Government of Western Australia
Department of Water and Environmental Regulation

Decision Document

Environmental Protection Act 1986, Part V

Licence Holder: Doral Mineral Sands Pty Ltd

Licence: L9018/2016/1

Registered office:	1 Alumina Road EAST ROCKINGHAM WA 6168
ACN:	096 342 451
Premises address:	Yoongarillup Mineral Sands Mine 1192 Sues Road YOONGARILLUP WA 6507 Being part of tenements M70/458 and M70/459, within Lots 1870, 1872, 1873 & 1874 on Plan 201690 and Lots 101 & 102 on Diagram 98906
Issue date:	Friday, 8 December 2017
Commencement date:	Monday, 11 December 2017
Expiry date:	Sunday, 25 March 2035

Decision

Based on the assessment detailed in this document the Department of Water and Environmental Regulation (DWER), has decided to issue a licence. DWER considers that in reaching this decision, it has taken into account all relevant considerations and that the Licence and its conditions will ensure that an appropriate level of environmental protection is provided.

Decision Document prepared by:	Daniel Hartnup Licensing Officer
Decision Document authorised by:	Tim Gentle Delegated Officer

Contents

1 Purpose of this Document

This decision document explains how DWER has assessed and determined the application and provides a record of DWER's decision-making process and how relevant factors have been taken into account. Stakeholders should note that this document is limited to DWER's assessment and decision making under Part V of the *Environmental Protection Act 1986.* Other approvals may be required for the proposal, and it is the applicant's responsibility to ensure they have all relevant approvals for their Premises.

2 Administrative summary

Administrative details		
Application type	Works Approval ☐ Concurrent Works Approval and Licence ☒ Licence ☐ Renewal ☐ Amendment ☐ Registration ☐	
Activities that cause the premises to become prescribed premises	**Category number(s)**	**Assessed design capacity**
	8: Mineral sands mining or processing	1,500,000 tonnes per annual period
Application verified Application fee paid	Date: 16/09/2016 Date: 20/09/2016	
Works Approval has been complied with Compliance Certificate received	Yes☒ No☐ N/A☐ Yes☒ No☐ N/A☐	
Commercial-in-confidence claim	Yes☐ No☒	
Is the proposal a Major Resource Project?	Yes☒ No☐	
Was the proposal referred to the Environmental Protection Authority (EPA) under Part IV of the *Environmental Protection Act 1986*?	Yes☒ No☐	Referral decision No: 1938 Managed under Part V ☐ Assessed under Part IV ☒
Is the proposal subject to Ministerial Conditions?	Yes☒ No☐	Ministerial statement No: 1030 EPA Report No: 1552 (July 2015)
Does the proposal involve a discharge of waste into a designated area (as defined in section 57 of the *Environmental Protection Act 1986*)?	Yes☒ No☐ Department of Water consulted Yes ☒ No ☐	
Is the Premises within an Environmental Protection Policy (EPP) Area Yes☐ No☒		
Is the Premises subject to any EPP requirements? Yes☐ No☒		

3 Executive summary of proposal and assessment

This report sets out DWER's assessment and decision making in relation to a concurrent application for works approval and licence under Division 3, Part V of the *Environmental Protection Act 1986* for the proposed Yoongarillup Mineral Sands Project (the project).

Background
Doral Mineral Sands Pty Ltd proposes to establish a small-to-medium scale heavy mineral sands mine in the locality of Yoongarillup, City of Busselton, approximately 250 km south of Perth. The project will form a continuation of mineral sands mining for its' Western Australian operations, by providing heavy mineral concentrate (HMC) feedstock to its mineral separation plant (MSP) located at Picton.

Proposed activities
The life-of-mine is expected to be 3 years, including an initial pre-mine development phase, mining and processing, backfilling of mine pits, and mine closure and rehabilitation. Operations will principally occur 24 hours a day, 7 days a week over the life-of-mine. Mining will be staged to minimise the area of disturbance at any one time.

The total resource for the deposit is 4 million tonnes (Mt) with an average grade of 12 – 15% heavy mineral. Ore will be mined progressively via a series of open-cut pits using dry mining techniques, to a maximum depth of 20 metres below ground level (mbgl). Groundwater inflows into the pit will be passively dewatered (i.e. sump pumping at the lowest point) to enable dry mining to occur. A projected water balance indicates the mine process water requirements will far exceed the volume of water collected onsite from dewatering, rainfall and stormwater runoff. As such, offsite discharge of mine water is not predicted to be a routine event, however infrastructure will be in place to allow water to discharge through a series of constructed channels off the premises, should a significant rainfall event exceed the site's water holding capacity.

