Government of Western Australia
Department of Water and Environmental Regulation

Amended Works Approval

Works Approval Number	W6065/2017/1
Works Approval Holder	Image Resources NL
Registered business address	23 Ventor Avenue WEST PERTH WA 6005
File Number	DER2017/000976
Duration	31/10/2017 to 30/10/2020
Date of amendment	26/06/2018
Prescribed Premises	Category 8: Mineral sands mining or processing
Premises	Boonanarring Mineral Sands Project Wannamal Road West BOONANARRING WA 6503 Legal description - Mining Lease M70/1194 and M70/1311

This Amended Works Approval is granted to the Works Approval Holder, subject to the following conditions, on 26 June 2018, by:

Date signed: 26 June 2018
Tim Gentle
Manager Licensing – Resource Industries
Regulatory Services (Environment)

an officer delegated under section 20 of the *Environmental Protection Act 1986* (WA)

Explanatory notes

These explanatory notes do not form part of this Works Approval.

Defined terms

Definition of terms used in this Works Approval can be found at the start of this Works Approval. Terms which are defined have the first letter of each word capitalised throughout this Works Approval.

Department of Water and Environmental Regulation

The Department of Water and Environmental Regulation (DWER) is 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 *Environmental Protection Act 1986* (WA) (EP Act). The Department also monitors and audits compliance with licences and works approvals, takes enforcement action and develops and implements licensing and industry regulation policy.

Works Approval

Section 52 of the EP Act provides that an occupier of any premises commits an offence if any work is undertaken on, or in relation to, the premises which causes the premises to become, or to become capable of being, Prescribed Premises, except in accordance with a works approval.

Section 56 of the EP Act provides that an occupier of Prescribed Premises commits an offence if Emissions are caused or increased or permitted to be caused or increased, or Waste, noise, odour or electromagnetic radiation is altered or permitted to be altered from Prescribed Premises, except in accordance with a works approval or licence.

Categories of Prescribed Premises are defined in Schedule 1 of the *Environment Protection Regulations 1987* (WA) (EP Regulations).

This Works Approval does not authorise any activity which may be a breach of the requirements of another statutory authority including, but not limited to, the following:

- conditions imposed by the Minister for Environment under Part IV of the EP Act;
- conditions imposed by DWER for the clearing of native vegetation under Part V, Division 2 of the EP Act;
- any requirements under the *Waste Avoidance and Resource Recovery Act 2007;*
- any requirements under the *Environmental Protection (Controlled Waste) Regulations 2004*; and
- any other requirements specified through State legislation.

It is the responsibility of the Works Approval Holder to ensure that any action or activity referred to in this Works Approval is permitted by, and is carried out in compliance with, statutory requirements.

The Works Approval Holder must comply with the Works Approval. Contravening a Works Approval Condition is an offence under s.55 of the EP Act.

Responsibilities of Works Approval Holder

Separate to the requirements of this Works Approval, general obligations of Works Approval Holders are set out in the EP Act and the regulations made under the EP Act. For example, the Works Approval Holder must comply with the following provisions of the EP Act:

- the duties of an occupier under s.61; and
- restrictions on making certain changes to Prescribed Premises unless the changes are in accordance with a Works Approval, Licence, closure notice or environmental protection notice (s.53).

Strict penalties apply for offences under the EP Act.

Reporting of incidents

The Works Approval Holder has a duty to report to the Department all Discharges of Waste that have caused or are likely to cause Pollution, Material Environmental Harm or Serious Environmental Harm, in accordance with s.72 of the EP Act.

Offences and defences

The EP Act and its regulations set out a number of offences including:

- Offence of emitting an Unreasonable Emission from any Premises under s.49.
- Offence of causing Pollution under s.49.
- Offence of dumping Waste under s.49A.
- Offence of discharging Waste in circumstances likely to cause Pollution under s.50.
- Offence of causing Serious Environmental Harm (s.50A) or Material Environmental Harm (s.50B).
- Offence of causing Emissions which do not comply with prescribed standards (s.51).
- Offences relating to Emissions or Discharges under regulations prescribed under the EP Act, including materials discharged under the *Environmental Protection (Unauthorised Discharges) Regulations 2004 (WA).*
- Offences relating to noise under the *Environmental Protection (Noise) Regulations 1997 (WA).*

Section 53 of the EP Act provides that a Works Approval Holder commits an offence if Emissions are caused, or altered, from a Prescribed Premises unless done in accordance with a Works Approval, Licence or the requirements of a closure notice or an environmental protection notice.

Defences to certain offences may be available to a Works Approval Holder and these are set out in the EP Act. Section 74A(b)(iii) provides that it is a defence to an offence for causing Pollution, in respect of an Emission, or for causing Serious Environmental Harm or Material Environmental Harm, or for discharging or abandoning Waste in water to which the public has access, if the Works Approval Holder can prove that an Emission or Discharge occurred in accordance with a Works Approval.

This Works Approval specifies the Emissions and Discharges, and the limits and Conditions which must be satisfied in respect of specified Emissions and Discharges, in order for the defence to offence provision to be available.

Authorised Emissions and Discharges

The specified and general Emissions and Discharges from the Works authorised through this Works Approval are authorised to be conducted in accordance with the Conditions of this Works Approval.

Amendment of Works Approval

The Works Approval Holder can apply to amend the Conditions of this Works Approval under s.59 of the EP Act. An application form for this purpose is available from DWER.

The CEO may also amend the Conditions of this Works Approval at any time on the initiative of the CEO without an application being made.

Duration of Works Approval

The Works Approval will remain in force for the duration set out on the first page of this Works Approval or until it is surrendered, suspended or revoked in accordance with s.59A of the EP Act.

Suspension or revocation

The CEO may suspend or revoke this Works Approval in accordance with s.59A of the EP Act.

Definitions and interpretation

Definitions

In this Works Approval, the terms in Table 1 have the meanings defined.

Table 1: Definitions

Term	Definition
AHD	Australian Height Datum
AS 2012	means the most recent version and the relevant parts of the Australian series of guidance standards on the measurement of airborne noise emitted by earthmoving machinery
AS 3580.1.1	means the most recent version and the relevant parts of the Australian Standard AS 3580.1.1 *Methods for sampling and analysis of ambient air – Guide to siting air monitoring equipment*
AS 3580.9.3	means the most recent version and the relevant parts of the Australian Standard AS 3580.9.3 *Methods for sampling and analysis of ambient air – Determination of total suspended particulates (TSP) – High volume sampler gravimetric method*
AS 3580.9.8	means the most recent version and the relevant parts of the Australian Standard AS 3580.9.8 *Methods for sampling and analysis of ambient air – Determination of suspended particulate matter – PM_{10} continuous direct mass method using a tapered element oscillating microbalance analyser*
Averaging Period	means the time over which a limit is measured or a monitoring result is obtained
Books	has the same meaning given to that term under the EP Act
CEO	means Chief Executive Officer CEO for the purposes of notification means: Director General Department Administering the *Environmental Protection Act 1986* Locked Bag 33 Cloisters Square PERTH WA 6850 info-der@dwer.wa.gov.au
Condition	means a condition to which this Works Approval is subject under s.62 of the EP Act
Commission/ Commissioning	means the process of operation and testing that verifies works and all relevant systems, plant, machinery and equipment have been installed and are performing in accordance with the manufacturer's design specification
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
Department Request	means a request for Books or other sources of information to be produced, made by an Inspector or the CEO to the Works Approval Holder in writing and sent to the Works Approval's address for notifications, as described at the front of this Works Approval, in relation to: a) compliance with the EP Act or this Licence; b) the Books or other sources of information maintained in accordance with this Licence; or c) the Books or other sources of information relating to Emissions from the Premises
Discharge	has the same meaning given to that term under the EP Act

DWER	Department of Water and Environmental Regulation
Emission	has the same meaning given to that term under the EP Act
Environmental Harm	has the same meaning given to that term under the EP Act
EP Act	means the *Environmental Protection Act 1986* (WA)
EP Regulations	means the *Environmental Protection Regulations 1987* (WA)
High Wind	means wind conditions rating 7 or greater on the Beaufort Windforce Scale (i.e. wind speeds 50 km/h or greater)
HMC	Heavy Mineral Concentrate
Implementation Agreement or Decision	has the same meaning given to that term under the EP Act
Inspector	means an inspector appointed by the CEO in accordance with s.88 of the EP Act
$L_{AS\ 90,30min}$ and $L_{AS\ 10,30min}$	means the A-weighted level exceeded for more than 90% and 10%, respectively, of the time over 30 minutes with the sound level meter set to 'Slow' time weighting
$L_{Aeq(20Hz-500Hz),30min}$	means the A-weighted equivalent noise level between 20 Hz and 500 Hz (one-third octave bands inclusive) averaged over 30 minutes
Material Environmental Harm	has the same meaning given to that term under the EP Act
Minimum Construction Requirements for Water Bores in Australia	means the document *Minimum Construction Requirements for Water Bores in Australia*, National Uniform Drillers Licensing Committee (3rd Edition, 2012)
NATA	National Association of Testing Authorities (Australia)
NATA Accredited	means in relation to the analysis of a sample that the laboratory is NATA accredited for the specified analysis at the time of the analysis
Noise Regulations	means the *Environmental Protection (Noise) Regulations 1997* (WA)
Noise Sensitive Premises	has the same meaning given to that term under the Noise Regulations
Non-directional system	means single microphone sound measuring equipment compliant with Schedule 4 of the Noise Regulations and capable of recording overall and one-third octave band statistical noise levels based on the A-weighted sound pressure level with 'Slow' time weighting (L_{AS})
Observation Specification No. 2013.1	means the document *Observation Specification No. 2013.1 – Guidelines for the Siting and Exposure of Meteorological Instruments and Observing Facilities,* Bureau of Meteorology (January 1997). Available at www.bom.gov.au/climate/cdo/about/observation_specification_2013.pdf
PM	means total particulate matter including both solid fragments of material and miniscule droplets of liquid
PM_{10}	means particles with an aerodynamic diameter of less or equal to 10 µm
Pollution	has the same meaning given to that term under the EP Act
Premises	refers to the premises to which this Licence applies, as specified at the front of this Licence and as shown on the map in Schedule 1 to this Licence
Prescribed Premises	has the same meaning given to that term under the EP Act
ROM	Run Of Mine

Serious Environmental Harm	has the same meaning given to that term under the EP Act
SMU	Slurry Mining Unit
Sound Power Level	has the same meaning given to that term under the Noise Regulations
Spot Sample	means a discrete sample representative of the time and place at which the sample is taken
TSP	means total suspended particles each having an equivalent aerodynamic diameter of less than 50 µm
Unreasonable Emission	has the same meaning given to that term under the EP Act
Waste	has the same meaning given to that term under the EP Act
Works	refers to the Works described in Schedule 2, at the locations shown in Schedule 1 of this Works Approval to be carried out at the Premises, subject to the Conditions
Works Approval	refers to this document, which evidences the grant of the works approval by the CEO under s.54 of the EP Act, subject to the Conditions
Works Approval Holder	refers to the occupier of the Premises being the person to whom this Works Approval has been granted, as specified at the front of this Works Approval
WQPN #30	means the document *Water Quality Protection Note #30: Groundwater monitoring bores*, Department of Water (February 2006). Available at www.water.wa.gov.au/_data/assets/pdf_file/0010/4033/59685.pdf

Interpretation

In this Licence:

(a) the words 'including', 'includes' and 'include' will be read as if followed by the words 'without limitation';
(b) where any word or phrase is given a defined meaning, any other part of speech or other grammatical form of that word or phrase has a corresponding meaning;
(c) where tables are used in a Condition, each row in a table constitutes a separate Condition;
(d) any reference to an Australian or other standard, guideline or code of practice in this Works Approval means the version of the standard, guideline or code of practice in force at the time of granting of this Works Approval and includes any amendments to the standard, guideline or code of practice which may occur from time to time during the course of the Works Approval; and
(e) unless specified otherwise, any reference to a section of an Act refers to that section of the EP Act.

Conditions

Infrastructure and equipment

1. The Works Approval Holder must install and carry out the Works within the Premises for the infrastructure and equipment:

(a) specified in Column 1;
(b) to the requirements specified in Column 2; and
(c) at the location specified in Column 3;

of Table 2 below.

2. The Works Approval Holder must not depart from the requirements specified in Column 2 of Table 2 except:

(a) where such departure does not increase risks to public health, public amenity or the environment; and

(b) all other Conditions in this Works Approval are still satisfied.

3. Subject to Condition 2, within 28 days of the completion of the Works specified in Column 1 of Table 2, the Works Approval Holder must provide to the CEO certification from a suitably qualified professional confirming each item of infrastructure or component of infrastructure specified in Column 1 of Table 2 below has been constructed with no material defects and to the requirements specified in Column 2.

4. Where a departure from the requirements specified in Column 2 of Table 2 occurs and is of a type allowed by Condition 2, the Works Approval Holder must provide to the CEO a description of, and explanation for, the departure along with the report required by Condition 3.

Table 2: Infrastructure and equipment requirements table

Column 1	**Column 2**	**Column 3**
Infrastructure/ Equipment	**Requirements (design and construction)**	**Site plan reference**
Mining unit & ROM pad	• Constructed with compacted overburden material or similar • Drainage designed to divert stormwater runoff to a constructed drainage depression or sedimentation basin	"Mining unit & ROM pad", as shown in Figure 2 of Schedule 1
HMC pad		"HMC pad", as shown in Figure 2 of Schedule 1
Off path tails cell	• Constructed with overburden material and track rolled with a dozer, with angle of repose for the outer pond wall being 1.0V:1.5H • Cell wall height not to exceed 2.5 m above natural ground level	"Off path tails cell", as shown in Figure 2 of Schedule 1
Off path solar drying cells	• Decant weir boxes and overflow drains to the process water pond	"Off path solar drying ponds", as shown in Figure 2 of Schedule 1
Noise bunds	• Phase 1 overburden removal – 13 m high noise bunds must be constructed along the north-east edge of Pit C, along the western edge of Pit C and a 5 m high bund west of the access road to the process plant • "As-built" survey of the constructed bunds to demonstrate the bunds have been constructed to the specified heights	N/A
Process water pond	• None specified	N/A
Wet Concentrator Plant (WCP)	• Constructed in the general location shown in Figure 3 of Schedule 1 • Pad constructed as low as practicable into the side of the hill • Cladding installed to ground level on the north, west and south facing facades • All pumps must be enclosed	"WCP", as shown in Figure 1 of Schedule 1

Column 1	Column 2	Column 3
Infrastructure/ Equipment	**Requirements (design and construction)**	**Site plan reference**
Pipelines carrying clay slimes, sand tailings and return water	Constructed with: • automatic cut-outs in the event of a pipe failure; OR • secondary containment sufficient to contain any spill for a period equal to the time between routine inspections; OR • telemetry systems and pressure sensors along pipelines to allow the detection of leaks and failures	N/A
Groundwater monitoring bores	• Minimum of 2 bores to be constructed immediately down-gradient of each mine pit • Sited in accordance with *WQPN #30* ("Siting of monitoring bores" section) • Installed to meet the requirements of *Minimum Construction Requirements for Water Bores in Australia* • Surveyed to allow the ground level (to AHD) at each location to be accurately determined • Be screened to permit effective monitoring of shallow groundwater quality in the vicinity of each mine pit	N/A

Hours of operation

5. The Works Approval Holder must only carry out overburden removal and initial mine pit development works between the hours of 0700 and 1900 Monday to Saturday (excluding public holidays).

Commissioning

6. The Works Approval Holder must notify the CEO, at least 7 days prior to, the commencement date of Commissioning.

7. The Works Approval Holder must not Commission the SMU, WCP and associated infrastructure for a period exceeding 4 months.

8. The Works Approval Holder must not Commission the SMU, WCP and associated infrastructure with more than 100,000 tonnes of ore.

9. The Works Approval Holder must notify the CEO, within 7 days of, the completion date of Commissioning.

10. The Works Approval Holder must provide to the CEO a Commissioning report along with the report required by Condition 3.

11. The Works Approval Holder must ensure the report required by Condition 10 includes:

(a) a summary of the Commissioning timeframes and amount of ore processed during Commissioning of the SMU, WCP and associated infrastructure;
(b) a summary of the monitoring results obtained under Conditions 25, 27 and 28;
(c) a list of any original monitoring reports prepared by third parties for the Commissioning period;
(d) a copy of the noise bund construction height report required by Condition 1;
(e) a summary of the environmental performance of all plant and equipment as installed, including but not limited to:

(i) hydro-testing of pipelines and pump system functions testing;
(ii) Commissioning of the raw water system;
(iii) dry Commissioning of the SMP, WCP circuit and thickener;
(iv) wet Commissioning of the SMP, WCP circuit and thickener;
(v) testing the clay/sand tailings system; and
(vi) Commissioning of the process control system;

(f) a review of performance against the manufacturer's design specification; and

(g) where they have not been met, measures proposed to meet the manufacturer's design specification and/or Conditions of this Works Approval, together with timescales for implementing the proposed measures.

Emissions

12. The Works Approval Holder must not cause any Emissions from the Works authorised through this Works Approval except for specified Emissions and general Emissions described in Column 1 of Table 3, subject to the exclusions, limitations or requirements specified in Column 2, of Table 3.

Table 3: Authorised Emissions table

Column 1	**Column 2**
Emission type	**Exclusions/Limitations/Requirements**
Specified Emissions	
Disposal of mine tailings	Only to the "off-path tails pond", mine void or the "initial solar drying pond", as specified in Table 2 and subject to compliance with Condition 13
Discharges to Air – fugitive dust	Subject to compliance with Conditions 14 - 16
Ambient Noise	Subject to compliance with Conditions 17 - 19
General Emissions	
Emissions which arise from undertaking the Works	Emissions excluded from General Emissions are: • Unreasonable Emissions; or • Emissions that result in, or are likely to result in, Pollution, Material Environmental Harm or Serious Environmental Harm; or • Discharges of Waste in circumstances likely to cause Pollution; or • Emissions that result, or are likely to result in, the Discharge or abandonment of Waste in water to which the public has access; or • Emissions or Discharges which do not comply with an Approved Policy; or • Emissions or Discharges which do not comply with prescribed standard; or • Emissions or Discharges which do not comply with the conditions in an Implementation Agreement or Decision; or • Emissions or Discharges the subject of offences under regulations prescribed under the EP Act, including materials discharged under the *Environmental Protection (Unauthorised Discharges) Regulations 2004*.

Disposal of mine tailings

13. Following construction of the "off-path tails cell" and the "initial solar drying pond" specified in Table 2, the Works Approval Holder must ensure that tailings produced during commissioning of the SMU, WCP and associated infrastructure are deposited in accordance with the requirements specified in Table 4.

Table 4: Tailings disposal requirements table

Column 1	Column 2	Column 3
Emission	**Requirements**	**Site plan reference**
Sand tailings from the WCP (by-product of wet commissioning)	Must be disposed directly into the mine void, or stockpiled at the location specified in Column 3, pending final disposal into the mine void	"Off-path tails cell", as shown in Figure 2 of Schedule 1
Clay slimes (by-product of wet commissioning)	Must be pumped as a thickened slurry to the location specified in Column 3	"Initial solar drying pond", as shown in Figure 2 of Schedule 1

Fugitive dust controls

14. Following the commencement of Works on the Premises, the Works Approval Holder must implement the controls specified in Column 1 of Table 5 in accordance with the actions/requirements specified in Column 2 of Table 5.

Table 5: Fugitive dust controls table

Column 1	Column 2
Control	**Actions/Requirements**
Topsoil stripping	• Schedule to avoid periods of High Winds from unfavourable direction relative to receptors; • Where there is a risk of dust affecting sensitive receptors, conduct when soil conditions are moist but not saturated; • Must cease/suspend topsoil stripping operations during High Wind conditions where there is a risk of dust affecting sensitive receptors
Water carts/sprays	• Must operate when visible dust is generated from ground surfaces on the Premises; • Must operate proactively subject to weather forecasting over a 24 hour period;
Dust suppressant (other than water)	• Must apply proactively to stockpiles, noise control bunds and pond embankments; • Must reapply proactively subject to visual inspection and weather forecasting over a 24 hour period;
Cessation of activities	• Must cease an activity causing visible dust liftoff where dust management measures have not prevented dust liftoff and there is a risk of dust affecting sensitive receptors;

Column 1	Column 2
Control	**Actions/Requirements**
Monitoring and trigger levels	• Must use meteorological data to assist in determining the potential for high dust generating activities, and take appropriate management action(s); • Must set trigger levels on ambient air quality monitoring equipment to prevent the occurrence of Reportable Events as specified in • Table 7; • Must reduce the trigger levels if necessary in response to complaints or other evidence of off-site impacts; • Must keep a log of dust trigger exceedance events including the identification of the sources and action(s) taken to control dust.

15. Prior to commencing Works on the Premises, the Works Approval Holder must establish ambient air quality monitoring locations:

(a) in the vicinity of the "central west" boundary of the Premises, in a location readily accessible to the Works Approval Holder and can be used to continuously measure dust levels during construction Works and Year 1 of operations;
(b) in the vicinity of the "north west" boundary of the Premises, in a location readily accessible to the Works Approval Holder and can be used to continuously measure dust levels during Years 2 and 3 of operations; and
(c) in the vicinity of the "south west" boundary of the Premises, in a location readily accessible to the Works Approval Holder and can be used to continuously measure dust levels during Years 4 and 5 of operations.

16. The Works Approval Holder must implement an ambient air quality monitoring system that:

(a) supplies continuous real-time data to allow real-time monitoring of TSP and PM_{10} concentrations;
(b) provides automatic feedback (SMS text message or equivalent) to the mine manager or supervisor if set trigger levels are reached; and
(c) complies with AS 3580.1.1.

Noise controls

17. Prior to commencing Works on the Premises, the Works Approval Holder must submit to the CEO, a report demonstrating the Sound Power Level for all earthmoving machinery to be used during the Works.

18. The Works Approval Holder must ensure the report required by Condition 17:

(a) comprises Sound Power Level measurements of the actual earthmoving machinery to be used during the Works; and
(b) the measurements are taken and analysed:
  (i) in accordance with the relevant parts of AS 2012; and
  (ii) by a suitably qualified professional.

19. Following the commencement of Works on the Premises, the Works Approval Holder must implement the controls specified in Column 1 of Table 6 in accordance with the actions/requirements specified in Column 2 of Table 6.

Table 6: Noise controls table

Column 1	Column 2
Control	**Actions/Requirements**
Heavy earthmoving equipment	• Must use the quietest equipment reasonably available; • Must install noise attenuation on the exhaust of all haul trucks and excavators used in overburden removal;

Column 1	Column 2
Control	**Actions/Requirements**
	• Must use broadband reversing alarms (squawkers/quackers) on all earthmoving fleet instead of beepers.
Cessation of activities	• When noise monitoring indicates noise levels are likely to exceed the Noise Regulations, remedial actions must be taken to reduce the likelihood of noise non-compliance; • Operations must be shut-down if the remedial actions fail to reduce the likelihood of noise non-compliance and an amenity agreement is not in place with the affected receptor(s).

20. Prior to commencing Works on the Premises, the Works Approval Holder must establish noise monitoring locations:

(a) in the vicinity of the "central west" boundary of the Premises, in a location readily accessible to the Works Approval Holder and can be used to continuously measure, and predict the noise levels received at Noise Sensitive Premises to the west and south-west of the Premises, during Year 1 of operations;
(b) in the vicinity of the "north west" boundary of the Premises, in a location readily accessible to the Works Approval Holder and can be used to continuously measure, and predict the noise levels received at Noise Sensitive Premises to the west, south-west and north-west of the Premises, during Years 2 and 3 of operations; and
(c) in the vicinity of the "south west" and "south east" boundary of the Premises, in a location readily accessible to the Works Approval Holder and can be used to continuously measure, and predict the noise levels received at Noise Sensitive Premises to the west of the Premises, during Years 4 and 5 of operations.

21. The Works Approval Holder must implement a noise monitoring system that:

(a) supplies continuous real-time data to allow real-time monitoring of noise emissions;
(b) supplies spectral statistics; and
(c) complies with Part 3 (as applicable) of the Noise Regulations.

Monitoring general

22. The Works Approval Holder must ensure that:

(a) all water samples are collected and preserved in accordance with AS/NZS 5667.1;
(b) all groundwater sampling is conducted in accordance with AS/NZS 5667.11;
(c) all noise measurements are carried out in accordance with Part 3 of the Noise Regulations (as applicable); and
(d) all laboratory samples are submitted to and tested by a laboratory with current NATA accreditation for the parameters being measured, unless indicated otherwise in the relevant table.

23. The Works Approval Holder must ensure that monthly monitoring is undertaken at least 15 days apart.

24. The Works Approval Holder must ensure that all monitoring equipment used on the Premises to comply with the Conditions of this Works Approval is calibrated in accordance with the manufacturer's specifications.

