to construct the OPF, TSF and associated infrastructure.

Monitoring and testing

Ambient groundwater

Depth to groundwater is at most embankment locations between 2.5 mbgl and 21.5 mbgl, depending on surface elevation, and in the TSF valley floor area at depths ranging of 2.3 m to 6.6 mbgl. The inferred groundwater elevation ranges from RL 241.7 m to RL 270.4 m at the TSF location, within an assumed hydraulic gradient of 1:100 towards the North West.

Groundwater quality is classed as fresh to slightly brackish with recorded values of total dissolved solids (TDS) in the range of 300 mg/L to 3,500 mg/L.

Groundwater monitoring results reported in the recent Annual Environmental Report (AER) (shown in Table 6 and Table 7, bore locations in Figure 5) which are within the TSF footprint, shows that groundwater levels in the TSF area (north of the current onsite Stage 1 TSF shown in Figure 5) can be shallow (2.88 m) and can fluctuate, suggesting that groundwater levels in the area may be responsive to significant rainfall.

TDS varied between 176 to 652 mg/L and pH was approximately neutral (6.76 – 7.75). Metals concentrations meet ANZECC/ARMCANZ (2000) livestock drinking water quality guidelines and ANZECC/ARMCANZ (2000) 95% species protection levels for freshwater, with the exception of copper (trigger level 0.0014 mg/L) and zinc (trigger level of 0.008 mg/L) which were generally exceeded.

Key Findings:

1. **Local groundwater quality is suitable for livestock.**

Table 6: Standing water levels and pH

Sample date	Standing Water Level		pH	
	Site NS-0624 (mbrp)	Site NS-0663 (mbrp)	Site NS-0624	Site NS-0663
10/01/2019	7.01	4.34	6.76	7.53
30/05/2019	2.88	-	7.74	7.75
27/06/2019	3.38	2.88	7.67	7.57
24/07/2019	3.95	3.03	7.54	7.53
29/08/2019	4.66	3.22	7.74	7.63
28/09/2019	5.07	3.38	7.62	7.7
30/10/2019	5.54	3.5	7.57	7.62
24/11/2019	5.86	3.79	7.51	7.59
17/12/2019	5.92	3.67	7.66	7.44

Table 7: Groundwater monitoring undertaken in 2019

Parameter	Units	Sample date: 10 January 2019		Sample date: 25 July 2019	
		Site NS-0624	Site NS-0663	Site NS-0624	Site NS-0663
pH	--	6.76	7.53	7.54	7.53
Electrical Conductivity	µS/cm	997	345	754	188
Total Dissolved Solids (TDS)	mg/L	652	176	490	122
Aluminium	mg/L	0.01	0.02	<0.005	0.005
Arsenic	mg/L	0.001	0.002	0.0012	0.0009
Berylium	mg/L	<0.001	<0.001	<0.0001	<0.0001
Boron	mg/L	0.3	0.1	0.174	0.008
Cadmium	mg/L	<0.0001	<0.0001	<0.00005	<0.00005
Chromium	mg/L	<0.001	<0.0001	0.0008	0.0006
Cobalt	mg/L	<0.001	<0.0001	<0.0001	0.0004
Copper	mg/L	**0.012**	**0.002**	0.0006	**0.0015**
Fluoride	mg/L	0.6	0.1	0.421	0.068
Iron	mg/L	<0.05	0.24	<0.002	0.006
Lead	mg/L	<0.001	<0.001	<0.0001	<0.0001
Manganese	mg/L	0.035	0.2	0.0012	0.0022
Mercury	mg/L	<0.0001	<0.0001	<0.00004	<0.00004
Molybdenum	mg/L	<0.001	<0.001	0.0012	0.0009
Nickel	mg/L	0.002	0.001	0.0007	0.0022
Selenium	mg/L	<0.01	<0.01	0.0007	0.0007
Uranium	mg/L	0.002	<0.001	0.00205	0.00011
Vanadium	mg/L	<0.01	<0.01	0.0038	0.0028
Zinc	mg/L	**0.05**	**0.01**	**0.010**	**0.075**

Bold text – exceeds trigger levels for ANZECC/ARMCANZ (2000) 95% species protection levels for freshwater.