Processing of ore will occur in-pit and slurry will be pumped from a feed preparation plant to a wet concentration plant (WCP) for further processing. Clay fines and sand tailings (quartz) will be combined and backfilled into the mine voids using co-flocculation where possible. Up to nine solar evaporation ponds (SEPs) are proposed to be constructed over the life-of-mine for the drying of clay fines, and to allow recycling of entrained water back to the process water pond, prior to being co-disposed into mine voids. Mined areas will then be back-filled and rehabilitated back to pre-mining land use.

HMC produced at the WCP will be stockpiled onsite prior to off-site transport to the Picton MSP for secondary processing. Target valuable minerals include zircon, ilmenite and leucoxene. Sand tailings (from processing Yoongarillup HMC) at the Picton MSP will be returned to the mine and blended with mine sand tailings, prior to backfilling into mine voids.

Other approvals and consultation
In 2015 the project was subject to an Environmental Impact Assessment (EIA) under Part IV of the *Environmental Protection Act 1986* (EP Act), at the level of Public Environmental Review (PER). The project was subsequently approved by the Minister for Environment in June 2016 (Statement 1030). The main environmental factor assessed through the EIA was flora and vegetation, as the original proposal included clearing of up to 20 hectares (ha) of the adjoining State Forest, which comprises regionally significant flora and vegetation values of the Whicher Scarp native forest ecosystem. Statement 1030 permits the clearing of a reduced area (8.9 ha), subject to the implementation of an offset.

Amenity (noise and dust) was also identified as a key environmental factor in the EIA. Ministerial conditions were not imposed for this factor following DWER advice that noise and dust can be regulated under Part V of the EP Act.

The project was also referred to the Federal Department of the Environment and Energy for assessment under the *Environment Protection and Biodiversity Conservation Act 1999*, due to the potential to affect

listed threatened species and communities (threatened flora: Long-leaved Daviesia and Long-stalked Featherflower; threatened fauna: Forest red-tailed Cockatoo, Baudin's Black Cockatoo and Carnaby's Black Cockatoo; and migratory bird species: Rainbow Bee-eater); and wetlands of international importance (under the Ramsar Convention): Vasse-Wonnerup wetland system. The outcomes of the assessment have resulted in an increase to the size of the offset under Statement 1030, and additional groundwater monitoring to ensure the mine does not impact on the values of the Vasse-Wonnerup wetland system.

Siting and location
The project is located on two mining tenements, on a strand of heavy mineral deposit that has been extensively mined. Yoongarillup will become the southern-most mine on the ancient shoreline strand that has also hosted the Tutunup, Yoganup, Gwindinup and Dardanup series of mineral sands mines.

Development of the mine will disturb 95.71 ha of mostly cleared agricultural land, including 8.9 ha of native vegetation within the adjoining State Forest. Surrounding land uses are predominantly farming and State Forest/National Park.

A number of farm houses are located around the site, including 9 within 1 km of the proposed mining pits, the closest 5 being within 400 – 600 m. A further 17 receptors are located within a 2.2 km radius, primarily to the north-east, of the proposed mining pits (total 26 receptors within 2.2 km).

The project is located on the lower/mid slopes of the Whicher Scarp, on the southern Swan Coastal Plain, southern Perth Basin. The superficial aquifer contains an unconfined groundwater lens in the Bassendean Sand towards the top and the sandy beds of the Yoganup Formation towards the base – the latter containing the mineral sand ore zones to be targeted by the project, and where most of the groundwater interception during mining will take place. Pit inflow is also likely to include indirect up-flow from the underlying sandstones and shales of the Leederville aquifer (Mowen Member), and from downslope drainage off the Whicher Scarp.

Public health and environmental risks
The key public health and environmental risks that may directly result from the project include:

- emissions to air (noise and dust emissions);
- emissions to surface water (offsite discharge of excess mine water); and
- emissions to land (disposal of tailings to mine voids).

Other risks that may indirectly result from the project include:

- impacts on ambient surface and groundwater quality from:
  - oxidation of potential acid sulfate soils (PASS) material in the Superficial aquifer as a consequence of groundwater drawdown;
  - leaching of contaminants and radionuclides into groundwater from the disposal of MSP tailings that contain naturally occurring radioactive materials (NORMs);
  - spills or leaks of pipelines carrying slurries of sand, ore and clay slimes;
  - contaminated stormwater (high turbidity) from disturbed areas;
  - acrylamide leaching (from flocculants) in settling ponds;
- impacts to native vegetation from:
  - mounding of groundwater beneath containment dams;
  - spills or leaks of pipelines carrying slurries of sand, ore and clay slimes; and
- impacts on adjacent receptors from light overspill.