Ambient environmental monitoring

25. Prior to commencing Works on the Premises, the Works Approval Holder must install a wind monitor (anemometer) on the Premises that complies with Observation Specification No. 2013.1.

26. The Works Approval Holder must undertake ambient air quality monitoring:

(a) at the locations specified in Column 1;
(b) for the parameters specified in Column 2;
(c) in the units specified in Column 3;
(d) over the averaging period specified in Column 4;
(e) at the frequency specified in Column 6; and
(f) using the method specified in Column 7;

of Table 7 below

Table 7: Ambient air quality monitoring table

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7
Monitoring point reference	**Parameter**	**Unit**	**Averaging Period**	**Reportable Event**	**Frequency[1]**	**Method**
Central West	TSP	µg/m^3	24 hours	> 260	One sample every sixth day	AS 3580.9.3
	PM_{10}			> 50	Continuous[2]	AS 3580.9.8 or AS 3580.9.11

Note 1: To commence prior to the start of Works on the Premises, and during the period 1 October and ending 31 May the following year.

Note 2: Availability >90% of the measurement interval on a monthly basis.

27. The Works Approval Holder must undertake ambient groundwater quality monitoring:

(a) at the locations specified in Column 1 of Table 8;
(b) for the parameters specified in Column 2 of Table 8;
(c) in the units specified in Column 4 of Table 8;
(d) over the averaging period specified in Column 5 of Table 8, and
(e) with the frequency specified in Column 6 of Table 8.

Table 8: Groundwater monitoring table

Column 1	Column 2	Column 3	Column 4	Column 5
Monitoring point reference	**Parameter**	**Units**	**Averaging Period**	**Frequency**
BNP003S BNP003D BNP004S BNMB04 BNP008D BNP010D BNP011D BNP019D BNP020S BNP020D BNP021S BNP021D BNP025S BNP027S	Standing water level[1,2]	m AHD	Spot sample	Monthly
	pH[1]	-		
	Electrical conductivity @ 25°C[1]	µS/cm		
	Redox potential[1]	mV		
	Major ions: bicarbonate, calcium, chloride, magnesium, potassium, sodium, sulfate, total dissolved solids	mg/L		At least once throughout the duration of this Works Approval
	Total titratable acidity (TTA)			
	Total alkalinity (TAlk)			
	Metals and metalloids: aluminum, arsenic, chromium (as CrVI and total Cr), cobalt, copper, iron, mercury, nickel, radium, radon, selenium, thallium, uranium, zinc			

Note 1: In-field non-NATA accredited analysis permitted.
Note 2: SWL to be determined prior to the collection of other samples.

28. Following the commencement of Works on the Premises, the Works Approval Holder must undertake ambient noise monitoring:

(a) at the locations specified in Column 1;
(b) for the parameters specified in Column 2;
(c) using the sound measuring equipment specified in Column 3;
(d) for the units specified in Column 4; and
(e) at the frequency specified in Column 5;

of Table 9 below.

Table 9: Ambient noise monitoring table

Column 1	Column 2	Column 3	Column 4	Column 5
Monitoring point reference	**Parameter**	**Sound measuring equipment**	**Units**	**Frequency[1]**
Central West	$L_{AS\ 90,30min}$	Non-directional system	dB(A)	Continuous[2]
	$L_{AS\ 10,30min}$			
	$L_{Aeq(20Hz-500Hz),30min}$			
	Audio recording			

Note 1: To commence at the start of Works on the Premises.
Note 2: Availability >90% of the measurement interval on a monthly basis and >95% in a calendar year.

29. Where the ambient noise levels measured in accordance with Table 9 indicate an exceedance of an assigned level specified in Table 1, Regulation 8 of the Noise Regulations, the Works Approval Holder must undertake an investigation of the exceedance, including but not limited to:

(a) the root cause analysis for the exceedance; and
(b) any common or contributory factors for the exceedance.

Record-keeping

30. The Works Approval Holder must maintain accurate Books including information, reports and data in relation to the Works and the Books must:

(a) be legible;
(b) if amended, be amended in such a ways that the original and subsequent amendments remain legible or are capable of retrieval;
(c) be retained for at least 3 years from the date the Books were made;
(d) be available to be produced to an Inspector or the CEO.

31. The Works Approval Holder must comply with a Department Request within 14 days from the date of the Department Request or such other period as agreed to by the Inspector or the CEO.

Complaints

32. The Works Approval Holder must record the number and details of any complaints received by the Works Approval Holder relating to its obligations under this Works Approval and its compliance with Part V of the EP Act at the Premises, and any action taken by the Works Approval Holder in response to the complaint. Details of complaints must include:

(a) an accurate record of the concerns or issues raised, for example a copy of any written complaint or a written note of any verbal complaints made;
(b) the name and contact details of the complainant, if provided by the complainant;
(c) the date of the complaint; and
(d) the details and dates of the actions taken by the Works Approval Holder in response to the complaints.

Schedule 1: Maps

Figure 1: Premises map

The Premises is shown in the map below. The red line depicts the Premises boundary.

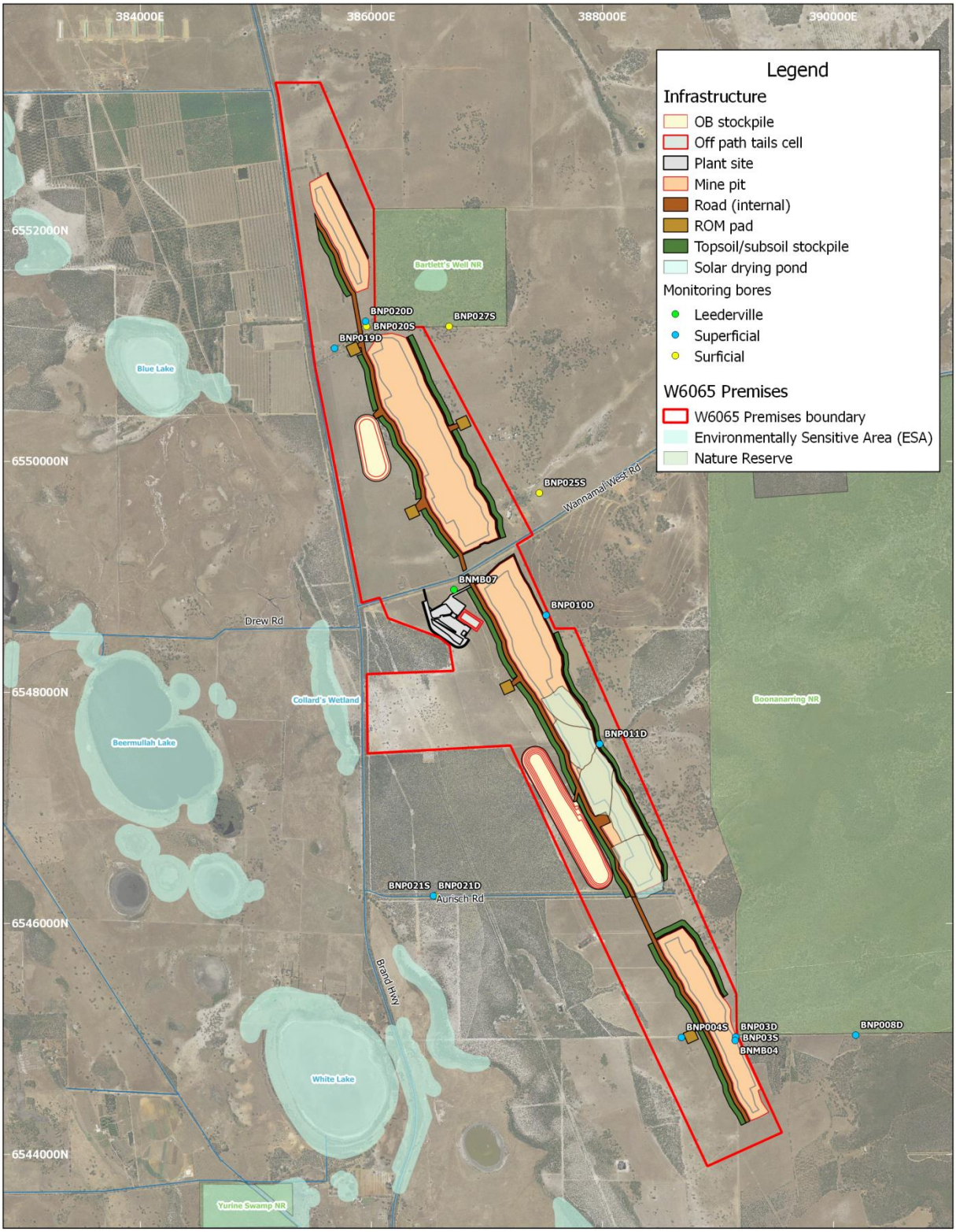
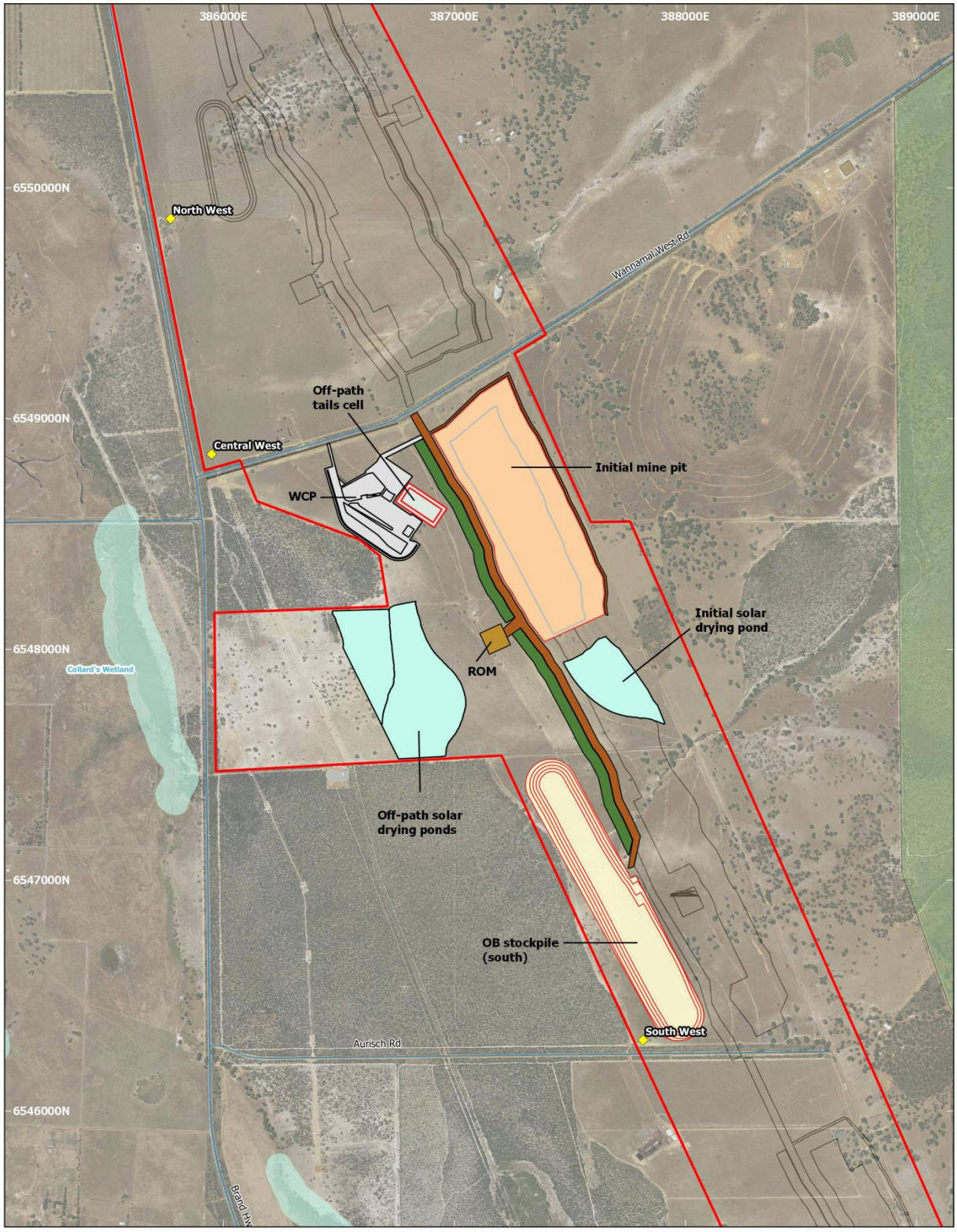


Figure 2: Works location map

The infrastructure and equipment approved as Works and the indicative monitoring locations for noise and dust are set out on the Premises in accordance with the map specified below.



Schedule 2: Works

At the time of assessment, Emissions and Discharges from the Works listed in Table 10 below were considered in the determination of the risk and related Conditions for the Works Approval.

Table 10: Authorised Works

Works
Civil excavation and earthworks, including clearing of vegetation
Road construction
Construction of WCP and associated infrastructure, including process water pond, off-path tails cell, off-path solar drying ponds, slurry pipelines
Construction of initial solar drying pond on mine path in Pit C
Stripping of topsoil and stockpiling
Overburden removal from initial mine pit and stockpiling, including construction of noise bunds for phase 1
Development of the initial mine pit
Commissioning of WCP (Not more than 100,000 tonnes of ore)
Disposal of sand tailings into the mine void, or stockpiling in the “off-path tails cell” (to be disposed in mine pit once void space is available)
Disposal of clay slimes in initial solar drying pond

Application for Works Approval

Division 3, Part V *Environmental Protection Act 1986*

Works Approval Number	W6065/2017/1
Applicant	Image Resources NL
ACN	063 977 579
File Number	DER2017/000976
Premises	Boonanarring Mineral Sands Mine Wannamal Road West BOONANARRING WA 6503 Legal description – Mining tenements M70/1194 and M70/1311
Date of Report	24 October 2017
Status of Report	Final

Table of Contents

1. Definitions of terms and acronyms

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

Table 1: Definitions

Term	Definition
ACN	Australian Company Number
AHD	Australian Height Datum
Applicant	refers to the applicant, as specified at the front of this Decision Report
Application	refers to the application made by the Applicant under section 54(1) of the EP Act on 6 June 2017, and includes the supporting documents and information as described in section 3.1 and listed in Table 3 of this Decision Report
ARI	Average Recurrence Interval
Category/ Categories/ Cat.	Categories of Prescribed Premises as set out in Schedule 1 of the EP Regulations
CSM	Conceptual Site Model
Decision Report	refers to this document
Delegated Officer	an officer under section 20 of the EP Act
DMIRS	Department of Mines, Industry Regulation and Safety
DWER	Department of Water and Environmental Regulation
EPA	Environmental Protection Authority
EP Act	*Environmental Protection Act 1986* (WA)
EP Regulations	*Environmental Protection Regulations 1987* (WA)
GL	gigalitre
GOS	Groundwater Operating Strategy
HMC	Heavy Mineral Concentrate
Implementation Agreement or Decision	has the same meaning given to that term under the EP Act
m^3	cubic metres
mbgl	metres below ground level
Minister	the Minister responsible for the EP Act and associated regulations
Mtpa	million tonnes per annum
MS	Ministerial Statement
Noise Regulations	*Environmental Protection (Noise) Regulations 1997* (WA)
Occupier	has the same meaning given to that term under the EP Act.
PER	Public Environmental Review
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
Representative Assessment Period	has the same meaning given to that term under the Noise Regulations, and is typically set at 4 hours for mineral sands mining operations
Risk Event	As described in *Guidance Statement: Risk Assessment*
ROM	Run of Mine
SMU	Slurry Mining Unit
µg/m^3	micrograms per cubic metre
UTL	upper threshold limit
WCP	Wet Concentrator Plant

2. Purpose and scope of assessment

Image Resources NL (the Applicant) proposes to develop the Boonanarring Mineral Sands Mine. An application for works approval was submitted by the Applicant under Division 3, Part V of the EP Act on 6 June 2017.

This Decision Report sets out the Delegated Officer's assessment of risks arising from emissions and discharges that will be generated from mine establishment works at the Premises.

3. Background

Boonanarring is a large scale heavy mineral sands mine proposed to be developed by the Applicant on coastal sand dunes immediately west of the Gingin Scarp, approximately 90 km north of Perth, in the Shire of Gingin.

The original mining proposal was formally assessed in 2013 by the Environmental Protection Authority (EPA) at the level of Public Environmental Review (EPA Report 1516). The proposal was approved by Ministerial Statement 981 on 22 August 2014 (refer to section 5.1).

Mining was planned to commence in late 2014 and be completed by 2019, however the Applicant has delayed the start of the project due to market conditions.

Table 2 below describes the Prescribed Premises category that the Application is subject, as defined in Schedule 1 of the EP Regulations.

Table 2: Prescribed Premises Categories

Classification of Premises	Description	Premises throughput (as per Application)
Category 8	Mineral sands mining or processing: premises on which mineral sands ore is mined, screened, separated or otherwise processed.	3,700,000 tonnes per annual period

3.1 Application details

The Application is specific to the Primary Activity of mineral sands mining or processing. It involves initial mine establishment, followed by progressive dry mining and processing processing only) of up to 3.7 Million tonnes per annum (Mtpa) of ore. The documents and information submitted with the Application are listed in

Table 3.

Table 3: Documents and information submitted with the Application

Document/information description	Author	Date/version
Application form and supporting document	Preston Consulting	2 June 2017
Appendix 1 – Ministerial Statement 981	EPA	22 August 2017
Appendix 2 – Project Mining Proposal	Preston Consulting	18 May 2017
Appendix 2-2 – Mine Closure Plan	Preston Consulting	20 April 2017
Appendix 2-3 – Environmental Management System Manual	Image Resources	March 2017
Appendix 2-4 – Ore Sterilisation Memo	Optiro	17 March 2017
Appendix 2-5 – Soils and Overburden Characterisation Report	Outback Ecology	June 2013
Appendix 2-6 – Hydrogeological Assessment	URS	9 August 2013
Appendix 2-7 – Hydrogeological Assessment - Addendum	URS	4 November 2013
Appendix 2-8 – Environmental Risk Register	Image Resources	Undated
Appendix 3 – Environmental Noise Assessment Report	Lloyd George Acoustics	21 March 2017
Appendix 4 – Surface Water Studies Report	URS	25 July 2013
Appendix 5 – Acid Sulfate Soils Investigations Report	Soilwater Consultants	18 April 2017
Appendix 6 – Air Quality and Greenhouse Emissions Management Report	Outback Ecology	April 2013
Appendix 7 – Detailed Operating Strategy	COOE	13 May 2015
Email confirming the removal of Category 5 from the application, and clarifying that Category 6 does not apply to the Application	Preston Consulting	19 June 2017
Letter requesting withdrawal of Licence application	Preston Consulting	24 July 2017
Boonanarring Project – Noise Management Plan. Prepared for Image Resources NL	Preston Consulting	26 July 2017
Further information on noise management of the project (email)	Preston Consulting	27 July 2017
Further information on commissioning works and other mine aspects (email)	Preston Consulting	9 August 2017
Further clarification on commissioning works (email)	Preston Consulting	28 August 2017
Boonanarring Project – Revised Mining Proposal. Prepared for Image Resources NL	Preston Consulting	26 July 2017
Further clarification on management of pipelines (email)	Preston Consulting	14 September 2017
Additional noise modelling – with noise bunds (email)	Lloyd George Acoustics	2 October 2017

4. Overview of the Boonanarring Mineral Sands Project

The Application seeks to develop an open pit mine, processing plant and supporting infrastructure for the mining and processing of heavy mineral sands. A summary of the Application is provided in Table 4.

Table 4: Summary of the Application

Element	Description
Premises name	Boonanarring Mineral Sands Mine
Mine status	Undeveloped 'greenfield' project
Commodity mined	Mineral sands
Life of mine	6 – 7 years
Land tenure	M70/1194 and M70/1311 are held exclusively by the Applicant. The land within the Premises boundary comprises private freehold lots and agreements are in place to allow initial mining and processing to commence
Ore quantity	19.8 million tonnes at a rate of approximately 3.7 Mtpa
Overburden removed	104.2 million tonnes
Total material disturbed	43.7 million tonnes
HMC recovered	1.1 million tonnes
Pit depth	15 to 60 m below ground level
Area of disturbance	400.0 hectares (within a 1,205 ha disturbance envelope)
Clearing	50.0 hectares
Dewatering	Abstraction of groundwater for dewatering purposes (from the superficial aquifer), to be used in processing
Ore processing	In-pit mining trommel, wet separation plant, flocculant thickener and associated infrastructure to be used to produce a heavy mineral concentrate
Secondary processing	To be conducted off-site at existing mineral separation plants, with sand and clay tailings to be returned to the Premises for backfill to mine voids

The Premises is located within mining leases M70/1194 and M70/1311, which are approximately 1,145 ha in total area and comprise several third party freehold lots. It is immediately adjacent to the Brand Highway and the Bartlett's Well and Boonanarring Nature Reserves (Figure 1).

4.1 The Boonanarring orebody covers an area approximately 10 The total disturbance area (i.e. the orebody and disturbance mine infrastructure) is approximately 400 ha. Construction and site development

The construction and site development phase of the Project will take approximately 6 months and is expected to commence in late 2017. The initial site development works will involve installation of the main mine access and internal roads and crossings, installation of water supply and management infrastructure, installation of power supply infrastructure and development of the process plant area where the Wet Concentrator Plant (WCP), thickener and associated infrastructure will be located.

Table 5 provides a summary of the disturbance area by type over the two mining leases.

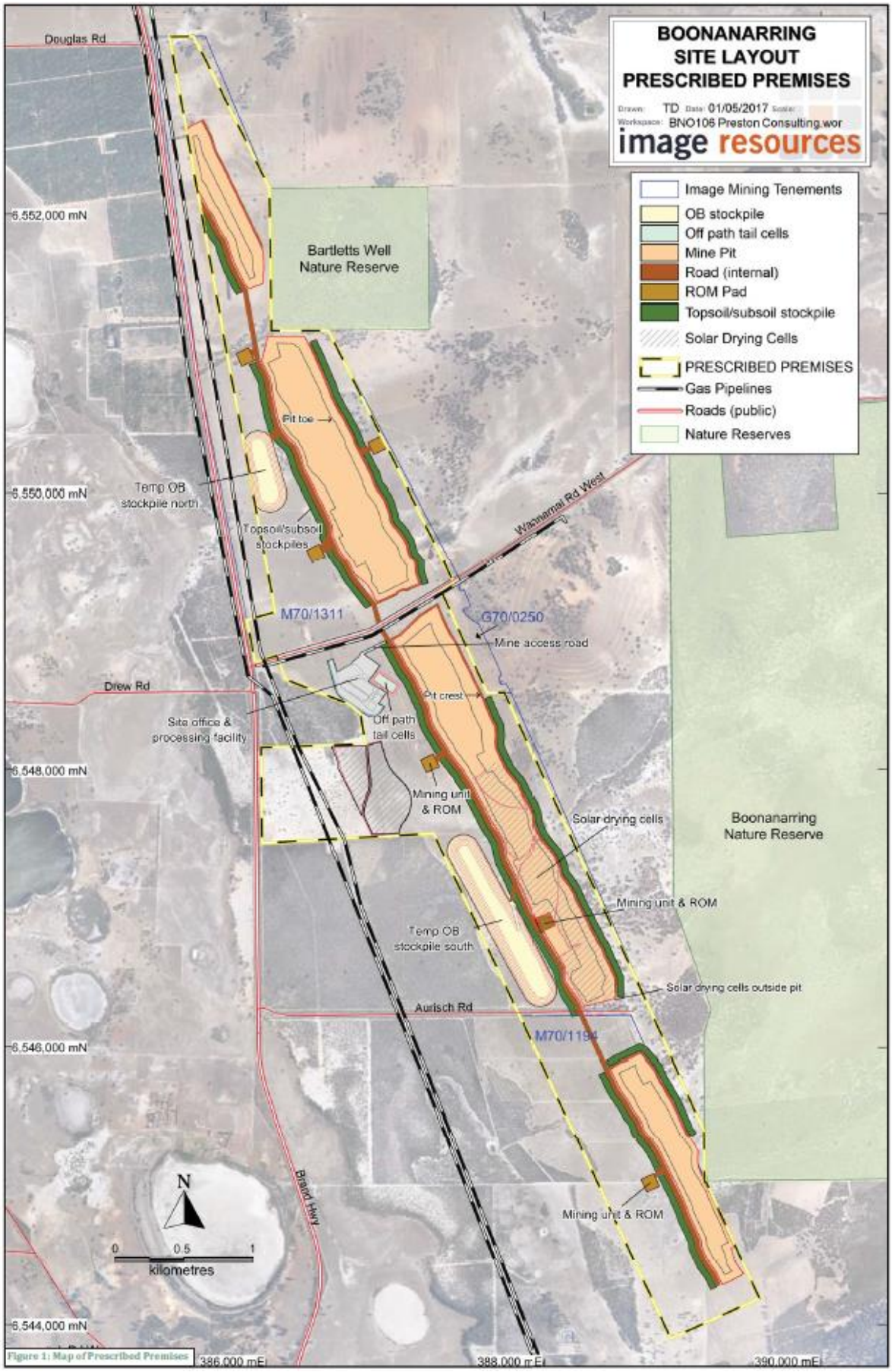


Figure 1: Location and features of the proposed mine

4.2 Construction and site development

The construction and site development phase of the Project will take approximately 6 months and is expected to commence in late 2017. The initial site development works will involve installation of the main mine access and internal roads and crossings, installation of water supply and management infrastructure, installation of power supply infrastructure and development of the process plant area where the Wet Concentrator Plant (WCP), thickener and associated infrastructure will be located.