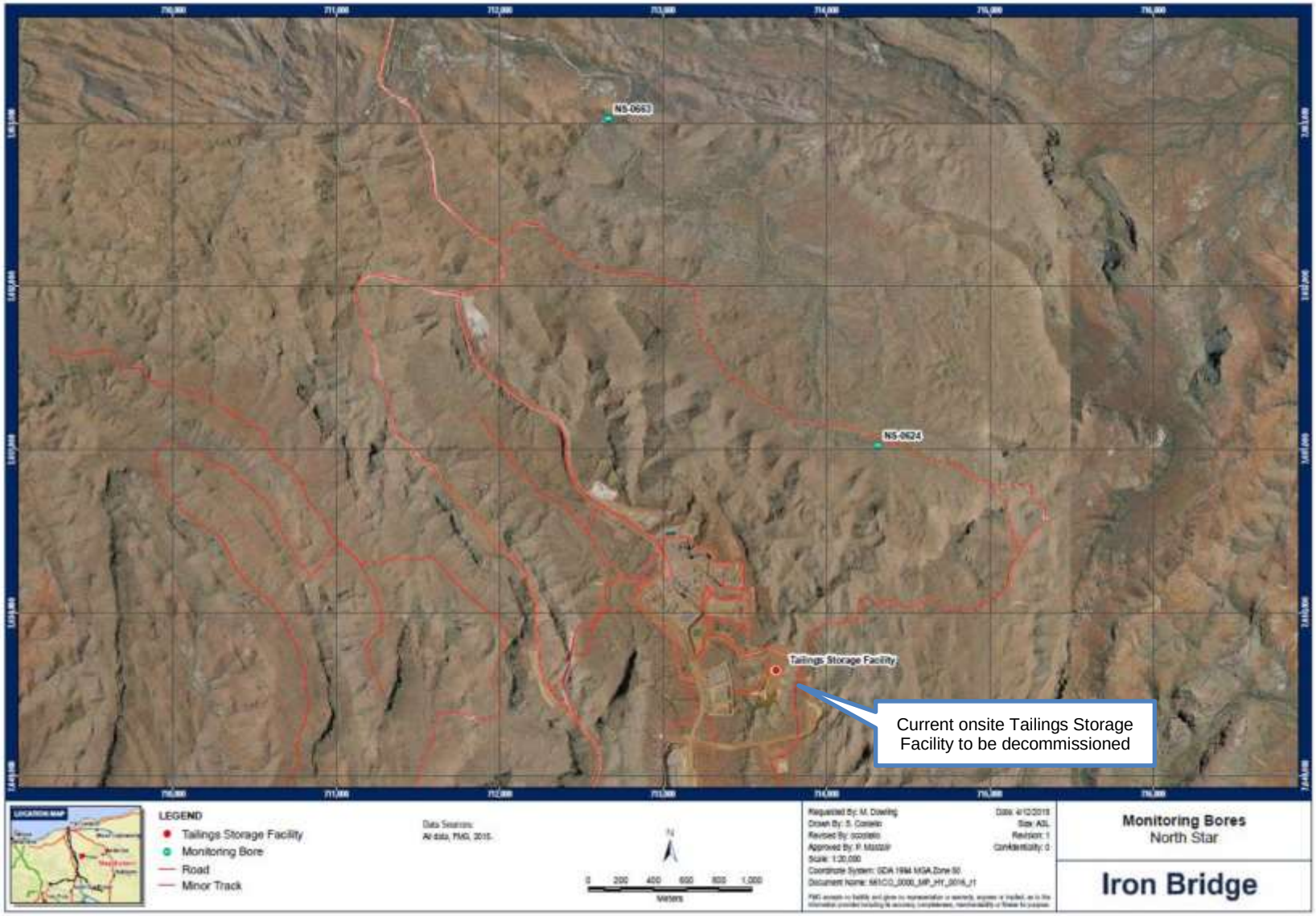

Figure 5: Existing groundwater bores

Tailings characterisation

Two rounds of tailings characterisation testing were been undertaken for the project; one in 2015 and one in 2016. The 2015 samples contained two separate streams that were both tested, denoted as “Figure 5” and “Figure 6”, with a Particle Size Distribution (PSD) of 42 µm to 45 µm, respectively. Sample size was three 20 Litre samples. The 2016 samples contained two streams that were combined, denoted as “Combined Tailings” and had a PSD of 75 µm. Sample size was eight 10 Litre samples.

The current composition of the tailings PSD is approximately 40 µm indicating characterisation of tailings samples conducted in 2015 represent the most appropriate data. However, not all tests were undertaken on the 2015 sample; hence, some results have been extrapolated from the 2016 sampling.

Material characterisation tests that were conducted for both the 2015 and 2016 samples included:

- PSD and hydrometer
- Atterberg Limits
- Soil Particle Density / Specific Gravity (SG)
- Initial Settled Density
- Rotational Rheology.

Material characterisation tests conducted for the 2016 samples included:

- Segregation Threshold
- Shrinkage Limit Density.

As the shrinkage limit density and segregation threshold tests were not conducted on the 2015 samples, a comparison and interpolation exercise was conducted using the 2016 wet tailings testwork. Results are shown in **Table 8**.

Table 8: Tailings testwork results

Test	2015 “Figure 5”	2015 “Figure 6”	2016 “Combined Tailings”
Particle size distribution (P80)	45 µm	42 µm	75 µm
Atterberg Limits - Liquid Limit	25	19	18
Atterberg Limits - Plasticity Index	4	2	2
Particle Density (t/m^3)	2.97	2.97	3.04
Segregation Threshold	*Not tested estimated to be 52% - 55%*		58%
Unified Soil Classification	Low plasticity Silt		Low plasticity Silt
Initial Settled Density - Solids Content (%)	65	65	65
Initial Settled Density - Density (t/m^3)	1.45	1.43	1.52
Shrinkage Limit Density (t/m^3)	*Not tested – estimated to be 1.75 – 1.80*		1.87
Bleed Water Rate (m^3/t)*	0.19		0.21

*Equates to just under 40% of the water contained in the slurry being released to flow to the decant pond at discharge.

Seven Long term (12 month) kinetic leachate tests were conducted in 2012/2013 on waste rock and tailings samples. The tailings samples were reported to be acid consuming whereas the waste rock samples were found to be Non-Acid Forming (NAF) to PAF.

Further static (short term) testing was undertaken in 2015 for tailings and waste rock materials on a total of 44 samples to assess changes in the expected iron recovery rate in the process. The short-term testing found that all tailings samples were NAF. Of the waste rock, most of the samples were likely to be NAF with excess Acid Neutralising Capacity (ANC); however, approximately 20% of all samples of waste rock materials were found to be PAF.

X-ray diffraction (XRD) analyses were conducted to identify the mineralogy of waste rock and tailings. Sulfide minerals were identified in ten of the 46 waste rock samples.

Two types of tailings were tested; oxide tailings and fresh tailings samples. The oxide tailings were mainly quartz and iron oxide, with no sulfide or carbonate minerals identified. The fresh tailings samples contained a wide variety of minerals and no pyrite (or any other sulfide phase) was detected; however, trace phases may still be contained within tailings, below the XRD detection limit. Significant sulfate mineral content (fibroferrite) was observed in the fresh tailings. While the potential for acid formation from fibroferrite is lower than pyrite, this could act as a temporary sink for acidity.

Key Findings:

1. **Settling tests not conducted on the 2015 or 2016 samples, noting no samples undertaken since.**
2. **Approximately 40% of the water contained in the slurry is expected to be released from the tailings to flow to the decant pond at discharge.**
3. **There is a considerable distance from the tailings initial deposition to the decant embankment (kms).**
4. **PAF materials may be present in the waste rock, based on the 2015 and 2016 samples.**
5. **No sulfide or carbonate minerals identified in the oxide tailings sampled.**
6. **Fresh tailings contains significant sulfate mineral fibroferrite and may contain trace sulphide phases.**
7. **DMIRS has not yet approved the Mining Proposal.**