Risk assessment and decision
On the basis of the information provided within the application, the Delegated Officer has determined the public health and the environmental risks associated with the project are acceptable, if the proposed controls are implemented. As such, a licence will be granted following the validation of compliance with the works approval and the completed works.

4 Decision table

All applications are assessed in line with the *Environmental Protection Act 1986* (EP Act), the *Environmental Protection Regulations 1987* and DWER's Operational Procedure on Assessing Emissions and Discharges from Prescribed Premises. Where other references have been used in making the decision they are detailed in the decision document.

DECISION TABLE			
Licence section	**Condition number**	**Justification (including risk description & decision methodology where relevant)**	**Reference documents**
Occupier	N/A	Under the EP Act, works approvals and licences can only be granted to the occupier of the premises. The Licence Holder is the holder of mining tenements M70/458 and M70/459, which covers freehold land, road reserve and crown land, and expires on 25 March 2035. The Licence Holder has provided in-principle consent from all landholders. The Delegated Officer is satisfied the Licence Holder is the occupier of the premises.	
General conditions	No conditions	Bunding and drainage will be constructed to divert surface water flows away from the mining area, and to minimise impacts on natural surface water flows. Stormwater falling within the mine footprint will be harvested for operational water requirements. The risk of surface water contamination from mining activities is considered to be low and therefore no controls have been imposed on the works approval or proposed for the licence. DWER's assessment and decision making on Surface Water Management is detailed in Appendix A1.	
Premises operation	1.2.1 – 1.2.5	***Containment of Processing Wastes Risk*** Conditions have been included on the licence to: • specify the authorised infrastructure on the premises for the containment of processing wastes and the minimum infrastructure requirements; • require adequate safeguarding of pipelines carrying slurries of ore and tailings to prevent uncontrolled discharges in the event of an incident or malfunction; and • require daily inspections of all containment infrastructures for leaks, integrity and freeboard requirements, with a log book to be kept with each inspection record to be signed by the responsible person. DWER's assessment and decision making on Containment of Processing Wastes are detailed in Appendix A2.	

DECISION TABLE			
Licence section	**Condition number**	**Justification (including risk description & decision methodology where relevant)**	**Reference documents**
	2.6.1	***Acid Sulfate Soils Risk*** Acid sulfate soils (ASS) investigations involving drilling and soil sampling across the site detected the presence of pyrite within dark coloured (grey to black) sandy clay materials, located below the maximum depth of mining. It is unlikely this material will be directly disturbed by mining, however it has been identified as being at risk of becoming oxidised as a result of dewatering drawdown. Controls are proposed for the licence to mitigate this risk. DWER's assessment and decision making on ASS is detailed in Appendix A3.	
Emissions general	2.1.1	Descriptive and numerical limits are included within the licence. Controls are included on the licence regarding recording and investigation of exceedances of limits.	
Point source emissions to air including monitoring	No conditions	There are no point source emissions to air proposed in the application during mining operations.	
Point source emissions to surface water including monitoring	2.2.1 & 3.2.1	Dewatering of mining areas will occur passively, via in-pit sumps located at the deepest point of the pit. Groundwater will be pumped from the sump to a drop-out pond, which will provide makeup water to the WCP (via the process water pond). As the operational water requirements of the mine are predicted to exceed the volume of water collected onsite from dewatering, rainfall and stormwater runoff, routine offsite discharge is not expected. However, in the event all water storages are at capacity and prolonged heavy rainfall occurs within the pit catchment area, controlled discharge of surplus mine water will occur via cut-off drains and constructed channels, to divert water into an existing paddock drain that flows to the existing roadside drain along Yoongarillup Rd. The discharge of mine water to surface water has the potential to impact on offsite environmental values through changes in water flows and quality. Controls have been included on the licence to mitigate this risk. DWER's assessment and decision making on Point Source Emissions to Surface Water is detailed in Appendix A4.	
Point source emissions to groundwater including monitoring	No conditions	There are no point source emissions to groundwater proposed in the application during mining operations. Discharge of surplus mine water (if required) is proposed via surface drains (See Point Source Emissions to Surface Water).	