Table 5: Area of disturbance by mining lease

Disturbance type	Mine activity reference	M70/1311 (ha)	M70/1194 (ha)
Tailings storage facility (class 2)	Off path tails cell	2.0	-
Overburden stockpile (class 1)	Temporary waste stockpile north	12.3	-
	Temporary waste stockpile north-south	32.3	-
Evaporation pond	Solar drying ponds	26.4	-
Plant site	Process plant	10.0	-
Mining void (depth greater than 5m below groundwater)	Pit A (1,800 m x 320 m)	21.0	-
	Pit B (2,950 m x 560 m)	76.0	-
	Pit C (4,500 m x 460 m)	93.0	-
	Pit D (2,500 m x 360 m)	-	39.0
Run of mine pad	ROM pads	5.0	1.0
Miscellaneous mine activities[1]		65.6	16.4
Total tenement area		343.6	56.4
Total mine activity area		**400.0**	

Note 1: Includes fuel storage areas, mine workshops, stormwater drainage, mining operations area and office, haul and access roads, laydown areas, dewatering/production and monitoring bores, cleared land, topsoil stockpiles.

4.2.1 Pre-production mining and stockpiling

An initial starter pit, 300 m square at the base, is proposed to be excavated using a truck and excavator fleet. The SMU and ROM pads (refer to section 4.3.1) will also be excavated on the mine path in preparation for start-up, commissioning and mining.

Initially, topsoil and subsoil will be stripped from the starter pit, haul roads, overburden stockpile and the initial solar drying pond (refer to section 4.3.3) areas. Overburden will be stripped from the starter pit area and will be initially stored off the mine path. Topsoil and subsoil will be stored in separate temporary stockpiles to the side of the initial mine void.

Overburden from the starter pit will be mined with a fleet of excavator and trucks or similar and stockpiled in designated off mine path stockpiles adjacent to the mine oath. Ore from the starter pit will be pre-mined to basement and stockpiled at the ROM pad.

4.2.2 Commissioning

Commissioning will be carried out over a 3 – 4 month period, at the completion of which the mine will be operational, and will generally include:

- Hydro-testing of pipelines and pump systems function testing;
- Commissioning of the raw water system;
- Dry commissioning of the SMU, WCP circuit and thickener;

- Wet commissioning of the SMU, WCP circuit and thickener; and
- Commissioning of the process control system.

To wet commission the SMU and WCP circuits and associated equipment, it will be necessary to process a volume of ore. Approximately 100,000 tonnes of ore will be processed, with the heavy mineral concentrate (HMC) stored at a temporary HMC stockpile. Management of the tailings streams produced during commissioning is discussed in section 4.3.3 below.

4.3 Operational aspects

The mining and processing operations will incorporate conventional dry mining, followed by wet concentrating, utilising industry standard mineral sands separation technology to produce HMC or intermediate products rich in ilmenite, leucoxene, rutile and zircon.

The HMC (averaging 220,000 tonnes per annum (tpa)) will then undergo secondary processing to produce various grades of zircon concentrates, leucoxene, rutile and primary and secondary ilmenite products. At this stage, secondary processing is planned in China; however should further tenements be developed in the region the Applicant has indicated the potential to construct its own mineral separation plant on the Premises.

4.3.1 Mining operations

Mining is expected to commence in mid-2018, following the commissioning period. Mining will be conducted using a five stage approach, with the initial open pit excavation situated immediately east of the process plant and infrastructure area (i.e. south of Wannamal Rd). Mining would then progress south in Pit C, with backfill following the sequence. After the initial 12 months, mining would relocate to the north side of Wannamal Rd West and begin in the east side of Pit B and progress north. Once the eastern side of Pit B is mined, Pit A will begin and be mined in conjunction with the west side of Pit B in a southerly direction. Once Pits A & B are complete, mining would recommence in Pit C and then progress south to Pit D to close out the operation over the six year mine life.

The general sequence of mining operations is outlined below:

- vegetation clearing and topsoil stripping;
- extraction of mineral sands ore using conventional dry mining equipment (e.g. trucks, excavators, dozers and loaders);
- backfilling of sand residues (i.e. clay fines, sand tailings, coarse rejects (oversize), and tailings returned from off-site secondary processing) following mineral processing to either the active mining area (behind the advancing ore extraction area) or solar drying ponds; and
- progressive rehabilitation behind the advancing mining operation.

4.3.2 Ore processing

The mining operation will involve excavators and trucks, dozers and loaders to excavate and stockpile mined ore on a run-of-mine (ROM) pad, prior to being fed directly into a loader hopper, consisting of coarse oversize screening, before being transferred to the feed preparation plant and slurry pumps (collectively known as the Slurry Mining Unit, SMU). After removal of coarse oversize and trash, the remaining material will report as ‘undersize’ and will be made into a slurry of approximately 30% solids, and then pumped to the WCP for further concentration.

Slurry from the SMU will enter the WCP via a de-sliming circuit comprising a cluster of de-sliming cyclones, followed by a constant density tank (CD tank). Overflow from the cyclones will report through to the thickener, while the underflow will go through to the CD tank, which will provide a steady state de-slimed feed to the WCP gravity spiral circuit.

Ore will then pass through a series of gravity spirals where the heavy minerals with specific gravities >3.5 will flow to the inside of the spirals and separate from the principal waste mineral quartz, which has a specific gravity <3 and will travel towards the outside of the spirals. This

process will recover the majority of the heavy mineral as HMC, which will typically comprise of 90 – 95% valuable heavy minerals (principally ilmenite, leucoxene, zircon and lesser amounts of monazite) on a dry weight basis.

HMC concentrate will be pumped to a stockpile via dewatering cyclone stackers. Cyclone overflow will be returned to the process water circuit while the underflow will be stockpiled and dried before being transported off-site for sale or further processing. A subsurface drainage system will capture stockpile seepage and return it to the process water circuit.

4.3.3 Tailings management

The tailings streams produced from the WCP will comprise benign sands, clays and heavy minerals (quartz, kaolinite, goethite and ilmenite).

Sand tailings

Sand tailings will form the majority of the residues from the WCP and will be pumped back to, and deposited in, the mining void using tailings cyclone stackers. Initially, there will be a requirement to stockpile the sand tailings, until the initial mine void has been opened up.

Tailings backfill levels will be managed by a combination of reshaping with dozers and moving the cyclone stackers around the mine void, while maintaining adequate freeboard around the void edge, and directing sand tailings as required. The sand tailings are expected to beach at a noticeable angle as water runs off and sand settles out. Water recovered from the tailing slurry will be recovered from these areas and recycled back into the process water circuit via in-pit sumps and pumps. Tailings deposition will typically follow the mining path and schedule, and mine pits will usually be backfilled within 6 – 8 months.

Clay tailings (clay fines)

Approximately 17% of the tailings material will be classed as fines (less than 63 microns), which are typically dominated by the mineral kaolinite and originate mainly from the cyclone overflow at the WCP.

Clay fines will be treated in a thickener with flocculants and coagulants, to assist in fines separation. An anionic water-soluble flocculent (e.g. Flopam AN 934 SH) will be used for flocculation purposes.

The thickened underflow will be pumped to specially constructed solar drying ponds that will be initially located on the mine path (also known as “on-path” solar drying cells) and at later stages, on top of the backfilled mine void, for drying by solar evaporation.

The clay fines will be deposited in the solar drying ponds as a slurry via a pipeline run down the inside face the deposition level and moved around the pond edge. Clay fines will develop a beaching angle away from where it is deposited, as the fines will preferentially settle on the pond floor over time and release contained (supernatant) water to the surface. Each pond will contain a slime box equipped with level boards that can be removed to decant the clean water on surface. This water will be collected for recycling back to the process water circuit.

The solar drying ponds will be shallow (2 m deep) and filled to a depth of approximately 1 m to optimise the drying timeframe, which is estimated between 66 and 196 days, depending on the time of year.

After drying, the material will be mixed with the coarse sand tailings and used in the upper layers of the soil profile in preparation for rehabilitation.

Secondary tailings management

HMC will be shipped to China for secondary processing; therefore no tailings from off-site processing will be disposed at the Premises.

Pipeline network

Slurried materials will be transferred around the Premises using high density polyethylene pipelines. The pipelines, which will be in 6 m lengths with flanged sections (butt flanged welded to the end of the line and bolted to a corresponding flange), will be used to transfer the following:

- HMC from the concentrator to the HMC stockpile;
- Clay fines to the solar drying ponds;
- Supernatant water from the solar drying ponds back to the process water pond; and
- Sand tailings to mine pit voids.

Pipelines from the WCP to the SMU and solar drying ponds will have designated pipeline corridors. Initially, the pipeline corridor will run direct from the WCP to the SMU and continue parallel to the mining haul road.

4.3.4 Mine water management

The Boonanarring deposit occurs within the Yoganup Formation, which sits below the Bassendean Sands together with colluvial deposits of the Beermullah Plain (URS, 2013a). It is typically 10 – 20 m thick and occurs between 15 and 60 m below ground level (mbgl).

The Yoganup Formation tends to be partially below the baseline water table (within the Superficial aquifer), which has been interpreted to vary between 68 and 80 m AHD (URS, 2013b). As a result, some dewatering of the open pit mining area is expected to be required, in settings where they extend beneath the water table.

Groundwater inflows will be abstracted temporarily via passive dewatering systems, such as v-drains and in-pit pumps, and recycled for use in the process water circuit to supplement the mine water demand.

As discussed in Section 4.3.3, water will also drain from areas within the Premises where partially saturated sand residues and HMC are stored (i.e. solar drying ponds, and tailings and stockpile return water). Where possible, this water will be captured and recycled via the process water pond to supplement the mine water demand.

Table 6 summarises the predicted high-level water balance for the site based on steady state operation. The water balance model will be refined based on actual site experience and seasonal conditions. A conceptual schematic of water inputs and outputs, including operations for obtaining process water is shown in Figure 2 and Figure 3.

Table 6: Proposed water balance

Water in	Volume	Water out	Volume
ROM feed	0.37 GL/a	Scrubber oversize stockpile, trommel oversize stockpile, final HMC stockpile	1.74 GL/a
Flocculant			
Attritioner modifier		Coarse tailings water losses to mining void, evaporation and drainage from solar drying ponds, process water pond evaporation, site dust suppression	
Required plant make up water[1]	1.37 GL/a		
Total water in	**1.74 GL/a**	Total water out	**1.74 GL/a**

Note 1: Sourced from Yarragadee production bore and dewatering of the Superficial aquifer.

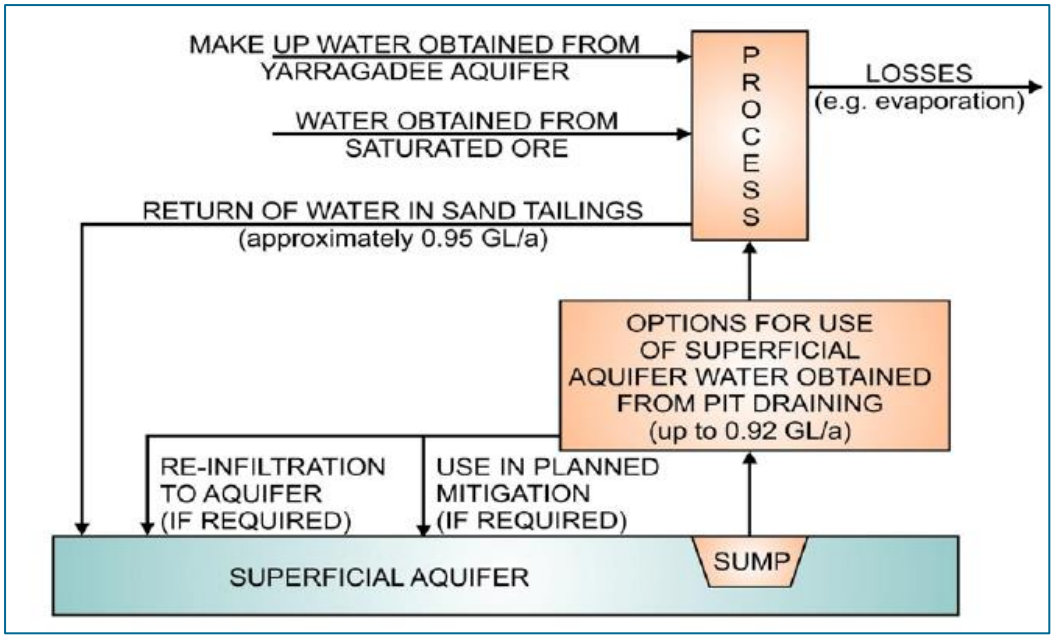


Figure 2: Yarragadee/Superficial aquifers water balance options

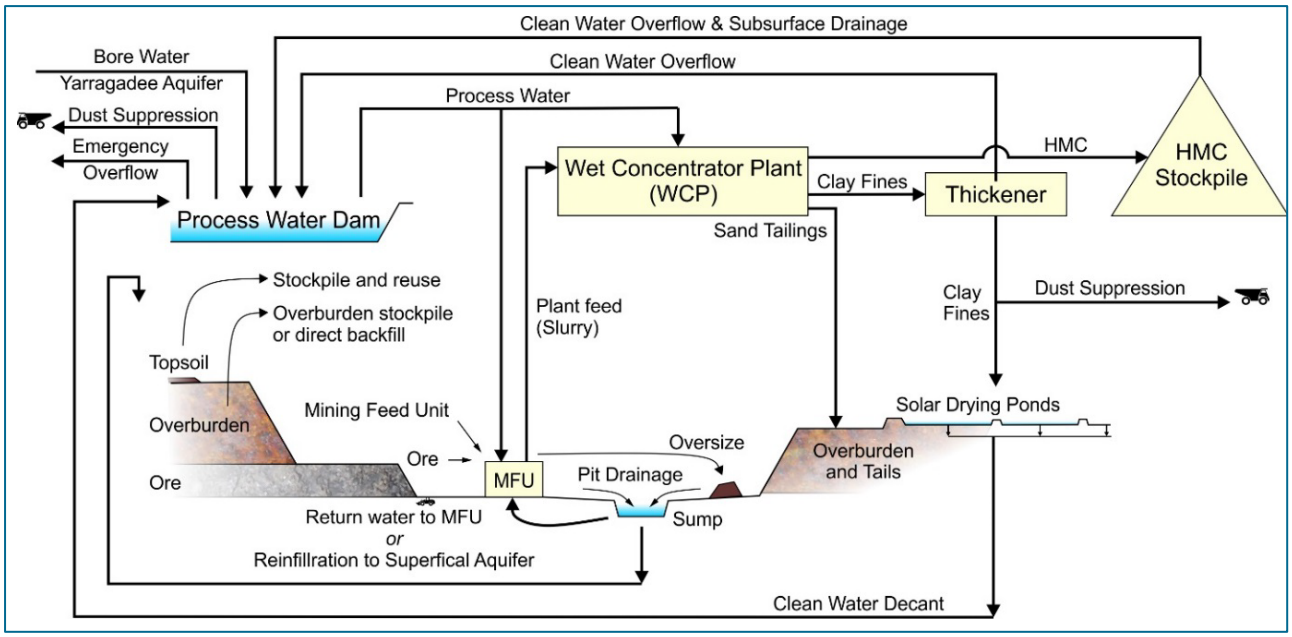


Figure 3: Mine water circuit for the proposed mine

4.3.5 Water distribution network

The proposed water distribution network begins by transferring water abstracted from the Yarragadee aquifer via production bores to a series of settling ponds prior to the process water dam, from where it will be distributed to processing facilities and associated activities. Water produced from the Superficial aquifer during passive dewatering of the mining void and orebody will supplement usage from the Yarragadee. Water systems have been designed to minimise site water usage.

Process water pond

The process water pond will be located in in-situ material and excavated below the ground surface. The proposed bund around the pond will be 1–2 m high and 2–3 m across the top and will be constructed of compacted clay material. The total proposed depth will be

approximately 6–8 m including the bund. The overall dimensions will be 34 m x 43 m. The floor lining will be HDPE or equivalent. The design batter angle will be approximately 35 degrees.

Emergency overflow will flow from the top dam into the bottom dam, and then into a designated area where the water will soak away or be pumped back into the process water circuit.

Stormwater management

Stormwater falling within the mine voids will be captured and directed to in-pit sumps and pumped back to the process water circuit. All stormwater within hardstand areas, such as the WCP and processing area, will be diverted to drains and directed towards the process water pond.

4.4 Infrastructure

The proposed infrastructure at the Premises, as it relates to Category 8 activities, is detailed in Table 7 and with reference to the Site Plan (attached in the Works Approval).

Table 7: Boonanarring mine infrastructure

Infrastructure	
Prescribed Activity Category 8	
Mineral sands ore will be mined using dry mining methods, and primary processing using wet separation to produce a heavy mineral concentrate	
1	Excavators and trucks, bulldozers, scrapers and front-end loaders
2	Wet concentrator plant. Includes hydrocyclones and gravity spiral circuits
3	Process water pond (1) and settling dams (2)
4	HMC stockpile (1)
5	Solar drying ponds (7)
6	Mining unit (mobile) and ROM pads (6)
7	Overburden (2) and topsoil/subsoil (7) stockpiles
8	Process water, HMC, tailings and return water distribution network
Directly related activities	
Groundwater abstraction (dewatering) of the Superficial aquifer to allow dry mining conditions, with mine water used to supplement mine water demand	
1	V-drains and in-pit pumps, including water pipelines
Other activities	
1	Groundwater abstraction (Yarragadee aquifer) for processing

4.5 Exclusions to the Premises

The following matters are out of the scope of this assessment and have not been considered within the technical risk assessment detailed in this Decision Report:

- contractors' laydown yards, mechanical workshops, equipment storage areas, wash down bay(s), etc.;
- fuel storage and re-fuelling area(s);
- bioremediation area(s); and
- rehabilitation (refer to Section 3).

The Applicant should note the Works Approval is related to Category 8 activities only and does not offer the defence to offence provisions in the EP Act (see s.74, 74A and 74B) relating to emissions or environmental impacts arising from non-Prescribed Activities, including those referenced above.

Key Findings:

1. The Delegated Officer notes the Superficial aquifer will be dewatered to allow dry mining to occur, with the mine water to be used in processing of ore and with no planned discharges to the environment. On these grounds, the Applicant has considered that Category 6: mine dewatering does not apply to the Application.
2. The Delegated Officer notes the EPA's assessment of the proposal includes groundwater re-infiltration as a contingency measure to prevent loss or degradation of the defined environmental values within the Bartlett's Well and Boonanarring Nature Reserves.
3. The Delegated Officer considers that any works approval and/or licence issued under Division 3, Part V of the EP Act would not provide a defence against potential offences under the EP Act, such as engaging in conduct affecting the environment (e.g. causing or allowing anything to be discharged, emitted or transmitted) without there being an authorisation in force in relation to it.

5. Legislative context

Table 5 summarises approvals relevant to the assessment.

Table 8: Relevant approvals and tenure

Legislation	Number	Approval
Part IV of the EP Act	MS 981	Ministerial approval for implementation of the proposal (to construct and operate the Boonanarring mine)
Mining Act 1978 (WA)	Registration ID: 67819	Mining Proposal for the Boonanarring Mineral Sands Project (M70/1311, M70/1194)
Rights in Water and Irrigation Act 1914 (WA)	GWL183866(1)	Licensed allocation 99,000 kL/yr from the Gingin Groundwater Area, Perth – Superficial Swan aquifer, for the purpose of dust suppression during mining, earthworks and construction activities The licensed allocation will be increased to 0.92 GL/yr for the purpose outlined above, prior to the commencement of mining
	GWL183864(1)	Licensed allocation 99,000 kL/yr from the Gingin Groundwater Area, Perth – Yarragadee North aquifer, for the purpose of dust suppression during mining, earthworks and construction activities The licensed allocation will be increased to 2 GL/yr for the purpose outlined above, prior to the commencement of mining

5.1 Part IV of the EP Act

5.1.1 Background

The original mine proposal was referred to the EPA in October 2012 under section 38 of the EP Act. A Public Environmental Review (PER) level of assessment was set by the EPA in November 2012, with a five week public review period (EPA Assessment No. 1947).

The Environmental Scoping Document for the assessment was released in April 2013,

followed by the PER in January 2014. A total of 11 submissions were received during the public review period, with the key issues raised relating to:

- potential impacts on the nature reserves and adjacent wetlands;
- impacts on sensitive receptors from fugitive dust;
- the proximity of sensitive receptors to the proposal and the predicted noise exceedances at some receptors; and
- radiation risk from mining mineral sands.

The EPA released its final report on the assessment (EPA Report 1516) in June 2014. The Minister subsequently approved the project through the publishing of MS 981 on 22 August 2014.

5.1.2 Ministerial Statement 981 of 2014

The key environmental factors identified in EPA Report 1516 are generally related to the impacts of mining on flora and fauna of conservation significance and on the nearby nature reserves, and hydrological impacts resulting from groundwater drawdown. A number of recommendations were made, however none that were specific to emissions and discharges from the mining operation.

The EPA also provided 'other advice' to the Minister with respect to acid sulfate soils, amenity and mine closure and rehabilitation, noting that other regulatory mechanisms can be used to regulate these aspects.

MS 981 contains a number of conditions that relate to ensuring there are no impacts to native vegetation values and wetlands from dewatering of the Superficial aquifer attributable to mining (including monitoring to demonstrate that any impacts will be contained within the areas predicted, and contingency measures to ensure confidence that values will be protected).

Key finding: The Delegated Officer notes that MS 981 requires the proponent to conduct monitoring of the following themes:

1) the health of native vegetation within the adjacent nature reserves and wetlands; and
2) groundwater levels and quality;

with respect to potential impacts from dewatering drawdown.

Consistent with section 54 of the EP Act:

(4) *If an application for a works approval made under subsection (1) is related to a proposal which has been referred to the Authority under section 38, the CEO shall not perform any duty imposed on him by subsection (3) –*

(b) contrary to, or otherwise that in accordance with, an implementation agreement or decision.

the Delegated Officer has drafted conditions in the operating licence for the sampling and annual reporting of groundwater quality in proximity to the mine pits.

5.2 Other relevant approvals

5.2.1 *Mining Act 1978 (WA)*

With the exception of land alienated before 1 January 1899, all minerals[1] are the property of the

[1] When occurring on private land, the following are not considered minerals for the purposes of the Mining Act: limestone, rock, gravel, shale, sand and clay (excluding oil shale, mineral sands, silica or garnet sand, kaolin, bentonite, attapulgite and montmorillonite).

Crown, and a mining title must be obtained from the Department of Mines, Industry Regulation and Safety (DMIRS) before ground disturbing exploration activities or any mining operations may be undertaken (DMP, 2015).

DMIRS has approved a Mining Proposal (Registration ID: 67819) to develop the mineral sands deposit on M70/1311 and M70/1194, which is over private land.

DMIRS also administer the *Mines Safety and Inspection Act 1994*, with respect to the standards of occupational safety and health. The Resources Safety Division administers occupational health (OSH) legislation for mining operations, and safety legislation and the licensing regime for dangerous goods, including regulation of the State's major hazard facilities. This includes the requirement to lodge and have approved a Project Management Plan, reviewing structural designs and specifications of tailings storage facilities and other engineered mine-related infrastructure, etc.

5.2.2 *Rights in Water and Irrigation Act 1914 (WA)*

Groundwater is a key component of the mining operation and will be used in various mining and processing facilities across the site, including potable water supply.

The Premises lies within the Gingin Groundwater Area which comprises the Red Gully, Cowalla and Wannamal sub-areas. These sub-areas are fully allocated or over allocated when considering the Superficial, Leederville and Yarragadee aquifer systems, which reflects the high groundwater demand in the vicinity of Gingin and associated competition for the available resources.