Risk assessment

Table 9: Determination of emission, pathway, receptor and Regulatory Controls

Risk Event					Consequence rating*	Likelihood rating*	Risk*	Reasoning	Regulatory controls (Refer to conditions of the granted works approval)
Source/Activities		**Potential emissions**	**Potential receptors**	**Potential pathway & receptor (impact)**					
Category 5: Processing or beneficiation of metallic or non-metallic ore Construction of the Ore Processing Facility, the Tailings Storage Facility and the tailings slurry and decant water pipelines	Earthworks, vehicle movements, construction of infrastructure	Noise	Closest receptor is the Atlas Iron Limited Abydos Ore Project accommodation camp located 7 km north east of the mine.	Air / wind dispersion, causing amenity impacts	N/A	N/A	N/A	The Delegated Officer considers there is sufficient separation from sensitive receptors to mitigate the risk of noise impacts. Construction is within an existing mine/processing area and for a finite period of time. The Delegated Officer also considers the Environmental Protection (Noise) Regulations 1997 sufficient to regulate noise emissions from the premises.	None specified
		Dust	Closest receptor is the Atlas Iron Limited Abydos Ore Project accommodation camp located 7 km north east of the mine; and vegetation adjacent the mine	Air / wind dispersion causing dust impacts, potential health impacts, smothering vegetation impacting photosynthesis	N/A	N/A	N/A	The Delegated Officer considers there is sufficient separation from sensitive receptors and specified ecosystems to mitigate the risk of dust impacts. Construction is within an existing mine/processing area and for a finite period of time.	None specified
	Use and storage of hydrocarbons and reagents	Spills and breach of containment causing hydrocarbon or chemical discharge to land.	Soil and vegetation adjacent to areas of spill or breach Groundwater is greater than 2 mbgl	Direct discharge to land and infiltration to groundwater impacting soil, inhibiting vegetation growth/survival, health impacts to fauna, groundwater contamination	N/A	N/A	N/A	The applicant has committed to comply with Australian Standard AS 1940 *The Storage and Handling of Flammable and Combustible Liquids*. The applicant has committed to: • Providing spill response equipment including absorbent socks, pillows or mats will be available • Locating key infrastructure above 100 year floodplain or using bunding to divert stormwater. The Delegated Officer considers there is sufficient separation from sensitive receptors, and that the proposed management measures adequately mitigate the risk of spills and breach of containment, and considers that additional regulatory controls are not required to mitigate this risk.	None specified
	ROM pad and stockpiles	Dust	Closest receptor is the Atlas Iron Limited Abydos Ore Project accommodation camp located 7 km north east of the mine; and Vegetation adjacent the mine	Air / wind dispersion causing dust impacts, potential health impacts, smothering vegetation impacting photosynthesis	Minimal onsite impact **Slight**	Not likely to occur in most circumstances **Unlikely**	**Low** Acceptable, not subject to controls	The applicant has committed to the following management measures during operation: • Water fogging sprays at key transfer points in the truck dumping locations at the ROM pad. • Discharge conveyor transfer points will be enclosed (covered by metal framework with rubber aprons attached to the inlet and outlet chutes) and dust suppression sprays used. • Water trucks will be available to wet down the stockpiles and prevent dust lift off as required. The Delegated Officer notes that in the EPA Report 1514, testing for asbestiform/fibrous materials was conducted and concluded that the geology at the mine does not support the formation of these materials. The Delegated Officer notes that management of asbestiform material is managed by the DMIRS. The Delegated Officer considers there is sufficient separation from sensitive receptors, and that the proposed management measures adequately mitigate the risk of dust impacts, and considers that additional regulatory controls are not required to mitigate this risk.	None
		Noise	Closest receptor is the Atlas Iron Limited Abydos Ore Project accommodation camp located 7 km north east of the mine	Air / wind dispersion causing amenity impacts	Minimal onsite impact **Slight**	Not likely to occur in most circumstances **Unlikely**	**Low** Acceptable, not subject to controls	The applicant has committed to the following management measures: • Low-noise equipment will be used to minimise noise during operation, where practicable. • Engines will be enclosed or screened for safety and operational purposes. The Delegated Officer notes that the Environmental Protection (Noise) Regulations 1997 apply and considers there is sufficient separation from sensitive receptors and as such, additional regulatory controls are not required to mitigate this risk.	None