DECISION TABLE			
Licence section	**Condition number**	**Justification (including risk description & decision methodology where relevant)**	**Reference documents**
Emissions to land including monitoring	2.3.1	Dried clay tailings will be removed from the SEPs during the dry periods and blended with sand tailings for co-disposal into completed mine voids. Sand tailings produced by the WCP will be returned to completed mine voids as a slurry, or blended with clay fines for co-disposal. Tailings will comprise quartzose sands, minor clay and unrecovered heavy mineral, and trash mineral tailings from secondary processing (Picton tails). The Picton tails will contain monazite, a naturally occurring radioactive material (NORM), and will be blended with mine site tailings to achieve radiation levels at or below pre-mining levels, prior to disposal. (Radiation management is regulated by the Department of Mines, Industry Regulation and Safety). DWER's assessment and decision making on Emissions to Land is detailed in Appendix A5.	
Fugitive emissions	2.4.1	***Dust Emissions Risk*** Amenity (dust) was assessed as a key environmental factor during the EIA[1] due to the potential for impacts on nearby residents, however, based on the advice of DWER that fugitive dust can be regulated, monitored and enforced under Part V of the EP Act, no ministerial conditions were imposed. Due to the proximity of receptors (including Sues Rd) and prevailing easterly/south westerly winds in the area, there is a potential risk of fugitive dust emissions during mining operations impacting on nearby sensitive land uses. Conditions have been imposed on the licence to mitigate this risk. The controls are consistent with commitments made by the applicant with respect to dust management measures, in its response to submissions on the PER[2]. DWER's assessment and decision making on Fugitive Dust is detailed in Appendix A6.	[1]EPA Report 1552 (2015) [2]Yoongarillup Mineral Sands Project Public Environmental Review Response to Environmental Submissions Final Issue (Doral Mineral Sands, 2015)
	2.4.2	***Light Emissions Risk*** <u>Emission Description</u> *Emission:* Light overspill from outdoor lighting, luminance diffusion, reflection from existing surfaces or atmospheric scattering. *Impact:* Nuisance value, affecting amenity of nearby receptors, or potentially creating safety hazards on adjacent roads. A public submission has raised concerns about the potential for light to impact on sleeping patterns of nearby residents. *Controls:* The location and orientation of artificial lighting will be managed in accordance with AS 4282, such as specially designed lighting equipment to minimise the spread of, near to, or above the horizontal, prevention of over-lighting, and ensuring the angle of the main light beam and any observer is < 70°.	

DECISION TABLE			
Licence section	**Condition number**	**Justification (including risk description & decision methodology where relevant)**	**Reference documents**
		Risk Assessment *Consequence*: Minor. *Likelihood:* Unlikely. *Risk Rating:* Moderate. Regulatory Controls A condition has been imposed on the licence to require outdoor lighting to comply with AS 4282. *Consequence*: Minor. *Likelihood:* Unlikely. *Risk Rating:* Moderate.	
Odour	No conditions	Odour is not expected during mining operations, as these activities do not involve the processing of chemicals, wastes or other organic compounds that can generate malodours.	
Noise	2.5.1	Amenity (noise) was assessed as a key environmental factor during the EIA[1] due to the potential for impacts on nearby residents, however, based on the advice of DWER that it will regulate the mine to ensure compliance with the Noise Regulations, no ministerial conditions were imposed. Due to the proximity of receptors (including Sues Rd) and the continuous (24/7) operation of the mine, there is a potential risk of noise emissions during mining operations impacting on nearby noise sensitive premises. Conditions have been imposed on the licence to mitigate this risk. The controls are consistent with commitments made by the applicant with respect to noise management measures in the PER[2], its response to environmental submissions on the PER, and the works approval application. DWER's assessment and decision making on Noise is detailed in Appendix A7.	[1]EPA Report 1552 (2015) [2]Yoongarillup Mineral Sands Project Public Environmental Review Response to Environmental Submissions Final Issue (Doral Mineral Sands, 2015)
Monitoring general	3.1.1 – 3.1.4	Conditions have been applied to the licence 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.	
Monitoring of inputs and outputs	No conditions	Monitoring of inputs and outputs is not required to adequately manage emissions from the Premises during mining operations. No specified conditions relating to the monitoring of inputs and outputs have been added to the licence.	
Process monitoring	3.3.1	Conditions have been included on the licence to require monthly monitoring of the amount and location of tailings returned from the Picton MSP disposed on the Premises (See Emissions to Land section). Reporting of annual production volumes will be included in the Annual Environmental Report (See Information section).	