Groundwater abstraction in gazetted areas is regulated by DWER under section 5C of the *Rights in Water and Irrigation Act 1914*. It is departmental policy not to issue groundwater licences above allocation limits; however due to the proposed temporary use of the resource DWER has approved the release of an unused allocation that has been reserved for Public Water Supply in the Yarragadee aquifer north of the Premises (Cataby Confined sub-area).

Two temporary section 5C Licenses to Take Water have been issued from the Perth-Yarragadee and Perth-Superficial aquifers (both 99,000 kL/yr) to provide a source of water for initial site works prior to commencement of the operational phase of the project. Licenses based on the Applicant's original applications (2 GL/yr from the Perth-Yarragadee aquifer for mining and processing, and 0.92 GL/yr from the Perth-Superficial aquifer for mine dewatering) will be issued for 5 years prior to the commencement of mining.

Key finding:

The Delegated Officer notes that DWER's assessment of groundwater abstraction for the Project is based on a limited 5 year mine life modelling scenario, and that any proposal(s) to extend the original mining schedule will require further assessment and approval, in addition to consideration of the competing demands on the water resource.

5.2.3 *Radiation Safety Act 1975 (WA)*

Deposits of mineral sands contain levels of naturally occurring radioactive materials (NORM). The radioactive constituents are mostly thorium with smaller amounts of uranium, and their respective decay products. Monazite is the most common radioactive mineral and typically constitutes less than 0.5% of the mined ore; however any operation in which radioactive containing material is extracted from the ground and processed can potentially concentrate NORM in product, by-product or waste streams.

The management of radiological risk (to human health and the environment) from NORM is undertaken jointly by DMIRS and the Radiological Council of WA (RCWA). Prior to the commencement of any stage of mining to which radiation regulations apply, the Applicant is required to obtain approval for a Radiation Management Plan (RMP) and a Radiation Waste Management Plan (RWMP) for the proposed activities at that stage. Both plans are reviewed

by DMIRS and RCWA against defined requirements before the grant of approval to operate.

5.2.4 Planning approvals

The Shire of Gingin has advised that planning approval is not required for the proposal.

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: Regulatory Principles (July 2015)*;
- *Guidance Statement: Setting Conditions (October 2015)*;
- *Guidance Statement: Licence Duration (August 2016)*;
- *Guidance Statement: Environmental Siting (November 2016)*;
- *Guidance Statement: Decision Making (February 2017)*; and
- *Guidance Statement: Risk Assessment (February 2017).*

5.3.2 Amendments

An administrative amendment was conducted in June 2018 to correct unintentional errors regarding the mining tenement number referenced in the Premises description, and the previously agreed exclusion of a specified noise control requirement.

5.3.3 Clearing of Native Vegetation

Clearing of native vegetation in Western Australia requires a clearing permit, unless exemptions apply. Under Schedule 6 of the EP Act, clearing assessed under section 40 of the EP Act as part of a proposal referred under section 38 of Part IV of the EP Act does not require a clearing permit, providing the clearing is done in accordance with the Implementation Agreement or Decision.

The EPA has assessed the clearing of remnant vegetation within the areas to be mined and clearing for access. The authorised extent of clearing has been limited to a maximum of 50 ha within a 400 ha disturbance envelope, as described and spatially defined in MS 981.

6. Modelling and monitoring data

6.1 Acid sulfate soils investigation

The Applicant has conducted a site investigation (SWC, 2017) to verify whether acid sulfate soils (ASS) are present based on soil characteristics. A total of 840 soil samples from 20 drill holes were taken across the central and southern deposit areas, based on the occurrence of black and dark grey soils recorded in the drilling database, to depths ranging from 27 to 60 mbgl[2].

6.1.1 Results

The key results from the soil sampling and associated analytical testing include:

- in-situ field pH (pH_F) values for all samples tested varied from 4.22 to 7.33. None of the

[2] Corresponding with the basal contact of the Guildford Formation with the underlying Yoganup Formation, or at the boundary between the Yoganup and underlying Leederville/Yarragadee Formations.

samples tested had a pH_F <4, indicating that actual ASS are unlikely to occur within the deposit;
- oxidised field pH (pH_{FOX}) values for all samples tested varied from 1.97 to 7.44. Approximately 20% of samples had a pH_{FOX} value <4, indicative of potential ASS (PASS). Approximately 5% of all samples tested had a pH_{FOX} value <3, indicative of soils which are likely to contain significant acid production potential;
- a comparison of the results of screen testing (pH_F and pH_{FOX}) with soil colour and texture indicate the majority of soils with low pH_{FOX} values are black or dark grey in colour, had a heavy clay texture and occur either below or at the base of the proposed mining pits (i.e. top of the Leederville Formation);
- the results of acid base account analysis, using the SPOCAS (Suspension Peroxide Oxidation – Combined Acidity and Sulfate) testing suite, have shown a strong link between the pH_{FOX} and soil colour/texture of a sample and its potential to hold significant sulfides – this can be useful in effective mine planning to ensure appropriate management tools are in place to mitigate environmental impacts from disturbance; and
- the results of multi-element analysis have shown the samples contain low concentrations of metals and metalloids generally below DWER ecological investigation limits. ASLP leach testing has indicated the release of metals under acidic conditions will be low.

6.1.2 DWER technical review

DWER's review of the *ASS Investigation Report* (SWC, 2017) provided as part of the Application identified that:

- The investigations conducted were carried out in an appropriate staged manner, and the conceptual site model (CSM) developed for determining the distribution of sulfide minerals in the deposit is also considered to be sound and should form a suitable basis for managing the disturbance of sediments during mining;
- The proposed strategy of using the CSM to guide sampling should enable sulfidic materials to be rapidly identified and managed as soon as they are excavated. However, the pH_{FOX} of random samples of sediments with different colours and textures should also be tested periodically on an ongoing basis to ensure that elevated sulfide levels in sediments not identified as being sulfidic by colour or texture in the field can also be detected;
- It is recommended that Total Acidity be included in the monthly groundwater monitoring suite carried out on the site, as it is a more sensitive indicator of groundwater acidification than changes in pH on their own. Trigger values for acidity should also be developed based on the upper threshold limit (UTL) value of background levels in groundwater in the area. Additional sampling should be undertaken where the UTL is triggered, followed by full chemical analysis;
- The frequency of monitoring of pumped effluent from mine dewatering is considered to be too low and will limit the ability of the Applicant to rapidly respond to any changes in pH and acidity that occur during dewatering. Field tests of pH, acidity and electrical conductivity should be undertaken at least weekly on the mine dewatering effluent. If trigger levels for these field parameters are exceeded, the dewatering effluent should be resampled and chemically analysed for the full suite of chemical parameters; and
- Contingency measures listed for managing the risk of sulfide oxidation in sediments that contain significant amount of sulfide minerals are suitable. However, only limited information has been provided about how groundwater might be managed in the event that drawdown leads to contamination of groundwater by metals.

Key Findings:

1. Given the relatively low rate of pumping required to dewater the pits, disturbance of ASS should be manageable.
2. Field testing of samples to provide quality control on the effectiveness of the CSM is required to enable sulfidic materials to be rapidly identified and managed as soon as they are

excavated. Biannual testing for pH_{FOX} of at least 5 random samples should be conducted to ensure the CSM continues to differentiate between sulfidic and non-sulfidic materials.

3. Weekly field tests for pH, acidity and electrical conductivity should be conducted on the mine dewatering effluent, to enable a rapid response to changes in pH and acidity.

6.2 Noise model

The Applicant has undertaken a noise impact assessment for the project using the noise modelling software *SoundPLAN 7.2*, to predict noise levels at each nearby receiver under a number of operating conditions. The CONCAWE algorithms were selected for the model, as it includes the influence of wind and atmospheric stability (LGA, 2017a).

The original noise impact assessment, submitted with the PER in 2013 (LGA, 2013), indicated exceedances of the Noise Regulations at four locations during construction and operation of the proposed mine. Comments received during the public review period of the PER process also expressed concern in relation to noise impacts on sensitive receptors. The model has since been revised as part of this Application and in response to submissions on the PER, to account for equipment and operational changes (LGA, 2017a).

Additional modelling was undertaken to take into account additional noise controls through the use of overburden as noise bunds (LGA, 2017b).

6.2.1 Results

The model predicts exceedances of the assigned noise levels at the four closest neighbouring residences, with the most significant exceedances predicted during overburden removal, pit development and night-time mining operations.

During overburden removal[3], exceedances of up to 17 dB[4] are predicted at the two closest noise sensitive receptors during most mining scenarios. Noise emissions will be dominated by haul trucks and excavators. Acoustic consultants for the Applicant, Lloyd George Acoustics (LGA), has recommended that all 9 haul trucks be retro-fitted with 'hushpaks' to reduce noise emissions by 5 – 6 dB at the two closest receptors and remove tonality from the noise emissions, and that private agreements or relocation be considered for the two closest receptors during specific mining scenarios.

During pit development[3], exceedances of up to 2 dB are predicted at the two closest receptors, even with the proposed 'hushpaks' installed on haul trucks and reduced fleet numbers. Noise emissions will be dominated by excavator operation. LGA recommends the use of an excavator with a (quieter) sound power level ≤110 dB(A), in addition to 'hushpaks' and private agreements/relocation (as above).

During full production[5], exceedances of up to 11 dB are predicted mostly during night-time operations (10:00 PM – 7:00 AM) at the closest receptor to the west during all mining scenarios. LGA has suggested a number of equipment and operational changes for each mining scenario that indicates (marginal) night-time noise compliance can be achieved, with the primary recommendation being relocation of the two closest receptors during specific mining scenarios.

Additional noise modelling has taken into consideration the use of overburden to construct a series of sizeable noise bunds that vary in height between 5 and 19 m. The modelling indicates that compliance with the Noise Regulations can be achieved in all operational scenarios with these bunds in place.

[3] Conducted during normal day time working hours only, i.e. Monday to Saturday, 7:00 AM – 7:00 PM.

[4] Assuming tonality.

[5] 24 hours per day, 7 days per week.

6.2.2 DWER technical review

DWER's review of the updated *Environmental Noise Assessment* (LGA, 2017) provided as part of the Application identified that:

- The selection of input data and assumptions made are accepted as presenting reliable conclusions on the predicted noise levels and compliance with the assigned levels at noise sensitive receptors under all likely operational scenarios;
- Despite the implementation of noise mitigation and management measures, the modelling indicates that compliance with the assigned noise levels cannot be achieved at all times due to the short buffer distances. DWER considers relocating these residents to be the only practical measure to ensure compliance with the Noise Regulations;
- The updated assessment has not assessed two of the four closest receptors that were identified in the original assessment, as they will not be occupied throughout the duration of the project. DWER supports LGA's recommendation that the remaining two affected properties be purchased or leased for the life of mine. The Applicant has indicated it has commenced negotiations into purchasing these properties, however advises these are reliant on full project funding, and approval to mine, being obtained from the company board;
- Much noisier equipment items have been proposed in the updated assessment. This change has significantly increased the sound power levels and subsequently, the level of noise exceedances has significantly increased, compared with the original assessment. The Applicant has indicated the processing capacity of ore has increased to 500 t/hr therefore larger volumes of material are required to be moved (the equipment in the original noise assessment did not have the capacity). As such, larger equipment is required to meet the updated mining schedule, provide increased efficiencies and reduce machine numbers on site;
- The retro-fitting of 'hushpaks' on haul trucks and excavators as noise mitigation measures is considered an expensive noise reduction option. However, the Applicant has confirmed that Hushpaks 'or similar' will be fitted to all haul trucks and excavators.

Key Findings:

1. Compliance with the Noise Regulations is heavily reliant on the implementation of extensive noise controls during specific mining scenarios. These include:
   - Retro-fitting of 'hushpaks' to haul trucks and excavators;
   - Constructing sizeable noise bunds during specific mining phases;
   - Utilising only one excavator during night-time operations, and working behind the bunds;
   - Continuous, real-time monitoring of noise emissions.
2. Larger equipment items are proposed due to increased mining schedule, which is potentially at variance to the Part IV assessment. The EPA advises the proponent committed to a number of items in response to comments during the Part IV assessment, and considers the proponent needs to meet these commitments or a similar outcome as was identified in the Part IV assessment in terms of noise amenity agreements and levels at the nearest sensitive receptors.
3. The EPA's objective for amenity (noise) is to ensure that impacts to amenity are as low as reasonably practicable. In addition, s.51 of the EP Act requires occupiers of premises to take all reasonable and practicable measures to prevent or minimise emissions. The use of larger (and noisier) equipment items is potentially at variance to these aspects.

7. Consultation

The Application was referred to several public authorities and receptors within 5 km of the Premises boundary (listed in Table 10), to which the Delegated Officer considered to have a direct interest in the subject matter of the Application. A summary of the responses is provided in Table 9.

Table 9: Direct interest stakeholder submissions and DWER consideration

Comment	DWER consideration
Department of Mines, Industry Regulation and Safety	
DMIRS standard mining conditions were applied to the mining tenements and the proponent is required to submit annual environmental reports, in addition to a revised Mine Closure Plan in 2020. DMIRS expects the revised plan will contain more detailed information and a refined closure strategy, and these requirements have been reflected in the final approval document sent to the proponent.	Noted.
Department of Biodiversity, Conservation and Attractions	
The proponent is required under MS 981 to prepare a Nature Reserve Vegetation and Groundwater Monitoring and Response Plan, on the advice of DBCA, to ensure that groundwater dewatering and abstraction associated with the activities does not cause any loss or degradation of defined values within Bartlett's Well and Boonanarring Nature Reserves.	Noted.
Shire of Gingin	
The Shire discussed the proposal at the September 2017 Concept Forum of Councils, in particular the operational aspects brought about by the increase in production rate that will result in an overall noise increase at the 5 and 10 km buffer zones, and the need to protect the immediate sub aquifer and the mine "pull water" only from the Yarragadee aquifer. Council supports DWER in taking a conservative and stringent approach to proposed operational changes to meet acceptable noise levels. Development approval is not required for the proposal.	Noted.
Nearby landowner	
A number of concerns were raised about water supply for the mine and potential impacts on surrounding land owners, in terms of drawdown on existing bores and wetlands in the area. The submitter also raised concerns about noise from operating machinery and reversing beepers, which they experienced during operation of the former Gingin mineral sands mine.	The concerns relating to groundwater abstraction will be considered by DWER as part of the assessment under the RIWI Act. The concerns relating to amenity impacts from noise have been addressed through the imposition of controls on the works approval.

8. Location and siting

8.1 Siting context

The Premises is located in the State's coastal Wheatbelt region, on the lower slopes of the Gingin Scarp, approximately 24 km north-west of Gingin and 100 km north of Perth. The Dandaragan Plateau is located to the east of escarpment and the Beermullah Plain to the west.

8.2 Residential and sensitive Premises

The distances to identified residential and sensitive receptors are detailed in Table 10 and illustrated in Figure 4.

Receptors assigned with an alphabetic value are located within a 2 km radius of the proposed mine and have been considered within the noise impact assessment for the project (refer to section 6.2). Receptors assigned with a numeric value have not been considered within the noise impact assessment, however have been identified by DWER as being 2 – 5 km from the proposed mine boundary.

Table 10: Receptors and distance from activity boundary

Residential and sensitive premises	Distance from Prescribed Premises
Lot 32 on Plan 400196, 120 Douglas Rd, Beermullah (A)	1.8 km north-west of Pit A; 5.3 km north-west of WCP
Lot 404 on Plan 71187, 5297 Brand Hwy, Beermullah (B)	1.2 km north-west of Pit B; 2.9 km north-west of WCP
Lot 5448 on Plan 206481, 2192 Wannamal West Rd, Boonanarring (C)	2.4 km north-east of Pit B; 2.6 km north-east of Pit C; 3.1 km north-east of WCP
Lot 5447 on Plan 206481, 2402 Wannamal West Rd, Boonanarring (D)	0.3 km east of Pit C; 1.5 km north-east of WCP
Lot 10 on Diagram 87243, 18 Drew Rd, Beermullah (E)	1.0 km west of WCP; 1.3 km west of Pits B & C
Lot 11 on Diagram 87243, 116 Drew Rd, Beermullah (F)	2.2 km west of WCP; 2.3 km west of Pit B; 2.5 km west of Pit C
Swan Location 192 4791 Brand Hwy, Beermullah (G)	2.4 km south-west of WCP; 2.6 km south-west of Pit C
Lot 1758 on Plan 114095, 4731 Brand Hwy, Beermullah (I)	2.9 km south-west of Pit C; 3.0 km west of Pit D; 3.4 km south-west of WCP
Lot 5918 on Plan 165282, 275 Aurisch Rd, Boonanarring (J)	0.3 km east of Pit C; 0.4 km north-east of Pit D; 3.1 km south-east of WCP
Lot 1 on Diagram 82561, 175 Highlands Rd, Boonanarring (K)	1.1 km south-east of Pit D 2.9 km south-east of Pit C
Lot 22 on Plan 68417, 536 Nine Mile Swamp Rd, Beermullah (1)	4.5 km west of WCP

Lot 2959 on Plan 143785, 391 Nine Mile Swamp Rd, Beermullah (2)	4.3 km south-west of WCP
Lot 1754 on Plan 104863, Beermullah (3)	5.4 km south-west of WCP
Lot 3123 on Plan 255126, 86 Mayfield Rd, Beermullah (4)	6.2 km south-west of WCP
Lot 13 on Plan 63604, 96 McVee Rd, Beermullah (5)	5.1 km west of Pits C & D
Lot 10 on Diagram 89983, 262 Beermullah Rd, Beermullah (6)	5.1 km west of Pit D
Lot 2956 on Plan 202657, 54 Nine Mile Swamp Rd, Beermullah (7)	4.1 km west of Pits C & D
Lot 2243 on Plan 124052, 23 White Lake Rd, Beermullah (8)	3.8 km west of Pits C & D
Lot 30 on Plan 65047, 102 Beermullah Rd, Beermullah (9)	3.6 km west of Pits C & D
Lot 31 on Plan 65047, 4523 Brand Hwy, Beermullah (10)	3.4 km south-west of Pit D
Lot 1215 on Plan 250008, 83 Harris Rd, Beermullah (12)	4.6 km south-west of Pit D
Lot 201 on Plan 302098, 4761 Brand Hwy, Beermullah (11)	3.1 km west of Pits C & D
Lot 503 on Plan 59680, 5857 Brand Hwy, Beermullah (13)	4.6 km north of Pit A
Lot 5382 on Plan 206477, 5708 Brand Hwy, Red Gully (14)	5.5 km north of Pit A

8.3 Physiography

The Premises is defined by the Swan Coastal Plain physiographic unit, which is bounded to the east by the Gingin Scarp and the Indian Ocean to the west.

8.3.1 Regional geology

The Premises is located on the Dandaragan Plateau and Swan Coastal Plain, to the west of the eastern edge of the Swan Coastal Plain, where the footslopes of the Gingin Scarp rise steeply to the Dandaragan Plateau. The local area comprises several surface geology units, however the Premises itself is predominantly located on the sand plain surface geology unit to the east of the Brand Hwy and the Gingin Scarp, and a smaller portion on the Bassendean Sand unit to the west.

The stratigraphic sequences relevant to the Premises include the Quaternary aged Colluvial/Bassendean Sands and Guildford Formation, the Late Tertiary Yoganup Formation and the Mesozoic Leederville and Yarragadee Formations. All of these surficial geological formations have either been formed or have been strongly influenced by marine regression and transgression events since the Early to Mid-Tertiary (approx. 50 million years ago).

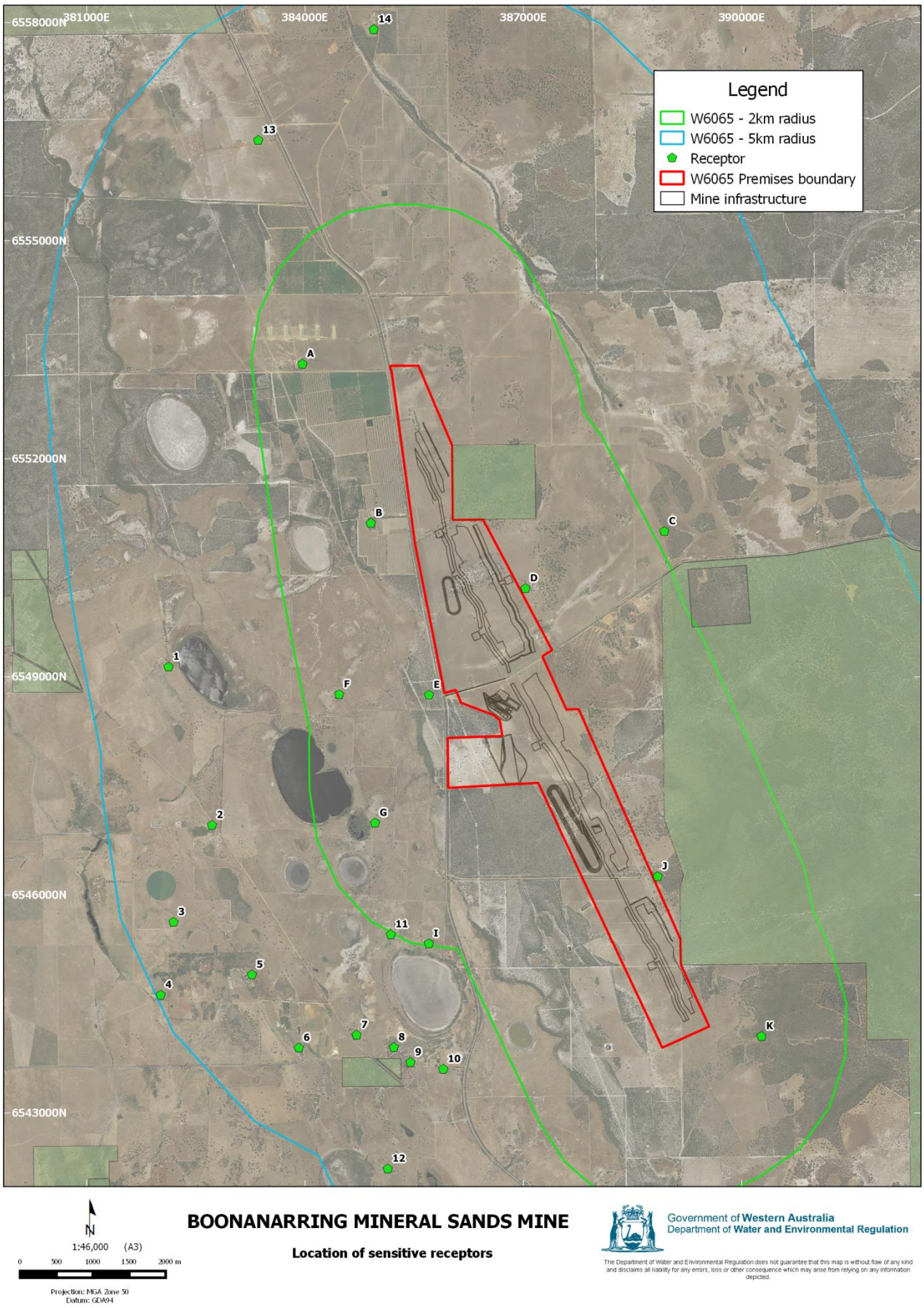


Figure 4: Location of sensitive receptors within proximity to the proposed mine

The Leederville and Yarragadee Formations, which typically forms the base of mineral sand operations on the Swan Coastal Plain, consists of interbedded, weakly to well consolidated sandstone, siltstone, shale and claystone that, in the upper portions, have been deposited in a non-marine, primarily fluvial setting. The Leederville Formation sediments conformably overlie the Yarragadee Formation. The mineralised sands of the Yoganup Formation unconformably overlie the Mesozoic Formations, and consists primarily of friable 'beach' sands which were deposited and developed during successive marine transgression and regression events.

The Yoganup Shorelines remained active for a prolonged period and during that time the surface topography would have resembled the current, present day coast. At the beginning of the Quaternary Period, sea levels regressed, bringing alluvial, fluvial and colluvial conditions which resulted in the deposition of the predominantly clayey Guildford Formation, directly over the shoreline deposits of the Yoganup Formation. Lastly, unconformably overlying the Guildford sandy clay to clay sediments are a series of Aeolian sand dunes belonging to the Bassendean Formation.

8.3.2 Landform and soils

The Premises is located within the Swan Coastal Plain geomorphological division and is situated on the Dandaragan Land System. This system is characterised as a subdued dissected lateritic plateau, with undulating low hills and rises with narrow alluvial plains.