Risk Event					Consequence rating*	Likelihood rating*	Risk*	Reasoning	Regulatory controls (Refer to conditions of the granted works approval)
Source/Activities		**Potential emissions**	**Potential receptors**	**Potential pathway & receptor (impact)**					
Category 5: Processing or beneficiation of metallic or non-metallic ore Commissioning and operation of the Ore Processing Facility		Contaminated stormwater (hydrocarbons and sediment)	Soil and surface water receptors [Chinnamon Creek (Immediately north of the Premises) which feeds into the Turner River 20 km downstream]	Direct discharge to land causing contamination of soil and impacts to surface water	Minimal onsite impact **Slight**	Could occur at some time **Possible**	**Low** Acceptable, not subject to controls	The applicant has committed to the following management measures: • Separate clean and potentially contaminated stormwater; divert clean stormwater away from work areas where practicable. • Direct all potentially contaminated stormwater to sedimentation basins or sediment traps prior to release to the environment. • Clean and maintain sedimentation basins and sediment traps as required to maintain capacity. In accordance with the Department's Guidance Statement: Risk Assessments (DER, 2017a), as these controls lower the risk of impacts, they will be conditioned in the works approval and licence.	<u>Works approval controls:</u> - Requirement to direct potentially contaminated stormwater to sedimentation basins or sediment traps.
	Crushing, grinding, screening and air classification	Dust	Closest receptor is the Atlas Iron Limited Abydos Ore Project accommodation camp located 7 km north east of the mine; and Vegetation adjacent the mine	Air / wind dispersion causing dust impacts, potential health impacts, smothering vegetation impacting photosynthesis	Minimal onsite impact **Slight**	Not likely to occur in most circumstances **Unlikely**	**Low** Acceptable, not subject to controls	The applicant has committed to the following management measures: • Water fogging sprays at key transfer points. • A baghouse dust collection system connected to the crushing rollers. • Feed and discharge transfer points are enclosed (covered by metal framework with rubber aprons attached to the inlet and outlet chutes). • Coarse material from the Air Classifiers is fed along a skirted conveyor into a down chute. • Use of trouser leg chutes to reduce potential for dust lift off. The Delegated Officer considers there is sufficient separation from sensitive receptors, and that the proposed management measures adequately mitigate the risk of dust impacts, and considers that additional regulatory controls are not required to mitigate this risk.	None
		Noise	Closest receptor is the Atlas Iron Limited Abydos Ore Project accommodation camp located 7 km north east of the mine	Air / wind dispersion causing amenity impacts	Minimal onsite impact **Slight**	Not likely to occur in most circumstances **Unlikely**	**Low** Acceptable, not subject to controls	The applicant has committed to the following management measures: • Low-noise equipment will be used to minimise noise during operation, where practicable. • Crushers, engines and screening operations will be enclosed or screened for safety and operational purposes (e.g. prevent projectiles). The Delegated Officer notes that the *Environmental Protection (Noise) Regulations 1997* apply and considers there is sufficient separation from sensitive receptors and as such, additional regulatory controls are not required to mitigate this risk.	None
		Contaminated stormwater (hydrocarbons and sediment)	Soil and surface water receptors [Chinnamon Creek (Immediately north of the Premises) which feeds into the Turner River 20 km downstream]	Direct discharge to land causing contamination of soil and impacts to surface water	Minimal onsite impact **Slight**	Could occur at some time **Possible**	**Low** Acceptable, not subject to controls	The applicant has committed to the following management measures: • Clean and maintain sedimentation basins and sediment traps as required to maintain capacity. • Install and operate auto shut off valves within the OPF and crushing hubs to ensure water is added only when ore is present. In accordance with the Department's Guidance Statement: Risk Assessments (DER, 2017a), as these controls lower the risk of impacts, they will be conditioned in the works approval and licence.	<u>Works approval controls:</u> - Requirement to direct potentially contaminated stormwater to sedimentation basins or sediment traps.
	Mobile crushing	Dust	Closest receptor is the Atlas Iron Limited Abydos Ore Project accommodation camp located 7 km north east of the mine; and vegetation adjacent the mine	Air / wind dispersion causing Dust impacts, potential health impacts, smothering vegetation impacting photosynthesis	Minimal onsite impact **Slight**	Not likely to occur in most circumstances **Unlikely**	**Low** Acceptable, not subject to controls	The applicant has committed to the following management measures: • Water fogging sprays at key transfer points. The Delegated Officer considers there is sufficient separation from sensitive receptors, and that the proposed management measures adequately mitigate the risk of dust impacts, and considers that additional regulatory controls are not required to mitigate this risk.	None
		Noise	Closest receptor is the Atlas Iron Limited Abydos Ore Project accommodation camp located 7 km north east of the mine.	Air / wind dispersion causing amenity impacts	Minimal onsite impact **Slight**	Not likely to occur in most circumstances **Unlikely**	**Low** Acceptable, not subject to controls	The applicant has committed to the following management measures: • Low-noise equipment will be used to minimise noise during operation, where practicable. • Crushers will be enclosed or screened for safety and operational purposes (e.g. prevent projectiles). The Delegated Officer notes that the *Environmental Protection (Noise) Regulations 1997* apply and considers there is sufficient separation from sensitive receptors and as such, additional regulatory controls are not required to mitigate this risk.	None

Risk Event					Consequence rating*	Likelihood rating*	Risk*	Reasoning	Regulatory controls (Refer to conditions of the granted works approval)
Source/Activities		**Potential emissions**	**Potential receptors**	**Potential pathway & receptor (impact)**					
		Contaminated stormwater (hydrocarbon)	Soil and surface water receptors [Chinnamon Creek (Immediately north of the Premises) which feeds into the Turner River 20 km downstream]	Direct discharge to land causing contamination of soil and impacts to surface water	Minimal onsite impact **Slight**	Could occur at some time **Possible**	**Low** Acceptable, not subject to controls	The applicant has committed to the following management measures: • Clean and maintain sedimentation basins and sediment traps as required to maintain capacity. The Delegated Officer considers there is sufficient separation from sensitive receptors, and that the proposed management measures adequately mitigate the risk of discharge to land, and considers that additional regulatory controls are not required to mitigate this risk.	None
	Processing of ore, including magnetic separation, fine grinding, desliming, screening and concentrating	Dust	Closest receptor is the Atlas Iron Limited Abydos Ore Project accommodation camp located 7 km north east of the mine; and vegetation adjacent the mine	Air / wind dispersion causing Dust impacts, potential health impacts, smothering vegetation impacting photosynthesis	N/A	N/A	N/A	The Delegated Officer considers that, as the processes use wet feeds, dust production would be limited, and there is sufficient separation from sensitive receptors to mitigate the risk of dust impacts.	N/A
		Noise	Closest receptor is the Atlas Iron Limited Abydos Ore Project accommodation camp located 7 km north east of the mine	Air / wind dispersion causing amenity impacts	Minimal onsite impact **Slight**	Not likely to occur in most circumstances **Unlikely**	**Low** Acceptable, not subject to controls	The applicant has committed to the following management measures: • Low-noise equipment will be used to minimise noise during operation, where practicable. • Engines and screening operations will be enclosed or screened for safety and operational purposes (e.g. prevent projectiles). The Delegated Officer notes that the Environmental Protection (Noise) Regulations 1997 apply and considers there is sufficient separation from sensitive receptors and as such, additional regulatory controls are not required to mitigate this risk.	None
		Spills and breach of containment causing release of ore and waste (tailings) prior to discharging to the TSF.	Surface water receptors; Chinnamon Creek (Immediately north of the Premises) which feeds into the Turner River 20 km downstream	Direct discharge to land causing contamination of surface water	Minimal onsite impact **Slight**	Not likely to occur in most circumstances **Unlikely**	**Low** Acceptable, not subject to controls	The applicant has committed to the following management measures: • OPF will be located on a raised earthen pad raised above flood levels • OPF sloped at approximately two degrees to designated sediment basins. The Delegated Officer considers there is sufficient separation from sensitive receptors, and that the proposed management measures adequately mitigate the risk of impacts to surface water, and considers that additional regulatory controls are not required to mitigate this risk.	None
		Contaminated stormwater (hydrocarbons and sediment)	Soil and surface water receptors [Chinnamon Creek (Immediately north of the Premises) which feeds into the Turner River 20 km downstream]	Direct discharge to land causing contamination of soil and impacts to surface water	Minimal onsite impact **Slight**	Could occur at some time **Possible**	**Low** Acceptable, not subject to controls	The applicant has committed to the following management measures: • Clean and maintain sedimentation basins and sediment traps as required to maintain capacity. • Install and operate auto shut off valves within the OPF and crushing hubs to ensure water is added only when ore is present. The Delegated Officer considers there is sufficient separation from sensitive receptors, and that the proposed management measures adequately mitigate the risk of discharge to land, and considers that additional regulatory controls are not required to mitigate this risk.	None
Category 5: Processing or beneficiation of metallic or non-metallic ore Commissioning and operation of the Ore Processing Facility	Process water transport and storage	Rupture/ failure of decant pipelines, overtopping of process water pond resulting in discharge to land	Soil and surface water receptors [Chinnamon Creek is immediately north of the Premises) which feeds into the Turner River 20 km downstream]; and vegetation adjacent the mine	Direct discharge to land causing contamination of soil and impacts to surface water and vegetation	Minimal onsite impact **Slight**	Could occur at some time **Possible**	**Low** Acceptable, not subject to controls	The applicant has committed to the following management measures: • Process water pond is 170,874 m^3 will be HDPE lined to minimise seepage with (high) level detection • Decant water pipeline approximately 7 km long will be above-ground, bunded HDPE pipe (with associated inspection access) with aluminium decant stoplogs at RWP embankment, controlling the level of water between the TSF/RWP In accordance with the Department's Guidance Statement: Risk Assessments (DER, 2017a), as these controls lower the risk of impacts, they will be conditioned in the works approval and licence.	<u>Works approval controls:</u> - Requirement to install infrastructure to specifications.
	Increased amount of waste reporting to the Dry Rejects Landform (DRL)	Dust	Closest receptor is the Atlas Iron Limited Abydos Ore Project accommodation camp located 7 km north east of the mine; and vegetation adjacent the mine	Air / wind dispersion causing Dust impacts, potential health impacts, smothering vegetation impacting photosynthesis	Minimal onsite impact **Slight**	Not likely to occur in most circumstances **Unlikely**	**Low** Acceptable, not subject to controls	The applicant has committed to the following management measures: • a chemical surfactant will be applied to manage dust • for each lift of the DRL, an oxide rock armour will be applied to manage dust. The Delegated Officer considers there is sufficient separation from sensitive receptors, and that the proposed management measures adequately mitigate dust impacts, and considers that additional regulatory controls are not required to mitigate this risk.	None
		Contaminated stormwater (sediment)	Surface water receptors; Chinnamon Creek (Immediately	Direct discharge to land causing sedimentation of	Minimal onsite impact	Could occur at some time **Possible**	**Low** Acceptable, not subject to	The applicant has committed to the following management measure: • A sediment containment bund will be installed at the stockpile toe The Delegated Officer considers that the proposed management	None