DECISION TABLE			
Licence section	**Condition number**	**Justification (including risk description & decision methodology where relevant)**	**Reference documents**
Ambient quality monitoring	3.4.1 – 3.4.3	Condition 3.4.1 has been added to the licence to require monitoring in accordance with Tables 3.4.1 – 3.4.3. Table 3.4.1 formalises, and expands on, the existing baseline groundwater monitoring program that has been ongoing since 2012. The table references parts of the extensive groundwater monitoring program[1] approved by the former-Department of Water, specifically the monitoring of groundwater levels and quality in selected existing and new groundwater monitoring bores in the vicinity of SEPs and mine pits (See Emissions to Land section). Table 3.4.2 requires monitoring of TSP and PM_{10} levels at up to 4 locations on the premises boundary during the period October – May in each year during mine construction works (See Fugitive Emissions section). Table 3.4.4 provides for an exemption of compliance with the ambient air quality limits if it can be demonstrated the exceedance was not attributed to mine construction works. Table 3.4.3 requires continuous monitoring of ambient noise levels, consistent with commitments made by the applicant with respect to noise management measures in the PER[2], its response to environmental submissions on the PER, and the works approval/licence application (See Appendix A7 for further assessment).	[1]Groundwater Operating Strategy – Yoongarillup Mineral Sands Project (July 2016)
Improvements	No conditions	The Delegated Officer considers no improvements are required at this stage on the basis that all controls in the licence are considered appropriate and sufficient to mitigate the risk of emissions and discharges expected during mining operations.	
Information	4.1.1 – 4.1.3 4.2.1 – 4.2.3 4.3.1	Conditions relating to minimum record keeping requirements, annual reporting and notification requirements have been included on the licence, and are necessary to demonstrate compliance with the requirements of specified conditions.	
Approval Duration	N/A	Mining tenements M70/458 and M70/459 expire on 25 March 2035. In accordance with DWER Guidance Statement: *Licence Duration* (May 2015), the licence has been aligned with this expiry.	DWER Guidance Statement: *Licence duration* (May 2015)

5 Advertisement and consultation table

Date	Event	Comments received/Notes	How comments were taken into consideration
26/09/2016	Works Approval application advertised in the *West Australian* newspaper	Two public submissions were received. A summary of the issues raised is provided at Appendix B.	DWER's response to the submissions is provided at Appendix B.
	Application referred to City of Busselton	The applicant should develop and implement management plans for dust and odour, noise and light, to ensure the development does not affect adjoining properties or road traffic along Sues Rd.	Management plans for dust, noise and light were submitted with the works approval application. Controls for these aspects have been imposed in the licence, to address the risk of impacts on human health and the environment.
		Groundwater drawdown should not adversely impact adjoining landowners or native vegetation.	Impacts from the groundwater abstraction activity are regulated by DoW under the GOS.
14/11/2016	Application referred to DoW	-	-
02/12/2016	Applicant sent a copy of preliminary drafts	Comments received to clarify SEP design details, logistics of noise monitoring, and clarification of groundwater monitoring analytes (radon, cobalt, radium, thallium)	Clarification provided and changes made to conditions where relevant.
06/12/2016	Applicant sent a copy of finalised drafts	Comments received regarding logistics of noise and dust monitoring.	Minor changes made to wording of relevant conditions.
19/12/2016	Licence application advertised in the *West Australian* newspaper	Nil.	N/A.

6 Risk Assessment

Note: This matrix is taken from the DWER Corporate Policy Statement No. 07 - Operational Risk Management

Table 1: Emissions Risk Matrix

Likelihood	Consequence				
	Insignificant	Minor	Moderate	Major	Severe
Almost Certain	Moderate	High	High	Extreme	Extreme
Likely	Moderate	Moderate	High	High	Extreme
Possible	Low	Moderate	Moderate	High	Extreme
Unlikely	Low	Moderate	Moderate	Moderate	High
Rare	Low	Low	Moderate	Moderate	High

Appendix A

A1 Surface water management

The key aspects of an effective stormwater control strategy at mineral sand mines involve isolation of dirty water sources, collection and containment of stormwater to allow maximum re-use in processing, and minimising the risk of stormwater runoff picking up and transferring sediment from disturbed areas.

Emission Risk Assessment

Emission Description

Emission: Uncontrolled stormwater runoff, contaminated with suspended solids, hydrocarbons or dissolved solids from areas disturbed by construction works and subsequent operational areas.

Impact: Contamination of surface water ecosystems with the potential for water quality exceeding background concentrations and Australian Water Quality Guidelines[1] for physical and chemical stressors.