The mineralisation of the Boonanarring deposit is hosted by the Yoganup Formation. The main geological units identified include:

- **Surface sands**: low clay, yellowish coloured and generally unconsolidated sands that occur from surface to depths of 4 – 10 m and which are interpreted as belonging to the Bassendean Sand unit. In some areas, lateritic surface gas formed at the base of this unit;
- **Red cover sands**: red to brown coloured iron-rich sands that have varying levels of induration and which often contain clayey lenses towards the base of the unit. Oversize material is common and goethite/limonite chips can report as heavy mineral concentrates. The sands are often coarse, suggesting a high energy depositional environment, and interpreted to correlate to the Guildford Formation;
- **Host sands**: brown to light grey, fine to medium grained sands that are well sorted and generally increase in grain size towards the base of the unit. This unit is correlated with the Yoganup Formation and contains heavy mineral accumulations associated with strandline deposition.

The heavy minerals within the Yoganup Formation have been concentrated in two main strandlines that coalesce in the south and are continuous over a strike length of 13.2 km. An additional strandline to the west is present in the southern part of the Premises. The basement to the strandline mineralisation is demarcated by the increased slimes content of the clay-rich Leederville Formation (refer to section 8.7).

8.4 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 (and other relevant ecosystem values which do not fit the definition of a specified ecosystem) are shown in

Table 11.

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

Table 11: Environmental values

Specified ecosystems	**Distance from the Premises**
Ramsar Sites in Western Australia	The closest Ramsar sites are the Forrestdale & Thomsons Lakes, located in the southern suburbs of Perth, approx. 100 km south of the Prescribed Premises.
Important wetlands – Western Australia (Environment Australia, 2001)	The closest listed important wetlands include the Wannamal Lake System (approx. 20 km east), Chandala Swamp (approx. 28 km south) and Karakin Lakes (approx. 38 km north-east).
Geomorphic Wetlands	The Premises is located at the toe of the Gingin Scarp and up-hydraulic gradient of the Beermullah Plain, which hosts a number of wetlands (palusplain, sumplands, damplands and lakes). The most prominent is the Mindarra Northwest Wetlands suite, which comprises the Beermullah and White Lakes, Little and Big Bootine Swamps, Yurine Nature Reserve and Collard's wetland (see Section 8.6.1).
Lands and Waters managed by the Department of Biodiversity, Conservation and Attractions	Several nature reserves are located in close proximity to the Premises, including Bartlett's Well Nature Reserve, which adjoins the north-eastern corner of the Premises, and Boonanarring Nature Reserve, located immediately east of the Premises. Other reserves in the vicinity include the Yurine Swamp Nature Reserve (approx. 4 km south-west), Sand Spring Well Nature Reserve, Moore River Nature Reserve and Moore River National Park (approx. 6 km west) and Bootine Nature Reserve (approx. 8 km south-west).
Threatened Ecological Communities and Priority Ecological Communities	The majority of the area within the immediate vicinity of the Premises boundary is mapped as the Banksia Woodlands ecological community, which was listed as 'endangered' under the EPBC Act in 2016. Several areas mapped as the TEC 'Muchea Limestone' (Endangered) are located 3 – 5 km west of the Premises. Several areas mapped as PECs 'SCP07' (Vulnerable), 'SCP22' (P2) and 'SCP23b' (P3) have been recorded in the broader locality.
Biological component	**Distance from the Premises**
Threatened/Priority Flora	A total of 26 rare flora species have been recorded within a 7.5 km radius of the Premises. Three Declared Rare species, *Banksia mimica*, *Goodenia arthotricha* and *Thelymitra dedmaniarum*, and 23 priority species have been identified, primarily within the adjacent Bartlett's Well and Boonanarring Nature Reserves.
Other relevant ecosystem values	**Distance from the Premises**
Hydrography – surface water	The local watershed is characterised by a number of small-scale drainage lines. Red Gully Creek is located approx. 5 km north of the Premises, and Boonanarring Brook is approx. 3 km south (see Section 8.5).
Acid Sulfate Soils Risk map, Swan Coastal Plain	The Premises is mapped as 'moderate to low risk of ASS'.

8.5 Surface hydrology

The Premises is located about midway between the Gingin Brook and the Moore River. At a local scale, the Premises occurs on the Gingin Scarp between Red Gully Creek (to the north) and Boonanarring Creek (to the south). The combined catchment is referred to as the Beermullah Plain Watershed.

In the immediate vicinity of the Premises, the watershed is characterised by a number of small-scale ephemeral drainage lines originating from the western Dandaragan Plateau and upper slopes of the Gingin Scarp. The Bartlett's Well and Boonanarring Nature Reserves occur within this watershed. Elsewhere, the agricultural land uses reflect altered hydrology settings.

Typically, the drainage lines are dry, with stream flow limited to periods after heavy rainfall. They are also discrete and disconnected, shedding the local slopes of the escarpment before truncating in outwash settings at the escarpment toe. The underlying soil composition is largely colluvium and undifferentiated sand in the upper catchment, with the lower outwash integrated with Bassendean Sands. The majority of stream flow infiltrates and is not transmitted to the wetlands and lakes of the Beermullah Plain.

The distances to surface water and water sources are listed in Table 12.

Table 12: Surface water and water sources

Surface water and water sources	Distance from Premises	Description and environmental value
Red Gully Creek South	Approx. 2.3 km north-east	A seasonal tributary of Red Gully Creek
Boonanarring Brook	Approx. 4 km south	A seasonal brook originating in the Boonanarring Nature Reserve and terminating at the Beermullah Plain
Whitfield Brook	Approx. 4.5 km west	A seasonal brook on the Beermullah Plain
Red Gully Creek	Approx. 7.5 km north	A seasonal creek system originating on the Gingin Scarp and terminating at the Beermullah Plain
Wallering Brook	Approx. 8 km south	A seasonal tributary of the Gingin Brook. Approx. 40% is covered by nature reserve
Gingin Brook	Approx. 12 km south	A freshwater tributary of Moore River that flows year-round due to springs and groundwater seepage. Classified as 'conservation significant' under the Gingin Surface Water Allocation Plan
Moore River	Approx. 18.5 km north	A major, permanent watercourse that originates in Perenjori and flows through the Gingin Scarp before discharging into the Indian Ocean at Guilderton. Salinity levels vary from brackish to saline

8.6 Wetlands and Groundwater dependent vegetation

8.6.1 Wetlands

No geomorphic wetlands have been mapped within the Premises; however various wetlands in the form of ephemeral or permanent lakes or low-lying swamps are located west of the Brand Hwy, at the toe of the Gingin Scarp and in the depressions on the Beermullah Plain.

Approximately 2 – 3 km west of the Premises lies a chain of conservation category wetlands

comprising Beermullah Lake, White Lake, Little and Big Bootine Swamps, and several unnamed water bodies, which together are referred to as the Mindarra Northwest wetlands. Many of these lakes and water bodies are interconnected by seasonal damplands, small creeks and palusplains, and most draw water from both seasonal flow of drainage lines and groundwater expressed at the surface.

8.6.2 Groundwater dependent vegetation

The Applicant has mapped areas of potential groundwater dependent vegetation (GDV) in Bartlett's Well Nature Reserve and an area of Boonanarring Nature Reserve adjacent to the proposed mining area, and identified other areas within and outside of the Premises that may be sensitive to changes in groundwater quality and levels (360 Environmental, 2013).

Potential wetland GDV within Bartlett's Well Nature Reserve was mapped in the flow area at the base of the main valley in the reserve, in an area of seasonal groundwater overflow from the perched Mirrabooka Aquifer, and was considered by the Applicant to be independent of the Superficial and Leederville aquifers.

Potential terrestrial GDV in the form of *Banksia attenuate – Banksia menziesii* low woodlands occurs in large parts of Boonanarring Nature Reserve and Bartlett's Well Nature Reserve, in areas west of the perched western margin of the Mirrabooka Aquifer. The water table with the greatest elevation west of the Mirrabooka Aquifer is that associated with the Superficial Aquifer at approx. 50 mbgl, which is considered inaccessible to native vegetation. As such, these wetland vegetation units are not considered to be GDV.

8.7 Hydrogeology

The hydrogeology of the Premises is characterised by five major aquifer systems (Figure 5):

- **Surficial Aquifer** – surficial sediments of Neogene and Quaternary period within the Red Gully sub-area. This aquifer is patchy and discontinuously present east of the Brand Hwy;
- **Mirrabooka Aquifer** – surficial formations of the Red Gully sub-area, beneath the Dandaragan Plateau. The Mirrabooka Aquifer lies beneath the Surficial Aquifer and is located east of the Brand Hwy and of the proposed mining footprint;
- **Superficial Aquifer** – superficial formations of the Red Gully and Beermullah Plain sub-areas, thus beneath the Gingin Scarp and Beermullah Plain;
- **Leederville Aquifer** – beneath the surficial formations (Dandaragan Plateau) and superficial formations (Gingin Scarp and Beermullah Plain); and
- **Yarragadee Aquifer** – unconformably underlies the Leederville Aquifer in the area, and separated from the Leederville Aquifer by a clay layer

8.7.1 Surficial

This aquifer, separate to the deeper Mirrabooka Aquifer, has been identified as a perched aquifer within the Bartlett's Well Nature Reserve. The Surficial Aquifer generally has salinity less than 500 mg/L TDS and is known to support groundwater dependent ecosystems.

8.7.2 Mirrabooka

Beneath the Dandaragan Plateau the surficial Mirrabooka Member, Osborne Formation forms an unconfined aquifer (Mirrabooka Aquifer). This aquifer is not interpreted to underlie the proposed mine pits and therefore will not be intercepted by dewatering activities; however it underlies both the Boonanarring Nature Reserve and Bartlett's Well Nature Reserve.

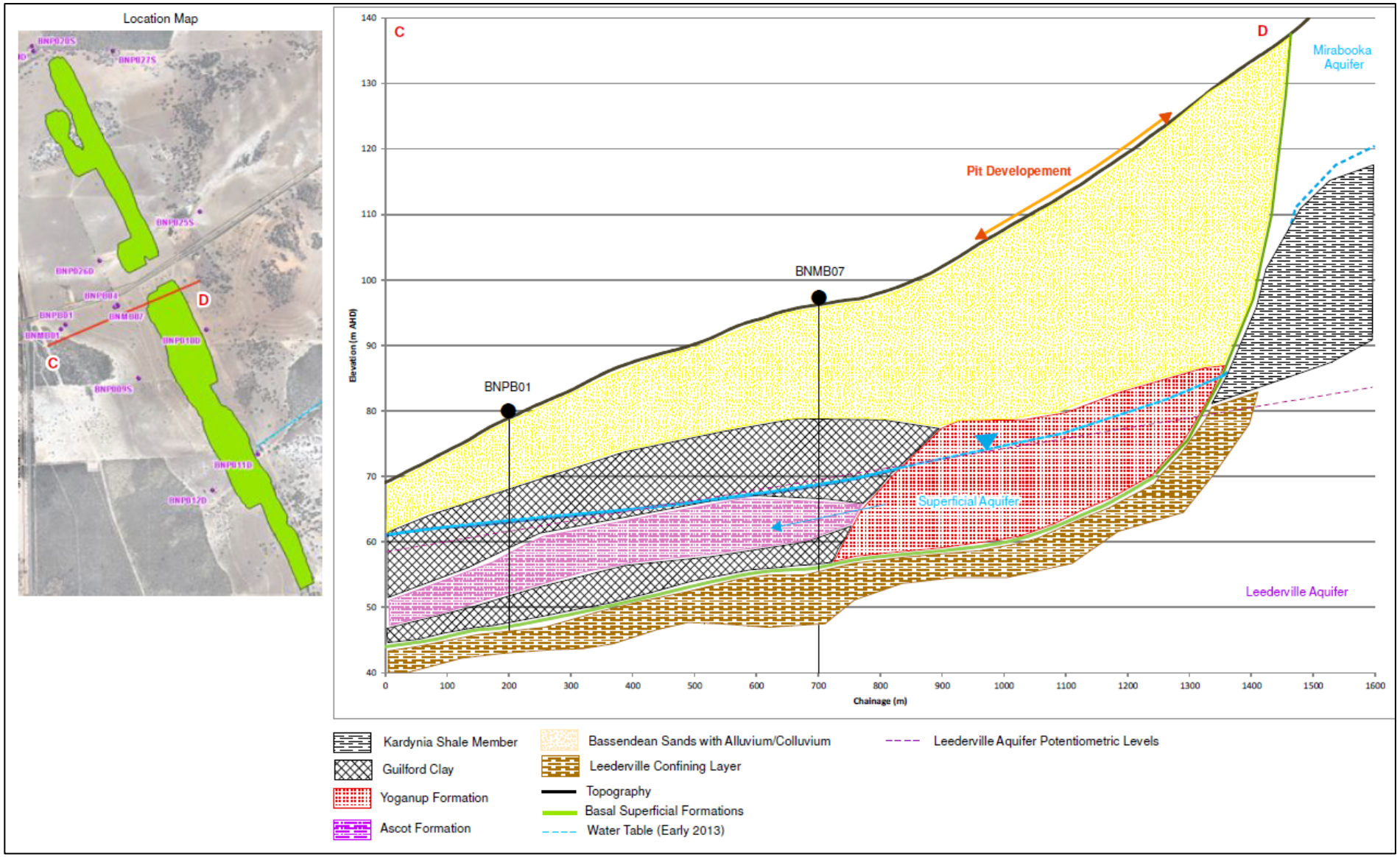


Figure 5: Conceptual local hydrogeology cross-section

8.7.3 Superficial

A water table aquifer system (Superficial Aquifer) occurs within the superficial formations beneath the Swan Coastal Plain. Locally, the aquifer system comprises Bassendean Sands, Guildford Clay and the Yoganup and Ascot Formations. The Bassendean Sands and Guildford Clay together with colluvial deposits are predominant beneath the Premises and adjacent settings of the Beermullah Plain. It is interpreted that the Collard's Wetland (west of the Brand Hwy) is supported by a perched aquifer within the Superficial formations and is associated with the Superficial Aquifer.

The proposed open pits of the Project will intersect the superficial formations. It is anticipated groundwater from the unconfined Superficial Aquifer will be abstracted temporarily via passive dewatering systems, such as V-drains and in-pit pumps, before the mine voids are backfilled. No water will be abstracted from the Superficial production bores for operational purposes.

8.7.4 Leederville

The Leederville Aquifer is a significant regional multi-layered groundwater flow system comprised of the Pinjar, Wanneroo and Mariginiup members of the Leederville Formation. The Leederville Aquifer is interpreted to be confined by the Kardinya Shale Member of the Osborne Formation beneath the Dandaragan Plateau; however beneath the Swan Coastal Plain, it become semi-confined, supporting the groundwater levels within the superficial formations with upward leakage

8.7.5 Yarragadee

The Yarragadee Aquifer is a regional confined multi-layered groundwater flow system aquifer formed by the Yarragadee Formation and Gage Formation. Locally, the Yarragadee Aquifer successions have a thickness greater than 2,800 m, comprised of interbedded sandstones, siltstones and shales. Within the Premises, the Yarragadee Aquifer is intersected by a production bore, with groundwater intended for use as site process water.

8.7.6 Groundwater occurrence and flow

Beneath the Dandaragan Plateau, a comparatively deep water table occurs associated with the Surficial Aquifer formed by the Mirrabooka Aquifer. Water table elevations range from about 75 to 130 mbgl.

Beneath the Gingin Scarp and Beermullah Plain, the water table is commonly hosted within the Bassendean Sands and Guildford Clay successions. Both the footslopes areas of the escarpment and the Beermullah Plain are characterised by shallow water table environments that support wetlands (including the perennial Beermullah Lake) and potential groundwater dependent ecosystems.

8.7.7 Groundwater quality

Beneath the Premises, groundwater in the Superficial Aquifer is predominantly fresh, though brackish at a local level, with Total Dissolved Solids (TDS) concentrations in the range 97 to 1560 mg/L. Regional data show wider salinity ranges 1,800 to 4,500 mg/L near to the Gingin Brook and Gingin mine project areas. Salinity appears to be influenced by recharge sources, stratigraphy and lithology, and depths to the water table.

Groundwater salinity in the Leederville and Yarragadee aquifers beneath the Premises indicates a sodium-chloride type groundwater, with TDS in the range 570 to 910 mg/L and 1,340 to 1470 mg/L, respectively.

8.8 Native vegetation

The local area falls within the Drummond Botanical Subdistrict of the Darling Botanical District of the South Western Botanical Province. Remnant vegetation of the Premises and surrounds is mainly mapped as comprising the Moondah Complex (low closed forest and low open forest), the Gingin Complex (open woodland) and the Reagan Complex (low open woodland to closed heath).

8.8.1 Flora and vegetation surveys

The disturbance footprint within the Premises has been extensively cleared for agriculture, with small areas of vegetation exhibiting low species richness and vegetation values (360 Environmental, 2013). There are pockets of relatively intact vegetation occurring along the road verges of Aurisch Road and Wannamal Road West and in the Bartlett's Well Nature Reserve access track corridor, and small remnants of scattered paddock trees. As such, flora and vegetation surveys conducted by the Applicant have targeted these areas, in addition to potential groundwater-dependent vegetation, particularly in the adjacent nature reserves, that could be indirectly impacted by the project.

Conservation areas

Previous surveys of the area have recorded a total of 222 taxa and a diverse range of vegetation types within Bartlett's Well Nature Reserve, including a small conservation category wetland. A DEC biological survey of Boonanarring Nature Reserve in 1996 recorded a total of 573 taxa and 10 vegetation associations, indicating the reserves have a very high conservation value.

8.9 Physical environment

8.9.1 Climate

Boonanarring is situated within a Mediterranean climate region that is characterised by warm to hot, dry summers and cool, wet winters.

Weather patterns are dominated by the regular passage of rain-bearing cold fronts from the Indian Ocean in winter, and dry easterly air flows from inland areas in summer. Rainfall progressively declines in northerly and easterly directions (i.e. as distance from the coast increases).

8.9.2 Wind direction and strength

The nearest Bureau of Meteorology (BoM) weather station is located at Gingin Aero (Site number 009178), approximately 25 km south of the Premises.

The average wind direction at 9 AM and 3 PM is presented in Figure 6. The following wind roses represent the various percentage of wind occurrences recorded during the period 1996 – 2010. The graphs illustrate predominantly moderate winds from the east in the mornings, shifting to moderate-to-strong afternoon west/south-westerly winds in the summer and winter months, respectively.

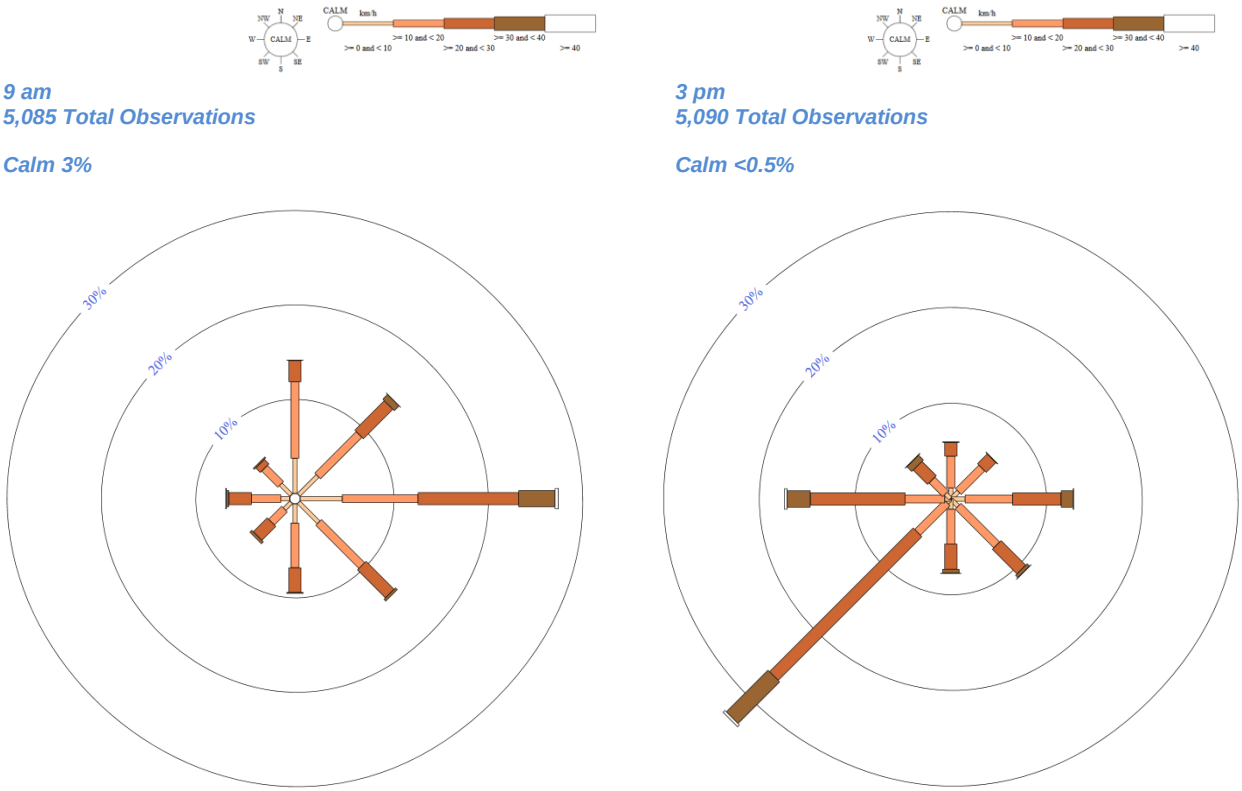


Figure 6: Wind roses, Gingin Aero 1996 – 2010 annual average at 09:00 am and 3:00 pm

8.9.3 Rainfall and temperature

According to the Köppen-Geiger climate classification system, Gingin is considered a hot-summer Mediterranean climate, where there is at least 3 times as much precipitation in the wettest month of winter as in the driest month in summer, and the driest month in summer receives less than 30 mm. The average temperature is 18.3 °C and annual average rainfall is 632 mm.

Rainfall is the lowest in December, with an average of 9.7 mm. Most of the precipitation falls in July, averaging 126 mm. January and February are the warmest months of the year, with an average of 33.2 °C. July is the coldest month, with temperatures averaging 6.2 °C (Figure 7).

There is a difference of 116 mm of precipitation between the driest and wettest months. Throughout the year, temperatures can vary by 27 °C.

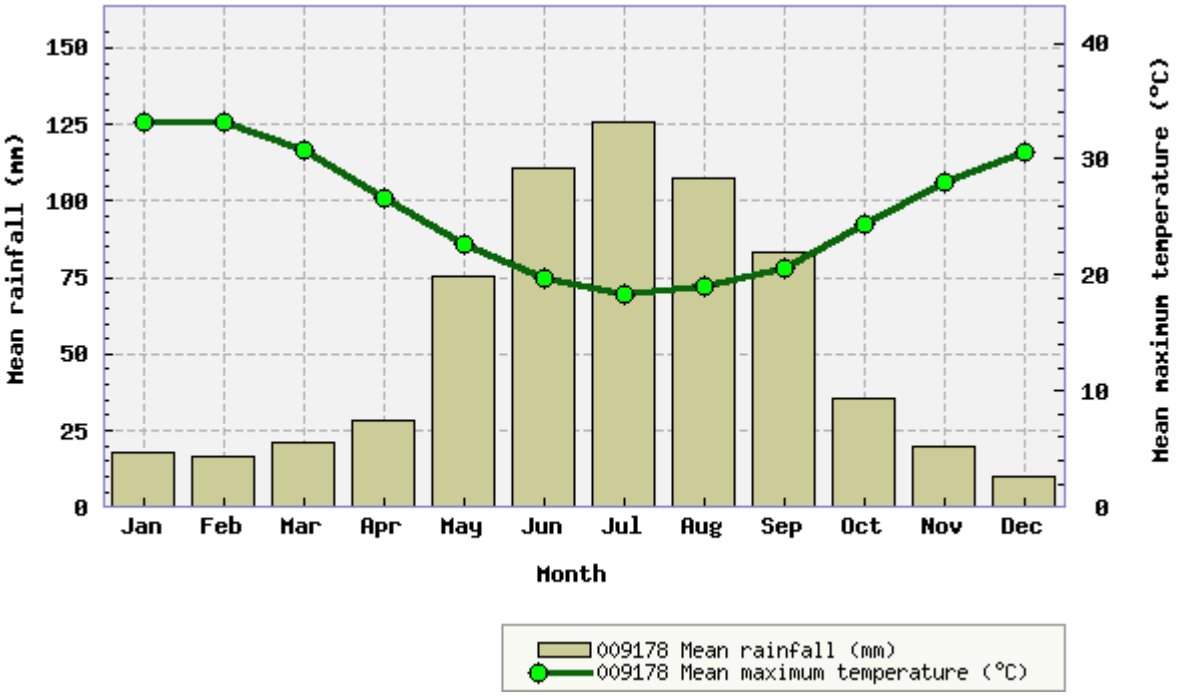


Figure 7: Average rainfall and maximum temperature for Gingin Aero 1996 – 2017

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 13.