Risk Event					Consequence rating*	Likelihood rating*	Risk*	Reasoning	Regulatory controls (Refer to conditions of the granted works approval)
Source/Activities		Potential emissions	Potential receptors	Potential pathway & receptor (impact)					
			north of the Premises) which feeds into the Turner River 20 km downstream	surface water	**Slight**		controls	measures adequately mitigate the risk of impacts to surface water, and considers that additional regulatory controls are not required to mitigate this risk.	
	Tailings thickening using reagents process prior to deposition in the TSF	Contaminated stormwater (tails and reagents – flocculent and coagulant)	Soil and surface water receptors [Chinnamon Creek (Immediately north of the Premises) which feeds into the Turner River 20 km downstream]	Direct discharge to land causing contamination of soil, and impacts to surface water	Minimal onsite impact **Slight**	Could occur at some time **Possible**	**Low** Acceptable, not subject to controls	The applicant has committed to the following management measures: • Clean and maintain sedimentation basins and sediment traps as required to maintain capacity. The Delegated Officer considers that containers for chemicals used in the process should be stored in a bunded impermeable area.	<u>Works approval controls:</u> - Requirement to store chemicals in a bunded impermeable area.
Category 5: Processing or beneficiation of metallic or non-metallic ore Commissioning and operation of the Tailings Storage Facility	Tailings surface lift-off	Dust lift from TSF surface transporting contaminants offsite	Closest receptor is the Atlas Iron Limited Abydos Ore Project accommodation camp located 7 km north east of the mine; and vegetation adjacent the mine	Air / wind dispersion causing potential health impacts or vegetation impacts	Minimal onsite impact **Slight**	Not likely to occur in most circumstances **Unlikely**	**Low** Acceptable, not subject to controls	The applicant has committed to the following management measures: • Maintain beaching locations to ensure crust forms, minimising dust lift off. The applicant has stated that the tailings have been reported as NAF and do not contain contaminants. The Delegated Officer considers there is sufficient separation from sensitive receptors, and that the proposed management measures adequately mitigate the risk of dust lift off, and considers that additional regulatory controls are not required to mitigate this risk. The Delegated Officer notes that as initial tailings deposition is lower in the valley, dust lift off may be more applicable as the tailings fills later in operation.	None
	Tailings pumps, pipelines and RWP return water infrastructure	Contaminated stormwater (tailings spills from pipeline failure)	Soils and surface water receptors [Chinnamon Creek (Immediately north of the Premises) which feeds into the Turner River 20 km downstream]	Direct discharge to land causing contamination of soil and impacts to surface water quality	Low-level onsite impacts Minimal offsite impacts on a local scale **Minor**	Could occur at some time **Possible**	**Medium** Acceptable, subject to regulatory controls conditioned	The applicant has committed to the following management measures: • Tailings will be delivered to the TSF from the OPF via a nominal 800 mm diameter steel pipeline, and will adapt into polyethene pipework and 2 spigot discharge points at the perimeter of the TSF • Low toxicity flocculent and coagulant are to be used in the process • Pipelines will be inspected regularly to identify leaks or weak points • All identified leaks will be repaired immediately • TSF and water pipelines will be equipped with leak detection, auto shut off and regularly checked. The Delegated Officer notes that Chinnamon Creek is immediately north of the premises and the area contains numerous drainage lines. The Delegated Officer considers that, in accordance with the Department's Guidance Statement: Risk Assessments (DER, 2017a), as the above control lowers the risk of impacts, the above will be conditioned in the works approval and licence.	<u>Works approval controls:</u> • Requirement for installation compliance.
	Tailings deposition	Overtopping of TSF with tailings and/or stormwater	Soil, groundwater and surface water receptors [Chinnamon Creek (Immediately north of the Premises) which feeds into the Turner River 20 km downstream] Impacts to vegetation	Direct discharge to land and infiltration to underlying groundwater causing contamination of soil and impacts to vegetation, groundwater or surface water quality	Low-level onsite impacts Minimal offsite impacts on a local scale **Minor**	Not likely to occur in most circumstances **Unlikely**	**Medium** Acceptable, subject to regulatory controls conditioned	The Delegated Officer notes that water balance modelling has been undertaken to determine likely water level fluctuations to gauge possible spillway discharge, TSF decant system performance and availability of return water to the process plant. Freeboard for each stage of the TSF has been designed to store run-off from a 1:100 AEP, 72 hour storm superimposed on the normal decant pond depth of 400 mm. The water balance assessed that overtopping of the TSF may occur during a major rainfall event (1:100 AEP, 72 hour) when TSF capacity is low towards the end of deposition into a stage, before the next lift is constructed. In this case, the overflow is diverted to the RWP and contained therein, with the exception of Stage 1A which spills at the sacrificial bund. Spillway capacity for Stage 1B has been designed for a 1:1,000 AEP rainfall event; for Stages 2+ spillway capacity is designed for a minimum 1:100,000 AEP rainfall event. Any overflow would be diverted to the RWP. The Delegated Officer considers that, as construction for the balance of Stage 1 is progressed at the same time as Stage 1A is being operated, this freeboard and spillway capacity is sufficient to manage Stage 1 of the TSF. The Delegated Officer notes the applicant will undertake regular inspections of the TSF. The Delegated Officer considers that, in accordance with the Department's Guidance Statement: Risk Assessments (DER, 2017a), as the following controls lower the risk of impacts, they will be conditioned in the works approval and licence: • Stage 1B freeboard is 1:100 AER, 72 hour • Stage 1B spillway capacity is 1:1000 AEP	<u>Works approval controls:</u> • Requirement for Stage 1B of the TSF to have minimum freeboard of 1:100 AER, 72 hour plus 400 mm operating pond depth • Requirement for Stage 1B of the TSF to have spillway capacity of 1:1000 AEP plus 400 mm operating pond depth • Requirement to undertake regular inspections.