The Vasse-Wonnerup wetland system is located 14 km downstream of the mine. There are no other surface water systems of significance (e.g. rivers, creeks, etc.) in proximity to the mine.

The watershed between the Vasse and Sabina rivers is located approx. 1.5 km south of the mine, from which the headwaters of two minor ephemeral drainage lines arise and flow down-gradient in a north-westerly direction, through the State Forest and proposed mining area, and onto cleared farming land. These drainage lines have been heavily modified to divert surface water off paddocks towards existing roadside drains, along Sues Rd and Yoongarillup Rd. Downstream flow goes to the Vasse Diversion Drain and out through to Geographe Bay. It does not flow to the Vasse-Wonnerup Wetlands Ramsar site.

Sheet flow or flow within the paddock drains may occur during periods of heavy rainfall. Because of the small volumes, the applicant expects the majority of stormwater flowing to these drains to sit until it evaporates.

Controls: The Licence Holder has proposed the following management measures:

- Runoff from the undisturbed catchment upstream of the mine site will be diverted away from mine pits and other operational areas into existing drainage lines through bunding and local drains; and
- Surface water runoff generated in active pits and non-rehabilitated areas will be collected via sumps within the pits and pumped to the process water dam for use in processing.

Risk Assessment

The likely consequence of contaminated stormwater runoff entering the ephemeral drainage lines would be insignificant off-site impacts at a local scale (Insignificant). The likelihood of this consequence occurring under typical mining operations is Unlikely (unlikely to occur), with a combined risk rating of Low.

Consequence: Insignificant.
Likelihood: Unlikely.
Risk Rating: Low.

Regulatory Controls

Due to the low risk rating, no controls are included on the licence.

[1] *Australian Water Quality Guidelines for Fresh and Marine Waters*, ANZECC/ARMCANZ (2000)

Residual Risk

The residual risk rating is Low.

Consequence: Minor.
Likelihood: Rare.
Risk Rating: Low.

A2 Containment of processing wastes

The clay fines component will be thickened (through addition of a flocculant at the thickener) and pumped to settling dams for solar drying (solar evaporation ponds, SEPs). Excess sand tailings will be pumped directly to mined voids for disposal, or stored in a discrete sand tails SEP until disposal.

Dirty water from the WCP, return water from the SEPs and water reclaimed from the mine pits will be pumped to the drop-out dam, which is engineered to promote sedimentation of particles, prior to overflowing to the process water dam, for reuse as process water.

Slurried materials will be transferred around the mine site using high-density polyethylene pipelines with flanged sections (butt flange welded to the end of the line and bolted to a corresponding flange). As with most mining operations, there is an inherent environmental risk associated with the design and operational practices of transferring slurries under pressure through pipelines.

Emission Risk Assessment

Emission Description

Emission: Clay fines (thickener underflow) from processing, pumped to SEPs for solar drying. Sand tailings from primary screening, pumped from the WCP to mine voids for disposal. Return water from in-pit sumps, pumped back to the drop-out dam for reuse in processing.

Sand tailings and clay fines 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, respectively, slurried with process water to facilitate transfer. Return water and dewatering water predominantly comprise clean water, with the potential to still contain some fines.

A polyacrylamide (PAM)-based flocculant will be used for flocculation purposes. PAM is adsorbed onto the clay slime material and disposed into SEPs to allow entrained water to be reclaimed. Once absorbed it is not released into the water phase and will remain with the slime material for disposal into the mine void.

Impact: Spills or leaks (due to pipeline failure) of sand tailings and/or clay fines can lead to contamination of nearby surface waters through sedimentation, being both an increased concentration of suspended sediments (i.e. turbidity) and an increased accumulation of fine sediments, where they are undesirable.

The deposition of coarse sediment (e.g. sand tailings) into minor waterways, such as creeks and brooks, or wetlands can cause bank erosion and channel instabilities, cause the loss of essential aquatic habitats, increase the weed infestation of creeks, and increase maintenance costs for stormwater assets. The release of fine sediments (e.g. clay fines) and turbid water can adversely affect the health and biodiversity of aquatic life, adversely affect fish numbers and breeding, increase the concentration of nutrients and metals, reduce light penetration into pools, and increase the frequency, cost and damage of de-silting operations.

There are no surface water systems of significance (e.g. rivers, creeks, etc.) in close proximity to the mine. The Licence Holder considers that any spills or leaks of sand tailings and/or clay fines will be localised and contained on the premises.