The identification of the sources, pathways and receptors to determine Risk Events are set out in Table 13 and Table 14 below.

Table 13: Identification of emissions, pathway and receptors during mine construction works

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		**Potential emissions**	**Potential receptors**	**Potential pathway**	**Potential adverse impacts**		
Construction, mobilisation, positioning of infrastructure and other pre-production mining works	Civil excavation/ earthworks/ vehicle movements on unsealed roads	Noise	21 residences within 5 km radius, of which 10 are within 2 km (4 residences immediately adjacent to the Premises boundary, 2 of which are continuously occupied) Users of the Brand Hwy	Air / wind dispersion	Amenity and human health impacts	Yes – refer to section 9.4	Potential impacts on amenity to nearby receptors
		Fugitive emissions (dust)				Yes – refer to section 9.5	Potential impacts on amenity to nearby receptors
			Vegetation, including riparian vegetation adjacent to the starter pit		Soil contamination, suppression of photosynthetic and respiratory functions	No	Dust loading on vegetation from civil excavation/earthworks has not been further risk assessed due to the short duration of construction works (6 months). The Delegated Officer considers that any actual dust impacts can be regulated under the provisions of Section 49 of the EP Act.
		Oxidation of Acid Sulfate Soils from physical disturbance of ASS material	Groundwater, groundwater dependent vegetation	Leaching from in situ ASS material	Groundwater contamination (acidification)	No	The ASS investigation and site conceptual model indicates the risk of disturbing ASS from excavations above the base of the proposed mining pits to be low. Disturbance of ASS from civil excavation/earthworks has therefore not been further risk assessed as the depth will not extend below the water table.
	Clearing of native vegetation, topsoil stripping and O/B removal	Noise	21 residences, users of the Brand Hwy (see above)	Air / wind dispersion	Amenity and human health impacts	Yes – refer to section 9.4	Potential impacts on amenity to nearby receptors
		Fugitive emissions (dust)				Yes – refer to section 9.5	Potential impacts on amenity to nearby receptors
			Vegetation, including riparian vegetation adjacent to the starter pit		Soil contamination, etc. (see above)	No	Dust loading on vegetation during the construction phase has not been further risk assessed for the reasons stated above.
		Oxidation of ASS	Groundwater, groundwater dependent vegetation	Leaching from in situ ASS material	Groundwater contamination (acidification)	No	Disturbance of ASS material during topsoil stripping and O/B removal has not been further risk assessed for the reasons stated above.
	Pre-production mining and stockpiling	Noise	21 residences, users of the Brand Hwy (see above)	Air / wind dispersion	Amenity and human health impacts	Yes – refer to section 9.4	Potential impacts on amenity to nearby receptors
		Fugitive emissions (dust)				Yes – refer to section 9.5	Potential impacts on amenity to nearby receptors
			Vegetation, including riparian vegetation adjacent to the starter pit		Soil contamination, etc. (see above)	No	Dust loading on vegetation during the construction phase has not been further risk assessed for the reasons stated above.
		Oxidation of ASS	Groundwater, groundwater dependent vegetation	Leaching from in situ ASS material	Groundwater contamination (acidification)	No	The risk of disturbing ASS during shallow excavations has not been further assessed for the reasons stated above.
Commissioning works	HMC stockpile	Seepage of water entrained in the HMC to groundwater	Groundwater, groundwater dependent vegetation	Through base of HMC pad	Groundwater contamination	No	Seepage to groundwater from the HMC stockpile during commissioning works has not been further risk assessed due to the low water content of the HMC and low volumes of seepage expected.
					Groundwater mounding	No	
		Contaminated stormwater	Surface waters, wetlands, ecosystems adjacent to stockpiles	Direct discharge	Contamination of surface waters, wetlands, soil, inhibiting vegetation growth and survival and health impacts to fauna	No	Contaminated stormwater runoff from the HMC stockpile during commissioning works has not been further risk assessment due to the low water content of the HMC and low tonnage of HMC to be produced during commissioning.
		Dust lift-off	21 residences, users of the Brand Hwy (see above)	Air / wind dispersion	Amenity and human health impacts	No	Fugitive dust from the HMC stockpile causing off-site impacts during commissioning works has not been further risk assessed due to the short duration of commissioning (3 months) and the low volume of HMC to be produced (100,000 tonnes).
			Vegetation, including riparian vegetation adjacent to the stockpile		Soil contamination, etc. (see above)	No	Dust loading on vegetation during the construction phase has not been further risk assessed for the reasons stated above.
	Drying of clay slimes	Seepage of water entrained in the clay slimes to groundwater	Groundwater, groundwater dependent vegetation	Through base of the solar drying pond	Groundwater contamination	No	The Delegated Officer considers the volume of seepage from clay slimes disposed to the initial solar drying pond during commissioning works to be low and does not require further risk assessment.
					Groundwater mounding	No	

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		
		Breach of containment causing slimes discharge to land or waters	Surface waters, wetlands, ecosystems adjacent to the solar drying dams	Direct discharge	Contamination of surface waters, etc. (see above)	Yes – refer to section 9.8	Potential impacts to off-site environmental values; erosion and sedimentation.
		Rupture of pipeline causing slimes discharge to land or waters	Surface waters, wetlands, ecosystems adjacent to pipeline alignment		Soil and surface water contamination, inhibiting vegetation growth and survival	Yes – refer to section 9.6	Potential impacts to surface waters, wetland, ecosystems adjacent to the pipeline alignment.
	Disposal of sand tailings (mine void)	Seepage of water entrained in the sand tailings to groundwater	Groundwater, groundwater dependent vegetation	Trough base of stockpile/mine void	Groundwater contamination	No	The Delegated Officer considers the volume of seepage from the stockpiling of sand tailings during commissioning works to be low and does not require further risk assessment.
					Groundwater mounding	No	
		Breach of containment causing tailings discharge to land or waters	Surface waters, wetlands, ecosystems adjacent to the mine voids	Direct discharge	Soil and surface water contamination, etc. (see above)	Yes – refer to section 9.8	Potential impacts to off-site environmental values; erosion and sedimentation.

Table 14: Identification of emissions, pathway and receptors during mining operations

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		Potential emissions	Potential receptors	Potential pathway	Potential adverse impacts		
Pre-mining works	Clearing of native vegetation, topsoil stripping and O/B removal	Oxidation of ASS	Groundwater, groundwater dependent vegetation	Leaching from in situ material	Groundwater contamination (acidification)	No	Disturbance of ASS material during topsoil stripping and O/B removal has not been further risk assessed for the reasons stated above.
		Noise	21 residences, users of the Brand Hwy (see above)	Air / wind dispersion	Amenity impacts	Yes – refer to section 9.4	Potential impacts on amenity to nearby receptors.
		Fugitive emissions (dust)			Amenity and human health impacts	Yes – refer to section 9.5	Potential impacts on amenity to nearby receptors.
Category 8: Mineral sands mining or processing: premises on which mineral sands ore is mined, screened, separated or otherwise processed	Mining and processing of ore	Oxidation of ASS	Groundwater, groundwater dependent vegetation	Leaching from in situ material	Groundwater contamination (acidification)	Yes – refer to section 9.7	Potential impacts on groundwater quality, beneficial users and environmental values.
		Noise	21 residences, users of the Brand Hwy (see above)	Air / wind dispersion	Amenity impacts	Yes – refer to section 9.4	Potential impacts on amenity to nearby receptors.
		Fugitive emissions (dust)			Amenity and human health impacts	Yes – refer to section 9.5	Potential impacts on amenity to nearby receptors.
			Vegetation, including riparian vegetation adjacent to mine voids		Soil contamination, etc. (see above)	No	Dust loading on vegetation from mining and processing of ore has not been further risk assessed due to the temporary nature of the mining operation (5 – 6 years). The Delegated Officer considers that any actual dust impacts can be regulated under the provisions of Section 49 of the EP Act.
		Contaminated stormwater	Surface waters, wetlands, ecosystems adjacent to stockpiles	Direct discharge	Contamination of surface waters, etc. (see above)	Yes – refer to section 9.8	Potential impacts to off-site environmental values; erosion and sedimentation.
	Return water pipelines	Rupture of pipeline causing return water discharge to land or waters	Vegetation, including riparian vegetation adjacent to pipeline alignment	Direct discharge	Soil and surface water contamination, etc. (see above)	Yes – refer to section 9.6	Potential impacts to surface waters, wetland, ecosystems adjacent to the pipeline alignment.
	HMC stockpile	Seepage of water entrained within the HMC to groundwater	Groundwater, groundwater dependent vegetation	Through base of HMC pad	Groundwater contamination	No	Seepage to groundwater from the HMC stockpile has not been further risk assessed due to the low water content of the HMC and low volumes of seepage expected.
					Groundwater mounding	No	
		Contaminated stormwater	Surface waters, wetlands, ecosystems adjacent to stockpiles	Direct discharge	Contamination of surface waters, etc. (see above)	Yes – refer to section 9.8	Potential impacts to off-site environmental values; erosion and sedimentation.
		Dust lift-off	21 residences, users of the Brand Hwy (see above)	Air / wind dispersion	Amenity and human health impacts	Yes – refer to section 9.5	Potential impacts on amenity to nearby receptors.
			Vegetation, including riparian vegetation adjacent to stockpile		Soil contamination, etc. (see above)	No	Dust loading on vegetation from mining and processing of ore has not been further risk assessed for the reasons stated above.

Risk Events						Continue to detailed risk assessment	Reasoning
Sources/Activities		**Potential emissions**	**Potential receptors**	**Potential pathway**	**Potential adverse impacts**		
	Disposal of sand tailings (mine void)	Seepage of water entrained within the sand tailings to groundwater	Groundwater, groundwater dependent vegetation	Through base of mine void	Groundwater contamination	No	Sand tailings (consisting principally of silica sand) to be returned to the mine void will have undergone wet separation only and are unlikely to contain contaminants that might otherwise be present in sand tailings that have undergone secondary processing (i.e. mostly clean sand). As the HMC will be shipped overseas (China) for secondary processing, no tailings will be returned for disposal. The Delegated Officer therefore considers the material risk of groundwater contamination from sand tailings to be Low and does not require further risk assessment.
					Groundwater mounding	No	The Delegated Officer notes there has been a significant emphasis on potential impacts from dewatering drawdown on the shallow groundwater resource, other groundwater users and nearby environmental values, and that this aspect been subject to rigorous assessment under Part IV and the RIWI Act. In order to offset drawdown impacts, re-infiltration of tailings water (in addition to aquifer reinjection of dewatering water) has been authorised as a key mitigation strategy - mine voids will therefore be operated to promote infiltration/seepage. The Delegated Officer therefore considers the material risk of groundwater mounding to be Low and does not require further risk assessment.
		Rupture of pipeline causing mine tailings discharge to land or waters	Vegetation, including riparian vegetation adjacent to pipeline alignment	Direct discharge	Soil and surface water contamination, etc. (see above)	Yes – refer to section 9.6	Potential impacts to surface waters, wetland, ecosystems adjacent to the pipeline alignment.
	Drying of clay slimes (solar drying ponds)	Seepage of water entrained within the clay slimes to groundwater	Groundwater, groundwater dependent vegetation	Through base of pond	Groundwater contamination	No	The Delegated Officer considers the volume of seepage from clay slimes in the solar drying ponds to be low and does not require further risk assessment.
					Groundwater mounding	No	Groundwater mounding caused by seepage from clay slimes has not been further risk assessed for the reasons stated above.
		Rupture of pipeline causing slimes discharge to land or waters	Vegetation, including riparian vegetation adjacent to pipeline alignment	Direct discharge	Soil and surface water contamination, etc. (see above)	Yes – refer to section 9.6	Potential impacts to surface waters, wetland, ecosystems adjacent to the pipeline alignment.
		Dust lift-off	21 residences, users of the Brand Hwy (see above)	Air / wind dispersion	Amenity and human health impacts	No	Fugitive dust from the solar drying ponds causing off-site impacts has not been further risk assessed due to the location of the ponds on the Premises and the distance to sensitive receptors. The Delegated Officer considers that any actual dust impacts can be regulated under the provisions of Section 49 of the EP Act.
			Vegetation, including riparian vegetation adjacent to stockpile		Soil contamination, etc. (see above)	No	Dust loading on vegetation from mining and tailing operations has not been further risk assessed for the reasons stated above.
		Overtopping/breach of containment causing discharge to land or waters	Vegetation, including riparian vegetation adjacent to pond	Direct discharge	Soil and surface water contamination, etc. (see above)	No	Solar drying ponds are to be constructed on-path (within the mine void). Any breaches of pond walls will be contained within the mine void.
	Naturally Occurring Radioactive Materials (NORM)	Seepage to groundwater	Groundwater, groundwater dependent vegetation	Lateral or vertical seepage through base of mine void	Groundwater contamination	No	Radiation management is regulated by DMIRS.
Other	Dewatering	Excess mine water	Groundwater	Direct discharge (aquifer reinjection)	Groundwater mounding	No	Groundwater mounding caused by aquifer re-injection has not been further risk assessed for the reasons stated above.
					Groundwater drawdown	No	Managed under Part IV.
					Groundwater contamination	No	

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 14 below.

Table 15: 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 15 below.

Table 16: 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 16 below:

Table 17: 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 – Impact to off-site receptors from noise emissions

9.4.1 Description of risk event

Construction and Operation

Noise from operating heavy earthmoving equipment and fixed plant, causing adverse impacts to amenity at nearby residences.

9.4.2 Identification and general characterisation of emission

During mine construction works, noise generating activities will include the construction of mine infrastructure and bulk earthworks using typical heavy earthmoving equipment (e.g. scrapers, dozers, trucks, excavators, front-end loaders, etc.). Once commissioning is complete, the mine will transition from a 12 hours per day, six days per week construction site to a continuous (24 hours per day, seven days per week) operating mine.

Once operational, noise will be generated from the operation of mobile earthmoving equipment and fixed plant for mining and processing activities. Mining, screening and processing of ore will occur continuously (24 hours per day), while all other activities will occur during normal day time working hours (7 am – 7 pm, Monday to Saturday).

A Noise Impact Assessment carried out by Lloyd George Acoustics (LGA, 2017a) indicated that night time mining would be unacceptable at the four closest receptors, based on predicted noise levels during specific mining scenarios and proximity to those receptors. It was identified that extensive noise controls would be required to enable compliance with the Noise Regulations (refer to Section 6.2).

9.4.3 Description of potential adverse impact from the emission

Noise can cause nuisance and a reduced quality of life and health for human populations, particularly when the source is located near sensitive receptors. Noise can affect the psychological status of human populations nearby in terms of emotional stress, anger and physical symptoms. Frequency, intensity, duration, meteorological conditions and distance to receptor are all factors which may affect the impact of noise emissions on sensitive receptors.

9.4.4 Criteria for assessment

Noise Regulations

The *Environmental Protection (Noise) Regulations 1997* (Noise Regulations) operate as a prescribed standard under the EP Act.

Assigned levels

The Noise Regulations deal with noise passing from one premise to another, and prescribes assigned levels (the highest levels that can be received) at different types of receivers. A summary of the assigned levels applicable to the Application is set out in Table 18.

Table 18: Assigned noise levels applicable to the Application

Type of premises receiving noise	Time of day	Assigned level		
		$L_{A\ 10}$	$L_{A\ 1}$	$L_{A\ max}$
Noise sensitive premises: highly sensitive area	0700 to 1900 hours Monday to Saturday	45 + influencing factor	55 + influencing factor	65 + influencing factor
	0900 to 1900 hours Sunday and public holidays	40 + influencing factor	50 + influencing factor	65 + influencing factor
	1900 to 2200 hours all days	40 + influencing factor	50 + influencing factor	55 + influencing factor
	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays	35 + influencing factor	45 + influencing factor	55 + influencing factor
Noise sensitive premises: any area other than highly sensitive area	All hours	60	75	80

The $L_{A\ 10}$ noise level is the most significant for the Premises, as this is representative of the continuous noise emissions expected during mining operations, and is the level which is not to be exceeded for more than 10% of the Representative Assessment Period.

Penalties

In addition to noise levels, penalties may also apply if noise is emitted with annoying characteristics, i.e. noise that is tonal (contains a definite note or pitch, e.g. whining, droning), impulsive (is brief and abrupt, e.g. banging, thumping) or modulated (has a repeated cyclic pattern, e.g. like a siren).

Construction sites

Under Regulation 13, noise from construction work on construction sites need not comply with the assigned noise levels when the work is carried out between 0700 and 1900 hours (excluding Sundays and public holidays), is conducted in accordance with AS 2436, and the equipment used is the quietest reasonably available.

For noise to be exempted under Regulation 13 the site must meet the definition of a *construction site* and the work must meet the definition of *construction work*. DWER considers

that some activities during the development of a mineral sands mine do not meet the definition of construction work under Regulation 13, as they are considered to be part of the actual mining activity, i.e. overburden removal and stockpiling of ore for commissioning.

Key finding:

The Delegated Officer notes the Applicant has agreed the overburden removal operation during the mine establishment phase is not 'construction work' under Regulation 13, and that compliance with the assigned noise levels is required.

Must take reasonable measures

Section 51(b) of the EP Act requires occupiers of premises to take all reasonable and practicable measures to prevent or control emissions. The onus is therefore on the mine operator to ensure that impacts to amenity are as low as reasonably practicable, even if noise levels comply with the Noise Regulations.

9.4.5 Applicant controls

The Applicant has prepared a noise management plan to outline its approach to managing noise emissions arising during mine construction works and subsequent operations. A summary of the proposed controls are set out in Table 19 below.

Table 19: Applicant's proposed controls for noise emissions

Project area	Mitigation/management action
All areas	Comply with the requirements of AS 2436 during construction works
	Surrounding residents to be notified about construction dates and operational activities
	Construction activities limited to 7 am – 7 pm, Monday to Saturday during construction works
	The quietest reasonably available equipment, machines and vehicles to be used on site, will be routinely maintained
	Earthmoving equipment to be fitted with muffling exhausts and exhausts redirected
	Broadband reversing beepers to be used on mobile equipment
	Construction of noise bunds ranging in height from 5 – 19 m during specific operational scenarios
	'Hushpaks' to be retro-fitted to all haul trucks and excavators
WCP	WCP pad to be built as low as possible into the side of the hill
	WCP to be fitted with cladding
	Pumps to be enclosed
SMU	SMU to be installed within the mine pit (noise bunds to be constructed if installed at near surface)
Mine pits	Conduct noise monitoring to validate the LGA (2017) noise model
	Conduct quarterly attended noise monitoring at 3 locations during Phases 1 – 3 (Receptors D, E and F), and at 2 different locations during Phases 4 5 (Receptors E and J)

Limits and targets

In addition, the Applicant has set internal trigger levels that will trigger noise investigations and additional mitigation. Trigger levels have been set at 85% of the assigned noise levels at receiver monitoring locations, and the assigned levels for 'any other area other than highly sensitive area' will be used as a target at the Premises boundary (Table 20).

Table 20: Applicant's proposed trigger levels for noise emissions

Type of premises receiving noise	Time of day	Assigned level		
		$L_{A\ 10}$	$L_{A\ 1}$	$L_{A\ max}$
Receiver	0700 to 1900 hours Monday to Saturday	38	47	55
	0900 to 1900 hours Sunday and public holidays	34	42	55
	1900 to 2200 hours all days	34	42	47
	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays	30	38	47
Premises boundary	All hours	60	75	80

Contingency actions

In the event a noise-related complaint is received by the Applicant or DWER, or quarterly noise monitoring indicates that a trigger level has been exceeded, the Applicant will implement the following actions:

- Conduct targeted attended monitoring to verify the complaint;
- If the trigger level has been exceeded, then an investigation will be conducted to verify if the exceedance is attributed to the mine;
- If it is determined the mine is attributing to the exceedance, the remedial action(s) will be taken (see below); and
- Targeted noise monitoring will be conducted to verify if the remedial action(s) have been successful.

Remedial actions

The Applicant has proposed a number of remedial actions, in addition to the management actions listed in Table 19. A number of the actions listed may have been implemented prior to each phase. The remedial actions are listed below in Table 21.

Table 21: Applicant's proposed remedial actions

Activity	Remedial action(s)
Loading trucks with excavator	Build noise bund around work area
	Relocate excavator to a bench lower in the pit
	Reduce excavator fleet to one operator (night mining)
	Cease operating excavator in adverse wind conditions
Trucking of overburden to temporary stockpile	Build noise bund on western side of haul road
	Redirect trucks to haul material to direct return on surface, or in-pit only
	Cease operating haul trucks in adverse wind conditions
Bulldozer at overburden stockpile	Move dump tip head to a lower bench in the pit
	Re-route trucking so tip head is in-pit

Activity	Remedial action(s)
	Trucks can paddock dump so no dozer is needed for a shift
	Cease operating dozer in adverse wind conditions
Hauling of ore to ROM	Build noise bund along western side of haul road
	Reduce fleet of scrapers hauling ore
	Haul ore on day shift only
Loader/excavator at the ROM	Build noise bund around the ROM and SMU
	If excavator is sitting high to feed the SMU reduce the height of the pad
	Slow feed rate
	Stop feeding
Hauling of product	Build noise bund on western side of main access road
	Reduce fleet hauling HMC
	Haul ore on day shift only
Wet Concentrator Plant	Retrofit cladding onto the WCP
	Build noise bund around the WCP
Mine pit – overburden removal (pre-strip)	Conduct overburden removal works for each phase start-up only between 7 am – 7 pm, Monday to Saturday
	Do not commence overburden removal of Phases 1, 2 or 3 South unless noise monitoring and/or modelling demonstrates compliance with noise limits and targets (Table 20) and/or a private agreement/relocation has been negotiated with Receptor E
	Do not commence overburden removal of Phase 5 unless one of the following actions are implemented: • A private agreement is in place with Receptor J; • Receptor J has been relocated during this period; • A 10 m high bund has been built around the north-east corner of the mine pit. Only use one excavator working from behind the bund. The extent of the bund will be adjusted as the overburden removal progresses south to ensure the excavator always works from behind the bund
Mine pit – overburden removal (pre-strip)	Do not commence pit development of Phases 1, 2 or 3 South unless noise monitoring and/or modelling demonstrates compliance with noise limits and targets (Table 20) and/or a private agreement/relocation has been negotiated with Receptor E
	Do not commence pit development of Phase 5 unless one of the following actions are implemented: • An alternative excavator is used, with a sound power level > 110 dB(A) and/or positioning of excavator below surface to comply with noise limits and targets (Table 20); • A private agreement is in place with Receptor J; • Receptor J has been relocated during this period; • A 10 m high bund has been built around the north-east corner of the mine pit. Only use one excavator working from behind the bund. The extent of the bund will be adjusted as the overburden removal progresses south to ensure the excavator always works from behind the bund
Full production – Phase 1	Do not commence full production of Phase 1 unless noise monitoring and/or modelling demonstrates compliance with noise limits and targets (Table 20) and/or a private agreement/relocation has been negotiated with Receptor E

Activity	Remedial action(s)
	Only use one excavator between 7 pm – 7 am unless works are conducted below a pit depth of 20 m
Full production – Phases 2 & 3	Implement one or a combination of the following actions: • Only one excavator will be used at night time and the bund on the west side of the access road north will be extended to Wannamal Rd West; • Only one excavator will be used at night time and finished product will be hauled only during day time operations; • A private agreement is in place with Receptor E, or receptor is relocated during these phases
Full production – Phase 4	Implement one or a combination of the following actions: • A maximum of one excavator and two haul trucks will be used at night time and the excavator will work behind a pit face at all time to provide barrier effects to the receptor • A private agreement is in place with Receptor J, or receptor is relocated during this phase
Full production – Phase 5	Implement one or a combination of the following actions: • Only one excavator will be used at night time and the bund on the west side of the access road north will be extended to Wannamal Rd West; • Only one excavator will be used at night time and finished product will be hauled only during day time operations; • A private agreement is in place with Receptor E, or receptor is relocated during these phases

9.4.6 Key findings

The Delegated Officer has reviewed the information regarding the risk of mine noise impacting on sensitive receptors and has found:

1. Compliance with the Noise Regulations is heavily reliant on the implementation of extensive noise controls during specific mining scenarios. These include:
   - Retro-fitting of 'hushpaks' to all 9 haul trucks;
   - Constructing sizeable noise bunds during specific mining phases;
   - Utilising only one excavator during night-time operations, and working behind the bunds;
   - Continuous, real-time monitoring of noise emissions.
2. The controls proposed by the Applicant require expanding to mitigate the risk of noise non-compliance, including continuous, real-time noise monitoring.
3. The local area is a quiet, rural area – therefore any increase in noise levels may be considered significant to nearby receptors. In addition to the management strategies proposed by the Applicant, some of the remedial actions proposed in the Noise Management Plan are required to be implemented at the start of the Project, in order to ensure impacts to amenity are as low as reasonably practicable.
4. The Applicant has agreed the overburden removal operation during the mine establishment phase is not 'construction work' under Regulation 13, and that compliance with the assigned noise levels is required.