Risk Event					Consequence rating*	Likelihood rating*	Risk*	Reasoning	Regulatory controls (Refer to conditions of the granted works approval)
Source/Activities		**Potential emissions**	**Potential receptors**	**Potential pathway & receptor (impact)**					
								• Regular inspections.	
		Flocculent and coagulant in tailings decant water	Fauna utilising the site	Direct discharge to land (into TSF) causing impacts to fauna health	Minimal onsite impact **Slight**	Not likely to occur in most circumstances **Unlikely**	**Low** Acceptable, not subject to controls	The Delegated Officer notes that the flocculent and coagulant to be used at the site, BASF Magnafloc 338336 and BASF Magnafloc 1425, respectively, is of low toxicity to invertebrates. Flocculents should ideally adhere to tailings, and decant water samples should show any residual additives. Tailings and flocculent/ coagulants should not enter waterways. The Delegated Officer considers that the applicant should include testing of possible reagents/ thickeners in downstream bores to ensure no seepage of these contaminants is occurring downstream.	None
Category 5: Processing or beneficiation of metallic or non-metallic ore Commissioning and operation of the Tailings Storage Facility	Tailings -seepage	Seepage from tailings to groundwater	Groundwater greater than 2 mbgl at the TSF	Direct discharge to groundwater (via seepage) causing contamination of groundwater It should be noted that from discharge to decant structures is approx. 4.5 km hence seepage is very likely to occur initially and for some time.	High-level onsite impacts Mid-level offsite impacts on a local scale **Major**	The risk event could occur at some time **Possible**	**High** May be acceptable. Subject to multiple regulatory controls.	The Delegated Officer notes the TSF is located within a series of mesas of banded iron sediments and intervening wide valley areas containing localised hills of sandstone and relatively flat areas underlain by weathered shale. A water course also flows through the TSF and downstream. Permeability of TSF valley floor is expected to be between 10^{-6} to 10^{-7} m/s, groundwater may be as shallow as 2.3 mbgl**.** The Delegated Officer notes that the tailings will be thickened to minimum 62% and lateral seepage over the Stage 1 embankment will be collected in the downstream RWP, once deposition is further advanced. The Delegated Officer notes that an embankment will be installed to the north east of the TSF fitted with a BGM liner on the upstream face. The Delegated Officer notes that the applicant has not provided seepage calculations through the embankment nor groundwater modelling of potential impacts as the applicant has advised that the tailings have low permeability and seepage through the BGM liner is not anticipated. The applicant has included a subgrade under the BGM liner designed to act as a filter in the event that any tailings fines migrate through defects in the BGM liner. The Delegated Officer notes that the distance from spigot discharge points to decant is approximately 4.5 km, hence, seepage will occur for months until the tailings deposition is further advanced and consolidated. There are no provisions to remove water from the TSF initially. The Delegated Officer considers that as the groundwater may be shallow and that as the valley floor is unlined, it is possible for seepage to enter the groundwater and affect the quality of the groundwater. The applicant has advised that tailings have lower permeability and are not expected to be acid forming, metals and other contaminants are not expected to be mobilised from the tailings. The Delegated Officer considers that, if further testing finds the tailings to be acid forming, this may change the management of the tailings and the risk to receptors, and may require reassessment for additional controls. The Delegated Officer considers that it is also possible that as the TSF fills, lateral seepage may occur until the ground is saturated. The Delegated Officer notes the decant water level on the TSF will be 400 mm deep once at full operation so that spill into the decant structures will not transport tailings material. Decant water quality has not been provided; however, it is noted that geochemical analyses of decant water will be conducted to confirm design assumptions. The Delegated Officer considered that, in accordance with the Department's Guidance Statement: Risk Assessments (DER, 2017a), as the following controls lower the risk of impacts, they will be conditioned in the works approval and licence: • TSF embankment includes a BGM liner on upstream face with a subgrade designed to act as a filter, and piezometers • tailings are thickened to minimum 62% • decant water level on the TSF will be 400 mm deep • geochemical analyses of tailings and decant water will be conducted. The Delegated Officer notes that the applicant does not have a design permeability for the TSF (and RWP), and therefore, the amount and potential impact of seepage is not known. If the seepage is high, this could lead to offsite impacts downstream and laterally from the TSF and RWP. The Delegated Officer notes that six bores are proposed to be	<u>Works approval controls:</u> • Requirement to install a BGM liner with a subgrade on upstream face of the TSF embankment • Requirement to thicken tailings to minimum 62% • Requirement to maintain decant water level on the TSF at 400 mm deep • Requirement to install groundwater bores for monitoring, designed to be converted to seepage recovery bores • Requirement to provide a CCIR for the RWP, Stage 1A and Stage 1 B of the TSF • Requirement to provide TSF and RWP embankment as-constructed permeability in the CCIRs • Requirement to undertake ongoing validation and reporting on the site water balance (i.e. monthly recording and reporting) • Requirement to undertake testing of representative tailings samples • Requirement to monitor and validate decant water quality. • Requirement to validate adequate construction of all infrastructure with an endorsed engineer report and compliance documentation. • Requirement to provide a site water flow diagram. • Requirement to develop Seepage Monitoring Plan with triggers, limits and actions to avoid downstream impacts.