Controls: The Licence Holder proposes the following controls for all feed, return water and slurry lines:

- All pumps and pipelines will be operated and monitored using the process control Citect system, which has inbuilt low flow/high amp alarms to alert operators of potential issues with pumps and pipe flows;
- All slurry pipes will be laid within bunds designed to direct contents back into open voids, sumps or other on-site containment areas in the event of failure; and
- Where the above is not practical, pipelines will be fully welded and double-skinned, the double-skin terminating where the above is achievable.

Risk Assessment

The likely physical consequence of spills or leaks of sand tailings and/or clay fines 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). The likelihood of this consequence occurring is Possible (could occur at some time), with a combined risk rating of Moderate.

Consequence: Moderate.
Likelihood: Possible.
Risk Rating: Moderate.

Regulatory Controls

A condition (1.3.1) has been added to the licence to formalise the requirement for the installation of industry standard safeguards for all pipelines containing tailings and tails return water, such as the use of automatic cut-outs, secondary containment, or telemetry and pressure sensors to allow detection of leaks and failures. The Licence Holder will also be required to visually inspect pipelines for integrity every 12 hours and to maintain an inspection log with each inspection signed off by the responsible person.

Conditions have been included on the licence to specify the authorised infrastructure on the Premises for the containment of material that would otherwise pose a threat to the environment. The conditions expand into the standard of design and operation to ensure the risk of uncontrolled seepage or spills from containment infrastructure is minimised. A freeboard requirement has been included to prevent overtopping, in addition to 12 hourly inspections of containment infrastructure and pipelines, to enable early detection and proactive management of leaks and integrity issues.

Residual Risk

The likelihood of spills or leaks of sand tailings and/or clay fines, causing off-site impacts is not likely to change with the above regulatory controls imposed through the licence. The residual risk rating is therefore Moderate.

Consequence: Moderate.
Likelihood: Possible.
Risk Rating: Moderate.

Public submission

A public submission was raised during the works approval assessment regarding the possibility of public health and environmental risks associated with the use of polyacrylamide-based flocculants.

Although acrylamide polymers are considered environmentally benign and are widely used as flocculants, monomeric acrylamide, which is used in the manufacture of these polymers, may occur as a contaminant and is toxic, carcinogenic and mutagenic. Soil microbes normally break down this compound within a few hours to days. However recent research indicates that, under some specific conditions, the biodegradation of this material is impeded, for example at pH values of less than 6.

The Delegated Officer has determined to require monitoring of acrylamide monomer levels in groundwater at the site as a precautionary measure.

A3 Acid sulfate soils

Acid sulfate soils (ASS) are naturally occurring soils, sediments and peats that contain iron sulfide minerals, predominantly as the mineral pyrite. These materials are typically found at shallow depth (less than 3 m deep) in low-lying areas near the coast and are benign when undisturbed, but have the potential to cause environmental problems due to the release of sulfuric acid when exposed to oxygen by drainage, dewatering or excavation of soils[2].

The Yoongarillup deposit is located at the southern extent of the Yoganup shorelines, a series of ancient alluvial marine beach placers (strandlines) that have been extensively mined on the southern Swan Coastal Plain. The Superficial aquifer comprises the Bassendean Sand and the Yoganup Formation, which are sandy soils that typically contain trace amounts of pyrite and have poor acid buffering capacity. A combination of highly reactive pyrite and the extremely low pH buffering capacity of these soils make them prone to acidification, even after only short exposure (less than a week) to air during temporary excavation or dewatering.

Mining at Yoongarillup is proposed to extend 20 mbgl, with the majority of pits designed to extend below the current groundwater table. As such, dewatering is required in order for dry mining to occur. Dewatering poses a particularly high risk of triggering the oxidation of pyrite, due to the cone of depression of the water table required to maintain a dry pit extending beyond the margins of the pit excavation footprint.

The Licence Holder has conducted a site investigation[3] to verify whether ASS are present based on soil characteristics. A total of 1,445 soil samples from 72 drill holes were taken across the site, in areas to be directly disturbed by mining, or potentially indirectly disturbed by mining-related groundwater drawdown[4], and to a depth 2 m below the maximum depth of mining. The field pH (pH_F) ranged from pH 4.29 to pH 8.2, and the field pH after oxidation (pH_{FOX}) ranged from pH 1.98 to pH 7.79, with 86 samples (5.9%) having pH_{FOX} <3.0.