9.4.7 Consequence

The Noise Regulations prescribe the allowable levels of noise that can be received at a receptor. Noise received above the allowable levels is considered unacceptable; however noise may also be considered unacceptable if emitted in a manner that is not as low as

reasonable practicable, even if the received levels are below the allowable level.

The consequence of noise emissions exceeding the allowable levels at nearby receptors, or emitted in a manner that is not as low as reasonable practicable, may result in impacts to amenity, causing concern and complaints – particularly if it disturbs sleep at night. The level of impact to amenity can be influenced by many factors, including the amplitude of the exceedance (e.g. 1 dB is barely noticeable, compared to 10 dB which is usually twice as loud), the length of the exceedance, the time of day of the exceedance (night vs. day), or if it contains annoying characteristics (i.e. tonality, impulsiveness or modulation).

The Delegated Officer therefore considers the consequence of noise emissions from mine construction works and subsequent mining operations causing impacts to the amenity of nearby receptors to be **Major**.

9.4.8 Likelihood of Risk Event

The Delegated Officer notes that mineral sands mines are complex sites involving many different activities that produce different types of noise, that vary depending on the time of day and type and location of the mining activities. In addition the mining of mineral sands, in general, is a progressive process whereby new pits are opened and as the mine progresses old pits are backfilled. Given the temporary nature of the mining process, the impact of noise on any one particular receptor is unlikely to be constant and/or consistent throughout the life of mine, as the mine path progresses.

In DWER's experience of previous and existing mineral sands mines, noise emissions can become a significant issue for sensitive receptors in close proximity to mines that have continuous (24 hours per day) operations. This is particularly common for mines located in quiet, rural areas where background noise levels are very low, i.e. < 20 dB(A), and therefore any increase in noise levels is likely to be considered significant to nearby receptors.

In considering the noise modelling for the Project, the Delegated Officer considers it **Possible** that noise emissions from mine construction works and subsequent mining operations will cause impacts to the amenity of nearby receptors (at one point in time or another, most likely under worst case operating conditions during specific mining scenarios).

9.4.9 Overall rating of noise emissions

The Delegated Officer has compared the consequence and likelihood ratings described above with the risk rating matrix (Table 15) and determined that the overall rating for the risk of noise emissions causing impacts to the amenity of nearby receptors is **High**.

9.5 Risk Assessment – Impact to off-site receptors from fugitive emissions (dust)

9.5.1 Description of dust emissions

Construction and Operation

Dust generated from mine construction works and subsequent mining operations, causing adverse impacts on the health and/or amenity of local receptors and users of the Brand Hwy.

9.5.2 Identification and general characterisation of emission

Dust, or total suspended particulate matter (TSP), is comprised of coarse particulate matter (CPM), which is generally comprised of particles greater than 10 micron (µm) in diameter, and the respirable fraction comprised of particles less than 10 µm in diameter (PM_{10}). The majority of dust generated during the operation of a mineral sands mine is CPM, being comprised of unprocessed mineral oxide particles.

Mine construction works are likely to generate dust in excess of natural background levels, during clearing of native vegetation, removal, handling and stockpiling of topsoil, installation of the SMU and creation of the off-path solar drying pond and tailings cell, machinery movements and lift-off from exposed surfaces.

During mining operations, sources of dust may include fugitive dust from exposed mining areas, open areas or rehabilitated surfaces, overburden/ topsoil/ product/ waste stockpiles, movement of vehicles along haul roads and access tracks, and the mining, screening, processing and transporting of ore.

9.5.3 Description of potential adverse impact from the emission

Dust emissions can be harmful to human health and the environment. Human health effects of dust tend to be associated with PM_{10} and $PM_{2.5}$, which tend to remain suspended in the air for longer periods and can penetrate into the lungs. Elevated TSP levels may cause nuisance impacts, however the finer particle fraction (< PM_{10}) may pose a health risk as indicated above.

The Mid west region experiences a mild Mediterranean climate with hot/dry summers and mild/wet winters. The climate is strongly influenced by seasonal wind patterns, with the local area known for its strong off and on-shore winds (summer sea breezes frequently reach 46 km/hr or more).

DWER has identified 24 farm houses within a 5 km radius of the Premises boundary, with the majority located west of the mine and downgradient from the steep Dandaragan Plateau. In addition the Brand Hwy, being a primary road and major transport route, runs immediately adjacent to the western boundary of the Premises (the Brand Hwy is considered to be a sensitive land use). DWER has identified the closest 6 farm houses as being at risk of being impacted from nuisance dust during strong prevailing easterly winds, and 3 farm houses at risk when the winds are from the south/south-west.

In DWER's experience of previous and existing mineral sands mines, fugitive dust during adverse weather conditions can cause concern or complaints from residents within proximity to the mine, particularly those who suffer from asthma or hayfever. Other common complaints include impacts on amenity (hanging out washing, entertaining outdoors, etc.), and the response time of the mine to resolve excessive dust when the receptor is being/has already been impacted.

9.5.4 Criteria for assessment

<u>Separation distance</u>

DWER considers a minimum separation distance of 1,000 – 2,000 m is required between

mineral sands mining operations and sensitive land uses, to minimise the risk of impacts from light overspill, dust and noise.

Air quality standards

There are no directly applicable ambient air quality standards for the Premises.

The Ambient Air Quality NEPM provides a benchmark against which the risk of adverse health effects arising from exposure to PM_{10} (from any source) can be assessed (but is not considered a regulatory standard), and is shown in Table 22.

Table 22: Ambient Air Quality NEPM – Standards for pollutants

Pollutant	Averaging period	Maximum concentration standard	Maximum allowable exceedances
Particulates as PM_{10}	24 hours	50 µg/m^3	None
	Annual	25 µg/m^3	

The Kwinana EPP also provides an equivalent ambient air quality standard and limit with respect to TSP emissions from industry. Given the siting context and distances to residential and sensitive receptors, the standard and limit set for Policy Area C (rural and residential land, i.e. non-industrial) is considered to be the most relevant and is shown in Table 23.

Table 23: Kwinana EPP ambient air quality standards and limits for TSP

Policy Area	Averaging period	TSP standard	TSP limit
Area C	24 hours	90 µg/m^3	150 µg/m^3

9.5.5 Applicant controls

The Applicant has prepared an Air Quality Management Plan to outline its approach to managing fugitive dust emissions arising during mine construction works and subsequent operations. A summary of the proposed controls are set out in Table 24 below.

Table 24: Applicant's proposed controls for dust emissions

Activity	Mitigation/management action
Management	Overburden and waste material will be returned directly to the mine void, to minimise double-handling and excessive stockpiling
	Water sprays will be applied to any material that poses a dust risk
	Implementation of vehicle speed limits
	Unsealed roads will be sprayed with water on a regular basis using a dedicated water truck
	Dust emissions from stockpiles will be minimised by using water cannons from mobile water trucks when required
	Areas will not be disturbed unless required
	Temporary crops may be grown to bind soil
	Dust suppression sprinklers at the processing plant will focus on transfer points
	Biodegradable stabilising agents may be used
	Progressive rehabilitation will occur straight after mining has been completed in an area

	Continuous TSP and PM_{10} monitoring equipment will be fitted with trigger alarms to notify mine management when the NEPM standard levels have been exceeded for over 10 minutes
Monitoring	A TSP, PM_{10} and dust settlement monitoring program will be implemented, consisting of continuous monitoring at the four closest receptors
	Opportunistic inspections of dust levels will be undertaken during construction and operation
	If visible dust emissions are noted then an assessment of the source will be made and additional water will be applied to key source areas, or alternative treatments applied
	The potential for windy conditions will be monitored and extra water applied in preparation

9.5.6 Key findings

The Delegated Officer has reviewed the information regarding the risk of fugitive dust impacting on sensitive receptors and has found:

1. The local area is strongly influenced by seasonal wind patterns, and is known for strong off- and on-shore winds.
2. There are a number of sensitive receptors within proximity to the Premises, located to the west and down gradient of the Dandaragan Plateau, that are considered at risk of being impacted by fugitive dust.
3. Dust controls proposed by the Applicant lack specific detail and are inadequate/ incommensurate with the risk.
4. A high level of regulatory control is required through the Works Approval and Licence to ensure fugitive dust does not impact on off-site receptors.

9.5.7 Consequence

The consequence of TSP impacting on sensitive receptors located off-site or on the Brand Hwy is likely to be of nuisance value, causing amenity impacts by settling on surfaces and causing soiling and/or discolouration (**Minor**).

The consequence of PM_{10} impacting on sensitive receptors is likely to constitute exposure to a hazard with short-term adverse health effects (requiring treatment) and impact to amenity for short periods (**Moderate**).

9.5.8 Likelihood of Risk Event

Given the proximity of sensitive receptors and their location in the landscape, in addition to the prevailing local weather conditions during the summer months, and the inadequate level of dust controls proposed by the Applicant, the Delegated Officer considers it **Possible** that TSP and PM_{10} generated from the Premises will impact on sensitive receptors (at one point in time or another, most likely under worst case operating conditions during specific mining scenarios).

9.5.9 Overall rating of fugitive emissions (dust)

The Delegated Officer has compared the consequence and likelihood ratings described above with the risk rating matrix (Table 15) and determined that the overall risk rating for fugitive emissions (dust) causing impacts to the health and/or amenity of nearby receptors is **Moderate**.

9.6 Risk Assessment – Slurry pipeline failure

9.6.1 Description of risk event

Construction and Operation

Failure of slurry pipelines, releasing HMC and/or mine tailings (sand tailings, silts and clay slimes,) into the environment and causing adverse impacts on surface waters, wetlands, native vegetation or soil over a localised area.

9.6.2 Identification and general characterisation of emission

Sand tailings, silts and clay slimes comprise the coarse-grained (typically quartz sand) and fine-grained (typically silt sized clay material) solid material remaining after the heavy mineral concentrate has been separated from the mined ore, and are slurried with process water to facilitate transfer.

The clay slimes material is characterised as having very high clay content (approx. 77%) with no coarse fraction and a very high modulus of rupture, indicating a very high potential to hardset. The slimes are classed as having neutral pH (pH 6.9 $CaCl_2$) and being 'very saline' (EC 1.19 dS/m) (Outback Ecology, 2013). Clay minerals have a great affinity for water, with the ability to soak up ions from a solution and release them when conditions change, which can result in the transportation/dispersion of contaminants from one area to another (USGS, 1999).

9.6.3 Description of potential adverse impact from the emission

A number of important wetlands and groundwater dependent vegetation occur down hydraulic gradient of the Premises, west of the Brand Hwy (e.g. White Lake, Beermullah Lake, Collards Wetland, etc.). If spills or leaks of mine tailings reach these systems, it may cause contamination through sedimentation (increased concentration of suspended sediments (i.e. turbidity) and an increased accumulation of fine sediments) and potentially a number of other adverse effects on ecosystem health.

9.6.4 Applicant controls

Pipelines from the WCP to the SMU or solar drying ponds will run parallel with the mining haul road in pipeline corridors that will be roughly 300 mm below natural ground surface.

Pumps and slurry flow will be monitored with flow meters at designated pumping stations. The operator in the control room will monitor flow readings, and pressure gauges throughout the pipeline system will alert the operator of issues.

The Applicant considers that any spills or leaks from pipelines will be localised and contained on the Premises.

9.6.5 Key findings

The Delegated Officer has reviewed the information regarding the risk of pipeline failure/overtopping of mine tailings infrastructure and has found:

1. There is a possibility that important wetlands and groundwater dependent vegetation may be impacted from a spill or leak of mine tailings.
2. The risk of impacts is mitigated for low velocity leaks by running pipelines adjacent to the mining haul road and below the natural ground surface.
3. Flow meters and pressure gauges on the pipelines should enable early detection of spills and/or leaks.

9.6.6 Consequence

The consequence of spills or leaks of clay slimes and/or sand tailings from pipeline failure would constitute a potential or actual alteration of the environment, with the potential for off-site impacts at a local scale (**Minor**).

9.6.7 Likelihood of Risk Event

The Delegated Officer considers that any spills or leaks of clay slimes or sand tailings will be localised and contained on the Premises, and is **Unlikely** to cause off-site impacts to environmental values.

9.6.8 Overall rating of fugitive emissions (dust)

The Delegated Officer has compared the consequence and likelihood ratings described above with the risk rating matrix (Table 15) and determined that the overall rating for a pipeline failure causing impacts to environmental values is **Moderate**.

9.7 Risk Assessment – Sulfide oxidation (Acid Sulfate Soils)

9.7.1 Description of risk event

Direct disturbance (i.e. physical movement) or indirect disturbance (e.g. lowering of the water table) of ASS, causing acidification of groundwater and degradation of water quality and other environmental values.

9.7.2 Identification and general characterisation of emission

ASS occur naturally in soils and sediments that contain iron sulfide minerals (principally as the mineral pyrite) and/or their precursors. These minerals are typically found at shallow depth (less than 3 m deep) in low-lying areas near the coast and are harmless when left in a waterlogged, undisturbed environment, but have the potential to cause environmental problems due to the generation and release of sulfuric acid when exposed to air through drainage, dewatering or excavation (DER, 2015c).

Sulfidic sediments may also occur at depths greater than 3 metres on the coastal plains, which can be disturbed by large-scale sand mining operations. Although the general principles for managing these deeper sulfidic sediments are similar to that of managing shallow acid sulfate soils, the scale of mining operations and the characteristics of these deeper sediments can cause additional hazards on disturbance that require careful management to prevent environmental problems taking place.

An ASS investigation (SWC, 2017) identified soils indicative of potential ASS (PASS) material at the boundary between the base of the Yoganup Formation and upper portion of the Leederville Formation, which correlates to the base (or just below) of the proposed mining pits (refer to Section 6.2). Modelling indicates approximately 19.8 tonnes of ASS material is expected to be directly disturbed by mining, which constitutes ~0.1% of the total material proposed to be mined.

9.7.3 Description of potential adverse impact from the emission

ASS pose a number of significant environmental risks such as:

- Deoxygenation – the oxidation process consumes oxygen, and in extreme cases can remove all of the oxygen from the water column, resulting in the death of aquatic organisms;
- Release of metals and metalloids – many heavy metals (such as cadmium and lead) and metalloids (such as arsenic) form sulfidic minerals, which if oxidised, are released into the pore water or into the overlying water column, where they may be incorporated into animal or plant tissue and potentially into the food chain; and
- Impacts on public health – loss of amenity (preventing aquatic ecosystems being used for recreation), the generation of four odours (including toxic hydrogen sulfide), and impaired drinking water.

9.7.4 Criteria for assessment

The DWER guideline *Identification and investigation of acid sulfate soils and acidic landscapes* (DER, 2015c) is the accepted framework in Western Australia for assessing and managing environmental risks associated with ASS.

The framework underpins the management of ASS and water resources to avoid unacceptable impacts and involves:

- developing a sound conceptual model for the site, including an understanding of local hydrogeological conditions, of the distribution of sulfide minerals, and of the presence of sensitive environmental receptors;
- identifying risk mitigation measures on the basis of the conceptual model, and making firm

commitments that these measures will be implemented; and
- developing a long-term contingency plan, incorporating a commitment to undertake appropriate monitoring accepted by regulatory agencies.

The assessment is undertaken in an iterative manner where the suitability of site-specific data for making reliable management decisions is repeatedly questioned until a consensus is reached between the Licence Holder, DWER and other regulatory agencies (i.e. DMIRS).

9.7.5 Applicant controls

The Applicant has developed a conceptual model for the site, including a description of local hydrogeological conditions and the spatial distribution of sulfide minerals (SWC, 2017). Management and contingency strategies outlined in the DWER guideline *Treatment and management of soils and water in acid sulfate soil landscapes* (DER, 2015d) have been considered on the basis of the conceptual model. A summary is provided in Table 25 below.

Table 25: Applicant's proposed controls for managing ASS

Type	Site applicability
Avoidance	Based on the pre-screening geological data, no areas within the proposed orebody have been excised
Minimise disturbance	Disturbance of PASS material will be staged, minimising exposure time of reactive material
Neutralisation	If required, soil and/or water will be neutralised using lime at the rate determined by the following equation: Lime requirement (kg $CaCO_3$/t) = Net Acidity (mol H^+/t) x 0.05 Based on the amount of PASS material expected to be exposed, the total potential acidity that could be released by direct disturbance is 1,817,460 mol H^+; therefore approx. 100 tonnes of lime is estimated for effective neutralisation
Strategic reburial	This will be considered for oversize material within the mine pits and is likely to be undertaken in conjunction with soil neutralisation methods (see above)
Hydraulic separation	Not applicable as the proportion of PASS material within the ore is negligible (<2%)
Stockpiling	This will be considered in conjunction with soil neutralisation methods (see above)
Monitoring – routine screening	In-pit soil screening: - regular in-pit screening of material, based on mine scheduling; - frequency to be determined by the Applicant's environmental department
	Tailings sand testing: - will depend on the proposed utilisation of the material: - if to be used as a growth medium for rehabilitation, screen testing at a rate of 1 sample per 1,000 m^3 - if to be used to reconstruct the lower portion of the backfill profile then no monitoring will be conducted
	Fines material testing: - clay slimes will be screened prior to backfilling solar drying ponds; - 2 sampling sites per hectare, with samples collected at 0.5 m vertical intervals

	- detailed analysis to be conducted on a selected number of samples to confirm screen test results and the absence of PASS
	Process water neutralisation: - routine water monitoring to confirm characteristics - monthly monitoring is surrounding bores, water dams, HMC sumps and solar drying ponds - routing pH monitoring within the WCP - if pH drop below pH 4, then field testing will occur weekly in all process water/waste deposition areas
	Groundwater quality[1]: - monthly testing of all bores on the Premises for pH, EC and TDS - quarterly testing of major ions and metals/metalloids
	Post treatment verification: - take representative in-pit sampling within reactive areas which have required treatment after disturbance, to test effectiveness of soil neutralisation - groundwater monitoring as indicated above

Note 1: Mine pit dewatering will be managed in accordance with the Groundwater Operating Strategy. The groundwater monitoring program will be undertaken to detect changes in groundwater quality that could be attributed to dewatering and off-site impacts. Monitoring will provide an early indication of adverse effects of ASS on local groundwater, both during operations and mine closure.

9.7.6 Key findings

The Delegated Officer has reviewed the information regarding the risk of sulfide oxidation and has found:

1. The low number of samples that tested positive for pyrite minerals suggests that ASS is manageable at the site.
2. Management and contingency measures proposed by the Applicant for managing the risk of sulfide oxidation in sediments that contain significant amounts of sulfide minerals appear suitable; however the risk of groundwater contamination by metals due to drawdown has not been addressed.
3. Trigger values for acidity should be developed based on the upper threshold limit value of background levels in groundwater in the area (likely to be ~100 mg/L $CaCO_3$). Where acidity levels are triggered, additional sampling should be undertaken, including full chemical analysis.

9.7.7 Consequence

If not detected or managed early, the consequence of direct and/or indirect disturbance of ASS can lead to long-term environmental impacts at a local level (**Moderate**).

9.7.8 Likelihood of Risk Event

The likelihood ASS disturbance causing long-term environmental impacts at the site is low (**Unlikely**), if a regular screening and groundwater monitoring program is in place.

9.7.9 Overall rating of sulfide oxidation

The Delegated Officer has compared the consequence and likelihood ratings described above with the risk rating matrix (Table 15) and determined that the overall rating for sulfide oxidation is **Moderate**.

9.8 Risk Assessment – Impacts from surface water runoff

9.8.1 Description of risk event

Discharge of surface water runoff, causing erosion and adverse impacts to watercourses and wetlands.

9.8.2 Identification and general characterisation of emission

Contaminants conveyed in stormwater discharges from active haul roads, access roads, heavy vehicle operating areas (e.g. ROM pad), hardstand areas (e.g. plant site), will vary. The activities, contaminant sources, and contaminants detailed in Table 26 are commonly found at mineral sands mine and related facilities.

Table 26: Stormwater contaminant sources and contaminants at mineral sands mines

Activity	Contaminant source	Contaminants
Heavy earthmoving equipment movements – active haul roads, access roads	Surface grading and exposure of soils	Dust, total suspended solids (TSS), total dissolved solids (TDS), turbidity, pH and oil and grease
Mining and processing activities	HMC storage	Dust, TSS, TDS, turbidity, sulfates, iron
	Overburden/topsoil storage	
	Mine voids	
	Materials handling and loading/unloading	
Equipment/vehicle maintenance	Fuelling activities	Diesel fuel, petrol, oil, chemical oxygen demand (COD)
	Parts cleaning	Solvents, oil, heavy metals, acid/alkaline wastes
	Disposal of oily rags, oil filters, batteries, coolants, degreasers	Oil, heavy metals, solvents, acids, COD
Rehabilitation	Site preparation for rehab	Dust, TSS, TDS, turbidity, pH

9.8.3 Description of potential adverse impact from the emission

Rainfall runoff modelling (URS, 2013c) indicates that a 20-year ARI rainfall event is required to exceed infiltration and generate runoff, with peak flow rates ranging from 0.5 to 2 m^3/s. Runoff volumes are predicted to be low (~3% of rainfall for a 100-year ARI event) and represent a low flood risk.

There is an increased potential for erosion in disturbed areas and exposed soils, which may manifest in increased sediment concentrations and loadings in the local surface water flows.

9.8.4 Applicant controls

The Premises intersects several drainage lines shedding from the Dandaragan Plateau that will be temporarily diverted and managed to avoid the ingress of associated runoff into mine voids during mining and backfill operations.

The mine operations and processing area will be located outside of the drainage line boundaries. External sheet runoff will be diverted at the upstream side of the infrastructure, with relatively minor bund/channel diversions. Minor bunding will be installed to divert external sheet runoff around laydown/storage areas.

9.8.5 Key findings

The Delegated Officer has reviewed the information regarding the risk of surface water runoff and has found:

1. Streamflow infiltrates the Bassendean Sands on the footslopes of the Gingin Scarp and does not contribute to the wetlands and lakes of the Beermullah Plain.
2. The Surface Water Assessment (URS, 2013c) recommends an appropriate stormwater drainage plan is required for operational areas and upstream sub-catchments. Such a plan was not submitted with the Application.
3. Applicant controls for managing surface water runoff do not address the risk of runoff contaminated by activities on the Premises.

9.8.6 Consequence

The consequence of contaminated surface water runoff entering local drainage lines could lead to long-term environmental impacts at a local level (**Moderate**).

9.8.7 Likelihood of Risk Event

The likelihood contaminated surface water runoff causing long-term environmental impacts at the site is low (**Unlikely**), if an appropriate stormwater drainage plan is implemented.

9.8.8 Overall rating of sulfide oxidation

The Delegated Officer has compared the consequence and likelihood ratings described above with the risk rating matrix (Table 15) and determined that the overall rating of impacts from surface water runoff is **Moderate**.

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 27 below. Controls are described further in section 1.