Risk Event					Consequence rating*	Likelihood rating*	Risk*	Reasoning	Regulatory controls (Refer to conditions of the granted works approval)
Source/Activities		Potential emissions	Potential receptors	Potential pathway & receptor (impact)					
								located directly downstream of the RWP. The Delegated Officer notes that the placement of bores has not considered lateral seepage or the need for monitoring further downstream in the valley. A Critical Containment Infrastructure Report (CCIR) is required as per the Department's Industry Regulation Guide to Licensing (June 2019) for the Department to confirm that the environmental controls on TSF are properly constructed before materials are deposited into the TSF. As there are two phases of Stage 1 of the TSF and a RWP, three separate reports are to be supplied. The CCIR requires a declaration from a professional with suitable qualifications/experience to confirm that the RWP and each Stage of the TSF has been constructed with no material defects, and that all works approval conditions relating to the construction of the RWP and TSF have been complied with. The CCIR is to include the as-constructed permeability of the embankments. The CCIR assessment period will be 45 working days. The Delegated Officer considers that additional groundwater bores downstream and laterally from the TSF and RWP in the valley designed to establish background/ambient data to understand the wider groundwater movement in the local area, and to monitor the groundwater and receptors of the area is required. A Seepage Monitoring Plan is to be prepared and submitted to DWER which outlines the proposed bore locations, sampling frequency, and establishes triggers and limits. Actions will be determined based on results - these can be part of licence if deemed necessary and will also support further approvals to come. While high seepage through the liner is not expected, the Delegated Officer considers that a whole-of-site water balance should be conducted regularly, in addition to monitoring groundwater levels and analytes, to determine if the TSF is behaving as expected. The Delegated Officer also considers that further testing of tailings is required, such as US EPA (LEAF) Method No 1313 with geochemical modelling and other tests, such as Settling Tests, to understand the rate of tailing separation and settling.	

Risk Event					Consequence rating*	Likelihood rating*	Risk*	Reasoning	Regulatory controls (Refer to conditions of the granted works approval)
Source/Activities		**Potential emissions**	**Potential receptors**	**Potential pathway & receptor (impact)**					
Category 5: Processing or beneficiation of metallic or non-metallic ore Commissioning and operation of the Tailings Storage Facility	Seepage through RWP	Seepage from RWP to groundwater	Groundwater greater than 2 mbgl at the TSF Creek line noted to pass through TSF and RWP. RWP base is not lined.	Direct discharge to groundwater (via seepage) causing contamination of groundwater	High-level onsite impacts Mid-level offsite impacts on a local scale **Major**	The risk event could occur at some time **Possible**	**High** May be acceptable. Subject to multiple regulatory controls.	The Delegated Officer notes that the RWP is located directly north west of the TSF. Two small embankments will be constructed approximately 1.5 km downstream of the TSF embankment and those embankments will be constructed to full height (9.5 and 16 m) during the initial construction works. Both embankments will have a BGM liner on the upstream face anchored into an upstream toe cut off trench. The Delegated officer notes that the applicant has not provided seepage calculations through the embankment nor groundwater modelling of potential impacts, as the applicant has advised that seepage through the BGM liner is not anticipated. The Delegated Officer notes that to control foundation seepage, a grout curtain will be installed along the length of the upstream toe plinth of the RWP South embankment. The applicant has provided further contingency measures, such as the following, to further reduce seepage risk through the RWP embankments: • A rockfill seepage collection drain in the base of embankment foundation discharging into a seepage monitoring sump directly downstream of each embankment – water should be collected and retuned. • A seepage monitoring sump (soak well) installed in a rock-filled interception trench and lined with geofabric liner at the embankments. FMG – note this should be lined or a lined trench with water pumped back to the process. • Downstream groundwater monitoring bores (six bores). The Delegated Officer notes groundwater monitoring bores are proposed immediately downstream of the RWP designed to allow conversion to seepage recovery bores should there be significant rates of seepage. The Delegated Officer considered that, in accordance with the Department's Guidance Statement: Risk Assessments (DER, 2017a), as the following controls lower the risk of impacts, they will be conditioned in the works approval and licence: • Grout curtain to control foundation seepage at the RWP south embankment • Toe drain and piezometers installed at RWP • RWP embankments include a BGM liner on upstream face and further contingency measures to reduce seepage risk • groundwater bores for monitoring (six bores downstream of the TSF and RWP) initially with possibly more installed if and as required As discussed above, a CCIR is required as per the Department's Industry Regulation Guide to Licensing (June 2019), and a Seepage Management Plan is to be prepared to monitor and manage seepage impacts based on the as-constructed permeability of the embankments. Replacement monitoring bores are to be installed in the case that installed bores are converted to seepage recovery.	<u>Works approval controls:</u> • Requirement to install a grout curtain at the RWP south embankment to control foundation seepage • Requirement to have a BGM liner on upstream face of RWP embankments and further contingency measures to reduce seepage risk • Requirement to undertake baseline monitoring of groundwater levels and quality prior to operation, and regularly monitor groundwater levels and quality during operation, in downstream bores. • Requirement to develop Seepage Monitoring Plan with triggers, limits and actions to avoid downstream impacts.
Category 5: Processing or beneficiation of metallic or non-metallic ore Operation of the Tailings Storage Facility	RWP contingency discharge spillway	Decant water released into the environment	Soil, groundwater and surface water receptors [Chinnamon Creek (Immediately north of the Premises) which feeds into the Turner River 20 km downstream] including erosion Impacts to vegetation	Direct discharge to land and infiltration to underlying groundwater causing contamination of soil and impacts to vegetation, groundwater or surface water quality	Mid-level onsite impacts Low-level offsite impacts on a local scale **Moderate**	The risk event may only occur in exceptional circumstances **Rare**	**Medium** Acceptable, subject to regulatory controls conditioned	The Delegated Officer notes that water balance modelling has been undertaken to determine likely water level fluctuations to gauge possible spillway discharge and availability of return water to the process plant. The water balance assessed that for the average total rainfall case through the LOM, the RWP is expected to provide the required storage capacity. For the maximum total rainfall case through the LOM, the RWP could overtop and spill, resulting in an emergency discharge via the RWP contingency discharge spillway to protect the embankments from overtopping. The applicant has advised that the RWP spillway will be excavated through rock, with armour protection and bunding to protect the RWP embankment, where required. The maximum total rainfall case scenario is not expected to occur within the operation of Stage 1 of the TSF. This risk may be reviewed when results of decant water testing become available and during assessment of further lifts.	<u>Works approval controls:</u> • Requirement to monitor the quality during discharge and estimate volumes discharged.

**Consequence ratings, likelihood ratings and risk descriptions are detailed in the Department's Guidance Statement: Risk Assessments (February 2017).*

Consequence and likelihood of risk events

The risk rating has been determined for risk events in accordance with the risk rating matrix set out below.

Table 10: 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

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

Table 11: 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, the Department may have regard to the Department of Health's *Health Risk Assessment (Scoping) Guidelines.*
"onsite**"** means within the Prescribed Premises boundary.

Acceptability and treatment of Risk Event

The Department will determine the acceptability and treatment of Risk Events in accordance with the Risk treatment Table 12.

Table 12: Risk treatment table

Rating of Risk Event	Acceptability	Treatment
Extreme	Unacceptable.	Risk Event will not be tolerated. the Department 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.

Determination of Works Approval conditions

The conditions in the issued Works Approval in Attachment 1 have been determined in accordance with the Department's Guidance Statement: Setting Conditions. Table 13 provides a summary of the conditions to be applied to this works approval.

Table 13: Summary of conditions to be applied

Condition Ref	Grounds
Construction phase	
Infrastructure and Equipment 1, 2 and 3	These conditions require that infrastructure is constructed and designed as per the supporting documents and that groundwater monitoring bores are installed. These conditions are valid, risk-based and consistent with the EP Act.
Compliance reporting 4 and 5	These conditions require a compliance report to be provided following construction completion of items in condition 1. These conditions are valid, risk-based and consistent with the EP Act.
Compliance reporting 6 and 7	These conditions require a Critical Containment Infrastructure Report to be provided following construction completion of items in condition 2. These conditions are valid, risk-based and consistent with the EP Act.

Condition Ref	Grounds
Compliance reporting 8	This condition require a well construction report evidencing compliance with the requirements of condition 3. This condition is valid, risk-based and consistent with the EP Act.
Environmental commissioning phase	
Environmental commissioning requirements 9, 10 and 11	These conditions allow commissioning of the infrastructure to occur for 300 days provided that the compliance documentation has been received. These conditions are valid, risk-based and consistent with the EP Act.
Reporting during environmental commissioning 12 and 13	These conditions require that a commissioning report be provided that includes environmental performance of the infrastructure. These conditions are valid, risk-based and consistent with the EP Act.
Time limited operations phase	
Commencement and duration 14, 15 and 16	These conditions require that compliance and commissioning reports have been received prior to time limited operations commencing and sets operational requirements. Environmental compliance is a valid, risk-based condition to ensure appropriate linkage between the licence and the EP Act
Time limited operations requirements and emission limits 17, 18, 19, 20, 21, 22 and 23	These conditions require data collection on aspects of the project. These conditions are valid, risk-based and consistent with the EP Act.
Monitoring during time limited operations 24, 25, 26, 27, 28, 29 and 30	This condition requires emissions monitoring and ambient groundwater monitoring during time limited operations. These conditions are valid, risk-based and consistent with the EP Act.
Compliance reporting 31 and 32	These conditions require a time limited operations report be provided with a summary of the performance of the infrastructure and details on product produced, tailings produced, tailings water content, water balance etc. These conditions are valid, risk-based and consistent with the EP Act.
Records and reporting general	
Records and reporting (general) 33, 34 and 35	These conditions are valid and are necessary administration and reporting requirements to ensure compliance.

The Department notes that it may review the appropriateness and adequacy of controls at any time and that, following a review, the Department may initiate amendments to the works approvals under the EP Act.

Applicant comments

The applicant was provided with the drafts of the works approval and decision report on 9 April 2020 and 22 April 2020, and raised a number of matters that have been addressed in the final.

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 (listed in Appendix 1).

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

The Department notes that it may review the appropriateness and adequacy of controls at any time and that, following a review, the Department may initiate amendments to the approval under the EP Act.

Lauren Fox
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Lauren Fox
A/SENIOR 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 (where applicable)	Availability
Application - Works Approval - FMG Ltd - IB Operations Pty Ltd - Iron Bridge Magnetite Project Stage 2 - Supporting Documents - Shire of East Pilbara	Application 2019	DWER Trim reference: DER2019/000575
Application - Works Approval - FMG Ltd - IB Operations Pty Ltd - Iron Bridge Magnetite Project Stage 2 - Applicant response to Request For Information	Application 2020	DWER Trim reference: DER2019/000575
Guidance Statement: Regulatory principles. Department of Environment Regulation, Perth. July 2015	DER 2015a	Accessed at www.dwer.wa.gov.au
Guidance Statement: Setting conditions. Department of Environment Regulation, Perth. October 2015	DER 2015b	
Guidance Statement: Licence duration. Department of Environment Regulation, Perth. August 2016	DER 2016a	
Guidance Statement: Risk Assessments. Department of Environment Regulation, Perth. November 2016	DER 2016b	
Guidance Statement: Decision Making. Department of Environment Regulation, Perth. November 2016.	DER 2016c	
Industry Regulation Guide to Licensing. Department of Water and Environmental Regulation, June 2019.	DWER 2019	
Australian and New Zealand Guidelines for Fresh and Marine Water Quality; Volume 1, October 2000	ANZECC 2000	Accessed at https://www.waterquality.gov.au/sites/default/files/documents/anzecc-armcanz-2000-guidelines-vol1.pdf

Attachment 1: Works Approval W6322/2019/1