Table 27: Risk assessment summary

	Description of Risk Event			Applicant controls	Risk rating	Acceptability with controls (conditions on instrument)	Resulting regulatory controls
	Emission	**Source**	**Pathway/ Receptor (Impact)**				
1.	Noise	Heavy earthmoving equipment and fixed plant	Causing amenity impacts to off-site receptors	Equipment and operational controls Routine noise monitoring Setting noise trigger levels and contingency actions Remedial actions	Major consequence Possible likelihood **High Risk**	Acceptable subject to proponent controls conditioned and additional regulatory controls	Works approval to specify: - Approved construction times - Construction of noise bunds - Sound power level of earthmoving equipment to be demonstrated - Noise monitoring locations to be established - Must use quietest equipment reasonably available - Must install silencers on exhaust of machinery used in overburden removal - Must install broadband reversing beepers - Must undertake remedial actions is monitoring indicates exceedance of Noise Regulations - Shut down operations if remedial actions fail to reduce noise Licence to specify: - Above equipment and operational controls - Only one excavator to be used per mine block at night - Continuous noise monitoring

	Description of Risk Event			Applicant controls	Risk rating	Acceptability with controls (conditions on instrument)	Resulting regulatory controls
	Emission	**Source**	**Pathway/ Receptor (Impact)**				
2.	Fugitive dust	Exposed mining areas, stockpiles, vehicle movements, mining and processing activities	Causing health and/or amenity impacts to off-site receptors	Operational controls Routine dust monitoring Visible dust inspections	Moderate consequence Possible likelihood **Moderate risk**	Acceptable subject to proponent controls conditioned and additional regulatory controls	Works approval to specify: - Timing of dust generating activities - Dust monitoring locations to be established - Dust monitoring during works - Trigger values Licence to specify: - Above operational controls - Dust monitoring during summer months
3.	Slurry pipeline failure	Direct discharge of clay slimes/ sand tailings	Sedimentation and other effects on health of surface water ecosystems	Routing of pipeline along haul roads Bunding (300 mm) Pressure/flow sensors Daily inspections	Minor consequence Unlikely likelihood **Moderate Risk**	Acceptable subject to proponent controls conditioned and additional regulatory controls	Works approval to specify: - Pipelines to be constructed with automatic cut-outs or secondary containment or pressure sensors Licence to specify: - Automatic cut-outs/secondary containment/pressure sensors to be maintained on pipelines - Inspections of infrastructure
4.	Acid Sulfate Soils	In situ soils with sulfide minerals	Groundwater contamination (acidification)	Avoidance Minimise disturbance Neutralisation Strategic reburial Stockpiling Routine screening Groundwater monitoring	Moderate consequence Unlikely likelihood **Moderate Risk**	Acceptable subject to proponent controls conditioned	Works approval to specify: - Installation of minimum 2 bores immediately down-gradient of each mine pit Licence to specify: - Groundwater monitoring of ASS parameters - Setting of ASS triggers based on UTC
5.	Contaminated stormwater	Mine site runoff	Erosion, sedimentation and other effects on health of surface water ecosystems	Temporary diversion of drainage lines Bunding installed to divert sheet runoff around laydown/storage areas	Moderate consequence Unlikely likelihood **Moderate Risk**	Acceptable subject to proponent controls conditioned	Works approval to specify: - Design of hardstand areas, ROM pads, etc. to divert stormwater runoff to a constructed drainage depression or sedimentation basin

10. Regulatory controls

A summary of regulatory controls determined to be appropriate for the Risk Event is set out in Table 27. The risks are set out in the assessment in section 9 and the controls are detailed in this section. DWER will determine controls having regard to the adequacy of controls proposed by the Applicant. The conditions of the Works Approval and Licence will be set to give effect to the determined regulatory controls.

10.1 Works Approval controls

10.1.1 Infrastructure and equipment

The infrastructure and equipment authorised for construction have been specified in Table 2 of the Works Approval.

Note: *The requirements specified in Table 2 of the Works Approval have been determined by the Delegated Officer to be required to mitigate potential risks identified in this Decision Report.*

Grounds: *The design and construction requirements of MUP, ROM and HMC pads have been specified in the absence of detail provided in the Application and to minimise the potential for contaminated stormwater runoff.*

The design and construction requirements of the off path tails cell and solar drying ponds have been specified in the absence of technical detail provided in the Application and to minimise the risk of containment failure.

The design and construction requirements of the WCP have been specified as additional controls to minimise the level of noise from a fixed, continuous noise source.

The updated noise modelling (LGA, 2017b) indicates that compliance with the Noise Regulations is reliant on the construction of sizeable noise bunds in strategic locations around the mine pits and fixed plant.

The use of safeguards for pipelines carrying materials that could otherwise pose a risk to the environment have been considered necessary by the Delegated Officer to minimise the risk of accidental releases, spills or leaks of mine tailings.

Additional groundwater monitoring bores have been specified in the Works Approval, to be sited down gradient of each mine pit. The bores are for monitoring of shallow groundwater quality in the vicinity of each mine pit, to enable early detection of changes in groundwater quality that may be attributed to mine operations (e.g. leaching of metals, metalloids and sulfate from mine tailings when the water table rebounds after mining, particularly if shallow groundwater becomes acidic and depleted in alkalinity as a result of the lowering of the water table).

10.1.2 Hours of operation

The hours of operation for overburden removal and initial mine pit development works have been specified in the Works Approval (Condition 5) to reflect normal day time working hours (0700 – 1900 hours Monday to Saturday).

Note: *The hours specified above replicate the controls proposed by the Applicant during overburden removal and pit development works, and this was considered by the Delegated Officer in determining the risk of impacts to amenity of nearby receptors during construction works.*

Grounds: *A review of the noise model for the Premises indicates that compliance with the Noise Regulations during overburden removal and pit development in phase 1 can only be achieved during day time operations, and assuming that additional acoustic treatment has been implemented. The Delegated Officer considers limiting construction works to normal day time working hours is required to ensure compliance with the Noise Regulations.*

10.1.3 Commissioning

The Applicant intends on commissioning plant and equipment following installation and construction, namely the SMU, WCP and associated infrastructure. The following conditions have been specified for commissioning (Conditions 6, 7, 8, 9, 10 and 11):

- Notification of the commencement and completion of commissioning works;
- Maximum commissioning timeframe specified (4 months);
- Maximum amount of ore processed during commissioning (100,000 tonnes); and
- Submission of a commissioning report, providing a summary of monitoring undertaken and environmental performance of all plant and equipment as installed.

Grounds: *The Delegated Officer considers the above requirements to be necessary to ensure the commissioning period and commissioning works are clearly defined, as distinct from mining operations.*

10.1.4 Disposal of mine tailings

A control has been imposed (Condition 13) to specify the nominated location(s) as the authorised disposal area for mine tailings during commissioning works.

Note: *The requirements specified in Table 4 of the Works Approval generally replicate the requirements of the Mine Closure Plan for the Premises.*

Grounds: *DWER's risk assessment is based on the disposal of mine tailings in the locations specified in the Application. Disposal of mine tailings in locations other than those specified has not been risk assessed, and the defence provisions of s.74, 74A and 74B would therefore not apply.*

10.1.5 Fugitive dust controls

A number of fugitive dust controls have been specified in Table 5 of the Works Approval, including:

- Controls during topsoil stripping;
- Use of water carts and sprays;
- Use of dust suppressants (other than water);
- Conditions under which activities must cease; and
- Monitoring and setting trigger levels.

In addition, the Applicant is required to establish a minimum of 3 ambient air quality monitoring locations (including a background station), that will be directly downwind of mine operations and in the direction of sensitive receptors (Condition 15). A dust monitoring system must also be implemented that will supply continuous real-time data to allow real-time monitoring of TSP and PM_{10} concentrations, that will provide automatic feedback to the mine supervisor if trigger levels are reached.

Note: *The requirements specified in Table 5 generally replicate the management measures proposed by the Applicant in the Application, however more detail has been added. The monitoring locations specified in Condition 15 differ from the controls proposed by the Applicant, which involves monitoring off the Premises.*

Grounds: *In the absence of ambient air quality modelling, the Delegated Officer has determined that a high level of regulatory control is required through the Works Approval to mitigate the risk of fugitive dust impacting on off-site receptors during mine construction works.*

The dust controls specified in Table 5 are consistent with the operation of similar mineral sands mines on the Swan Coastal Plain, and are not considered to be overly onerous. The key control relates to the suspension of specific operations during high wind conditions, where there is a risk of causing off-site impacts. The onus is therefore on the Applicant to use

available tools (e.g. monitoring) and experience to mitigate the risk.

The implementation of a continuous dust monitoring system is consistent with that proposed by the Applicant and is considered necessary to provide assurance over the effectiveness of the dust controls specified in Table 5. However, the monitoring locations are required to be sited on the Premises for enforceability purposes (DWER cannot set conditions that relate to activities outside of the Premises boundary). The Delegated Officer has therefore nominated 3 locations within the Premises that correspond with the noise monitoring locations nominated by the Applicant.

The Delegated Officer expects the dust monitoring system to be installed and functional prior to the start of construction works on the Premises, to enable monitoring of dust levels throughout the construction period at the location closest to the works.

10.1.6 Noise controls

A number of noise controls have been specified in the Works Approval (Conditions 17, 18, 19, 20 and 21), including:

- Demonstrating the sound power level of machinery to be used during construction works;
- Establishing a minimum of 3 noise monitoring locations between mine operations and in the direction of sensitive receptors;
- Implementation of a noise monitoring system, that will supply continuous real-time data to allow real-time monitoring of noise emissions; and
- Operational controls on heavy earthmoving equipment, including:
  - Silencers on mufflers and broadband reversing alarms;
  - Restricting the sound power level of haul trucks; and
  - Cease activities when compliance with the Noise Regulations cannot be achieved (unless an amenity agreement is in place with the affected receptor).

***Note:** The requirements specified above generally replicate the controls proposed by the Applicant in the Application, and were considered by the Delegated Officer in determining the risk of impacts to the amenity of nearby sensitive receptors.*

The noise monitoring program differs to that proposed by the Applicant.

***Grounds:** A review of the updated noise model (2017) for the project indicates that compliance with the Noise Regulations is heavily reliant on relocation/ having private agreements in place with the closest 4 sensitive receptors and/or the implementation of extensive noise controls during specific mining scenarios.*

A comparison of the 2013 noise model submitted as part of the PER with the updated 2017 noise model submitted with the Application indicates that larger (and noisier) equipment items are being proposed, which has seen the sound power level significantly increase for key equipment items (e.g. haul trucks, excavator, loaders). Due to these changes, the levels of noise exceedances predicted are also significantly increased. The Applicant has indicated the mining schedule has increased from the 2013 proposal, and therefore larger equipment items are required. The Delegated Officer has determined to require the sound power level of all machinery to be used on the Premises during construction works to be demonstrated, prior to commencing construction works.

The noise controls specified in Table 6 are consistent with the operation of similar mineral sands mines on the Swan Coastal Plain, and are not considered to be overly onerous. The key control relates to the suspension of specific operations where there is a risk of noise not complying with the Noise Regulations. The onus is therefore on the Applicant to use available tools (e.g. monitoring) and experience to mitigate the risk.

The noise model (2017) indicates that reducing the sound power level of haul trucks will be key to achieving compliance with the Noise Regulations. The Applicant has therefore committed to retrofitting a noise reduction package ("Hushpak") to the haul trucks and

excavators, which is expected to reduce the sound power from 117 dB(A) to 113 dB(A). The Delegated Officer has determined to restrict the sound power level of haul trucks and excavators used on the Premises to 113 dB(A), to ensure this commitment is implemented, and to ensure consistency with the noise model.

The Delegated Officer considers the noise monitoring proposed by the Applicant lacks detail and is likely to be insufficient for managing the risk of noise non-compliance. In considering the risk of noise impacting on nearby receptors, the Delegated Officer has determined that a continuous noise monitoring system is required, to provide an indication of compliance with the Noise Regulations, and assurance over the effectiveness of the noise controls. Similar to dust, monitoring locations have been sited within the Premises for enforceability – the 3 locations within the Premises nominated by the Applicant are considered to be acceptable.

A continuous noise monitoring system must be implemented that will supply continuous real-time data to allow real-time monitoring of noise levels, and that will provide automatic feedback to the mine supervisor. The Delegated Officer expects the system to be installed and functional prior to the start of construction works on the Premises, to enable monitoring of noise levels throughout the construction period at the location closest to the works.

10.1.7 Monitoring general

A number of conditions have been applied to the Works Approval (Condition 22, 23 and 24) to prescribe the minimum monitoring requirements. They relate to the minimum requirements for sampling and analysis of samples, minimum timeframes for sampling frequency, and calibration requirements for instruments used by the Applicant.

Grounds: *The requirements specified above are to ensure sampling is conducted in a manner that is consistent with accepted standards, procedures and processes.*

10.1.8 Ambient environmental monitoring

Monitoring of ambient noise levels, air quality (dust) and groundwater quality have been specified in the Works Approval (Conditions 25, 26, 27, 28 and 29), requiring:

- Installation of a wind monitor;
- Monitoring of air quality at the location closest to the works;
- Monitoring of groundwater quality in the vicinity of mine pits;
- Monitoring of noise levels at the location closest to the works; and
- Actions to be taken in the event of a noise exceedance.

Note: *The Applicant has proposed to conduct monitoring of noise and dust – the requirements specified above expand on the scope relative to the risk of off-site impacts. Groundwater monitoring is proposed to be implemented after mining commences, in parallel with the programme under the Groundwater Operating Strategy.*

Grounds: *In consideration of the nearest BoM weather station, being 25 km south at Gingin Aero, the Delegated Officer has determined that more accurate, site specific wind data should be used to develop a reliable weather forecasting tool (for managing noise and dust), and for use in investigations into potential exceedances.*

Noise and dust

In consideration of the potential for off-site impacts from noise emissions and fugitive dust, the Delegated Officer has determined that monitoring of noise and dust during construction works is critical for providing assurance over the effectiveness of management controls at the Premises. This includes continuous monitoring of PM_{10} and noise levels, and weekly monitoring of TSP (24 hours), at the "central west" monitoring location. Internal trigger levels are to be set for each parameter, with alerts sent to the mine supervisor if trigger levels are reached, which will enable early identification and proactive management.

In order to establish if an exceedance of the Noise Regulations is attributed to the Premises, the Applicant must conduct an investigation to determine the root cause and any common or contributory factors.

Groundwater quality

A number of monitoring bores have been installed on the Premises for the purpose of monitoring impacts on groundwater dependent vegetation in the nature reserves from groundwater drawdown, which is a requirement of MS 981 and the GOS. The Delegated Officer has determined this groundwater bore network is not sufficient for monitoring potential impacts on groundwater quality caused by leaching of metals, metalloids and sulfate from mine tailings when the water table rebounds after mining, and that additional bores are required immediately down gradient of each mine pit.

Monitoring of shallow groundwater in the vicinity of each mine pit will enable early detection and proactive management of changes in groundwater quality. Monthly monitoring of standard physical parameters (SWL, pH, EC and redox potential) will be conducted as part of the GOS. Additional parameters include major ions, total acidity and alkalinity, and metals and metalloids once throughout the duration of the works approval to provide baseline data.

10.1.9 Record keeping

A number of conditions have been applied to the Works Approval (Conditions 30 and 31) to prescribe the minimum record keeping requirements. They relate to the standards for book-keeping and the requirement to produce records to the CEO upon request.

Grounds: *The requirements specified above are necessary to demonstrate compliance with other requirements of the Works Approval.*

10.1.10 Complaints

The recording of complaints has been specified in the Works Approval (Condition 32), to ensure the Applicant implements a suitable complaints management procedure.

Grounds: *The requirements specified above are necessary to document all complaints received by the Applicant, and to demonstrate that each complaint has been sufficiently addressed.*

11. Applicant's comments

The Applicant was provided with the draft Decision Report and draft issued Works Approval on 13 October 2017. The Applicant provided comments which are summarised, along with DWER's response, in Appendix 2.

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 key 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.

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

Appendix 1: Key documents

	Document title	In text ref	Availability
1.	Boonanarring Project – Works Approval Application supporting document. Prepared for Image Resources NL by Preston Consulting Pty Ltd (2 June 2017).	Application	DWER records (A1449925)
2.	Report and recommendations of the Environmental Protection Authority – Boonanarring Mineral Sands Mine, Image Resources NL (June 2014).	EPA Report 1516	accessed at www.epa.wa.gov.au
3.	Ministerial Statement 981	MS 981	
4.	Preston Consulting, July 2017. *Revised Mining Proposal: Boonanarring Project*. Prepared for Image Resources NL by Preston Consulting Pty Ltd.	Preston Consulting, 2017a	
5.	Preston Consulting, April 2017. *Mining Closure Plan: Boonanarring Project*. Prepared for Image Resources NL by Preston Consulting Pty Ltd.	Preston Consulting, 2017b	
6.	Image Resources, March 2017. *Environmental Management System – Boonanarring Project*.	Image Resources, 2017	
7.	Optiro, March 2017. *Boonanarring – Ore Sterilisation*. Memo prepared by Optiro Pty Ltd for Image Resources NL.	Optiro, 2017	
8.	Outback Ecology, June 2013. *Baseline Soil and Overburden Characterisation*. Prepared for Image Resources NL by Outback Ecology (MWH Australia Pty Ltd).	Outback Ecology, 2013	
9.	URS, August 2013. *Report – Boonanarring Project: H3 Hydrogeological Assessment*. Prepared for Image Resources NL by URS Australia Pty Ltd.	URS, 2013a	
10.	URS, November 2013. *Report – Boonanarring Project: Addendum to H3 Hydrogeological Assessment*. Prepared for Image Resources NL by URS Australia Pty Ltd.	URS, 2013b	
11.	Lloyd George Acoustics, June 2013. *Environmental Noise Assessment: Boonanarring Mineral Sands, Gingin*. Prepared for Image Resource NL by Lloyd George Acoustics Pty Ltd.	LGA, 2013	
12.	Lloyd George Acoustics, March 2017. *Environmental Noise Assessment: Boonanarring Mineral Sands, Gingin*. Prepared for Image Resource NL by Lloyd George Acoustics Pty Ltd.	LGA, 2017a	
13.	Lloyd George Acoustics, October 2017. *Memo – Boonanarring Mineral Sands – All Bunds Noise Modelling*. Prepared for Image Resources NL by Lloyd George Acoustics	LGA, 2017b	

14.	URS, July 2013. *Report – Boonanarring Project: Surface Water Studies*. Prepared for Image Resources NL by URS Australia Pty Ltd.	URS, 2013c	
15.	Soilwater Consultants, April 2017. *Boonanarring ASS Investigation*. Prepared for Image Resources NL by Soilwater Consultants Pty Ltd.	SWC, 2017	
16.	COOE, May 2015. *Detailed Operating Strategy – Boonanarring Mineral Sands Project*. Prepared for Image Resources NL by COOE Pty Ltd.	COOE, 2015	
17.	360 Environmental, October 2013. *Boonanarring Mineral Sands – Level 2 Flora and Vegetation and Groundwater Dependent Vegetation Survey*. Prepared for Image Resource NL by 360 Environmental Pty Ltd.	360 Environmental, 2013	
18.	DER, July 2015. *Guidance Statement: Regulatory principles.* Department of Environment Regulation, Perth.	DER, 2015a	accessed at www.dwer.wa.gov.au
19.	DER, October 2015. *Guidance Statement: Setting Conditions.* Department of Environment Regulation, Perth.	DER, 2015b	
20.	DER, November 2016. *Guidance Statement: Environmental Siting*. Department of Environment Regulation, Perth.	DER, 2016	
21.	DER, February 2017. *Guidance Statement: Risk Assessments*. Department of Environment Regulation, Perth.	DER, 2017a	
22.	DER, February 2017. *Guidance Statement: Decision Making*. Department of Environment Regulation, Perth.	DER, 2017b	
23.	DER, June 2015. *Identification and investigation of acid sulfate soils and acidic landscapes*. Department of Environment Regulation, Perth.	DER, 2015c	
24.	DER, June 2015. *Treatment and management of soils and water in acid sulfate soil landscapes*. Department of Environment Regulation, Perth.	DER, 2015d	
25.	Preston Consulting, July 2017. *Boonanarring Project – Noise Management Plan*. Prepared for Image Resource NL by Preston Consulting Pty Ltd.	Preston Consulting, 2017c	DWER records (A1532666)
26.	DMP, October 2015. *Mining Act Guidelines – Basic Provisions*. Department of Mines and Petroleum, Perth.	DMP, 2015	accessed at www.dmp.wa.gov.au
27.	USGS, September 1999. *Environmental characteristics of clays and clay mineral deposits*. U.S. Geological Survey, Reston, Virginia, United States.	USGS, 1999	accessed at pubs.usgs.gov/info/clays/clays.pdf

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

Condition		Justification	DWER response
3	Subject to Condition 2, within 28 days of the completion of the Works specified in Column 1 of Table 2, the Works Approval Holder must provide to the CEO an engineering certification from a suitable qualified professional confirming each item of infrastructure or component of infrastructure specified in Column 1 of Table 2 below has been constructed with no material defects and to the requirements specified in Table 2.	Most of the items specified in Table 2 are designed based on completed geotechnical test work and recommendations from specialist engineers. The onus is then on the construction managers and engineers to build according to those specifications. We propose that the best person to demonstrate that the requirements of Table 2 have been met would be a manager or engineer responsible for overseeing the construction. Image proposes the condition be revised to "…*the Works Approval Holder must provide to the CEO a* ***signed statement from a suitably qualified manager or engineer***…"	DWER requires certification that the 'as-built' structures meet design specifications. An engineer is considered a suitably qualified professional. DWER has revised the condition to remove the term 'engineering' to make this clearer.
4; Table 2	Minimum of 2 bores to be constructed immediately down-gradient of each mine pit	Bores should be able to be drilled progressively ahead of the mine path rather than drilling all bores at the start of construction. Image proposes the condition be revised to "*minimum of 2 bores to be constructed immediately down-gradient of each mine pit* ***prior to excavation within that mine pit***" Image has a network of groundwater monitoring bores and a groundwater monitoring program required under MS 981. These bores should be used if suitable given the comprehensive baseline data already obtained. If there are no suitable bores then new bores can be drilled as per the condition. Image considers existing monitoring bores can be used if they meet the siting requirements of WQPN#30.	DWER notes the existing groundwater monitoring bore network has been established under MS 981 to monitor impacts on groundwater levels in order to protect vegetation values of the adjacent nature reserves. Bores for monitoring changes in water quality caused by mining should be located as close as possible to the mining void and screened near the water table to detect changes in water quality. DWER considers existing bores are too far away from the mining area where the time taken for potential contaminants to travel to these bores will be too long, thereby defeating the purpose of monitoring to enable early a rapid management response.

Condition		Justification	DWER response
5	The Works Approval holder must only carry out the Works authorised through this Works Approval between the hours of 0700 and 1900 Monday to Saturday (excluding public holidays).	Overburden removal was the key works that the modelling showed had the potential to exceed noise limits. This condition is too onerous as it restricts all construction activities – even those that are low noise. Image proposes the condition be revised to "*the Works Approval holder must only carry out* ***overburden removal and initial mine pit development works*** *authorised through this Works Approval*…"	Noted and changes made.
8	The Works Approval Holder must not Commission the MFU, WCP and associated infrastructure with more than 100,000 tonnes of HMC.	Producing 100,000 tonnes of HMC is much higher than discussed. 100,000 tonnes of ore is lower, more appropriate amount for commissioning.	Noted and changes made.
14; Table 5	Schedule topsoil stripping for when soil conditions are moist but not saturated	The term "schedule for" infers that Image would need to wait until after rainfall to conduct topsoil stripping. Image proposed the condition be revised to **"*when there is a risk of dust affecting sensitive receptors, conduct topsoil stripping operations*** *when soil conditions are moist but not saturated*". This allows that dust suppression sprays could also be used to moisten the topsoil, and reduces water use when weather conditions pose a low dust risk.	Noted and changes made.
15	Prior to commencing Works on the Premises, the Works Approval Holder must establish ambient air quality monitoring locations:	Clarity is sought on whether this requires the installation of all three sites prior to any construction, or just one at a time prior to the years listed in (a) (b) and (c).	The condition refers to establishing dust monitoring locations in preparation for when monitoring will be required, i.e. choosing a location and prepping it. Equipment will need to be installed at the Central West location to enable monitoring under the construction phase of the works approval.
17	Prior to commencing work on the Premises, the Works Approval holder	The term "machinery" is too broad for the development of a mine site, which will have a large	Noted and changes made.

Condition		Justification	DWER response
	must submit to the CEO, a report demonstrating the Sound Power Level for all machinery to be used during the works.	number of mechanical equipment operating during the construction period. The revised conditions focus on the key noise-emitting equipment – **earthmoving** machinery.	
18(a)	Comprises Sound Power Level measurements of the actual machinery to be used during the Works		
19; Table 6	Must install silencers on the exhaust of all mobile earthmoving equipment	This requirement should not be applied to graders and other equipment with lower noise emissions. Image suggests the condition be revised to "*must install **noise attenuation** on all **excavators and haul trucks used in overburden removal***".	Noted and changes made.
19; Table 6	Haul trucks and excavators used on the premises must not exceed a manufacturers maximum rated power sound level of 113dB(A)	The current requirement means that a haul truck with a sound level of 113.1 dB(A) would not be able to be used on site, regardless of whether arrangements have been made with closest receivers and/or other mitigation strategies have been employed. The modelling assumption of 113 dB(A) is an estimate and shouldn't be used in a condition. What is more important is that Image meets the noise regulations and minimises its noise emissions, and the first two dot points already require this, with a specific requirement for excavators and haul trucks.	DWER has since revisited this requirement and in consideration of the additional noise controls to be implemented (noise bunding, etc.) in addition to Image's original commitment to seek amenity agreements with the closest receptors, this condition can be removed. However, should noise become an issue where the excavator/haul trucks are significantly contributing to the issue, this condition may be revisited.
20	Prior to commencing Works on the Premises, the Works Approval Holder must establish noise monitoring locations:	Can DWER please confirm whether this requires the installation of all three sites prior to any construction, or just one at a time prior to the years listed in (a) (b) and (c).	See comment above about dust monitoring locations.
Figure 2	Initial solar drying pond location shown below:	The reference to the initial solar drying pond location is incorrect. The initial pond will be closer to the initial mine pit as shown as Cell 1 in the figure provided.	Noted and changes made.

Attachment 1: Issued Works Approval W6065