The drill holes that returned pH_{FOX} <3.0 were determined to be uniformly concentrated within dark coloured (grey to black) sandy clay materials encountered approximately 1 – 3 m below the maximum depth of mining, in mine blocks 5 & 7. Although these locations will not be directly disturbed by mining, there is some risk they may be indirectly disturbed through dewatering drawdown.

Emission Risk Assessment

Emission Description

Emission: The disturbance of 'actual' ASS (AASS, acidic soils that have previously been oxidised) and/or 'potential' ASS (PASS, soils containing sulfidic materials which have not been exposed to air and oxidised) through the excavation, draining and/or exposure by lowering of the water table, in which the sulfides would react with oxygen to form sulfuric acid.

The site specific assessment[3] identified the following in regard to sources of pyrite oxidation hazard at the site:

- No soil samples contain pH_F <4.0, indicating the absence of AASS, but PASS may still be present;
- Less than 10% of soil samples contain pH_{FOX} <3.0, indicating a low number of samples testing positive for the presence of PASS; and
- Less than 10% of soil samples from below the current water table to the depth of the predicted drawdown contain pH_{FOX} <3.0.

Impact: The physical disturbance of ASS from mining operations can cause significant acidification on oxidation and leach contaminants (i.e. sulfuric acid and soluble metals) at levels of environmental concern into groundwater or surface waterways.

[2] Identification and investigation of acid sulfate soils in acidic landscapes, Department of Environment Regulation (June 2015)

[3] Yoongarillup Deposit ASS Survey (Version C), Soil Water Consultants (2012)

[4] With the exception of the State Forest, as this was not accessible during the investigation.

There are no direct environmental receptors of groundwater down hydraulic gradient within the vicinity of the mine; however several domestic bores are located within several kilometres down gradient.

Groundwater in the Superficial aquifer in the vicinity of the mine is currently acidic (i.e. groundwater has levels of titratable acidity that exceed alkalinity levels) and therefore could contain concentrations of metals and some other inorganic contaminants at levels that exceed relevant water quality criteria to protect sensitive environmental receptors.

Controls:

The Licence Holder has developed a conceptual model for the site, including a description of local hydrogeological conditions, the spatial distribution of sulfide minerals and the presence of environmental receptors. A risk management strategy has been prepared on the basis of the conceptual model, outlined in the Yoongarillup Environmental Acid Sulfate Soils Management Plan (ASSMP)[5].

As the ASS hazard at the site is not considered to be significant, active management of soil is not required during mining activities. However, due to the risk of PASS oxidation in undisturbed soils by dewatering drawdown, the Licence Holder proposes the following management measures:

- Management of dewatering to ensure that unnecessary groundwater drawdown is avoided;
- Management of dewatering effluent to ensure the pH and total acidity values are pH >6.0 and total alkalinity > total acidity;
- Treatment of ore to maintain a stable pH of 6 to assist in processing;
- Addition of lime sand into the pit hopper during the excavation of ore, to increase pH and buffering capacity of the dewatering water;
- Constructing drainage channels around the perimeter of each mine pit to divert groundwater inflows and re-infiltrate the superficial aquifer;
- Monthly monitoring of groundwater levels, both during and after pit dewatering at all locations of the groundwater monitoring network;
- Monthly monitoring of groundwater quality (field and laboratory) of 5 selected bores for PASS parameters (pH, EC, TTA, TAlk, SO_4^{2-}, Cl^-, sodium, dissolved metals (Al, Fe, Mn));
- Development of trigger values on PASS bores, calculated using the mean ± 2 x standard deviation of the background data set;
- Contingency actions in response to exceedances of the trigger values, involving an initial response (establish context of exceedance and subsequent actions) and secondary responses (such as increased monitoring frequency, prepare contingency action plan in consultation with DWER).

Mine pit dewatering will be managed in accordance with the Groundwater Operating Strategy (GOS) under the RIWI Act. The groundwater monitoring program (See A4 Point source emissions to surface water) will be undertaken to detect changes in groundwater quality that could be attributed to dewatering and off-site ASS. Monitoring will provide early indication of adverse effects of ASS on local groundwater, both during operations and during closure.

Risk Assessment

The Delegated Officer has reviewed the site investigation and is satisfied it has been developed using suitable investigation methods, and the risk assessment and management techniques are consistent with the draft DWER guidelines for assessing ASS issues at mineral sands deposits[6]. The low

[5] Yoongarillup Mineral Sands Project – Acid Sulfate Soils Environmental Management Plan – V1, Doral Mineral Sands Pty Ltd (August 2016).

[6] Investigation and management of acid sulfate soil hazards associated with silica and heavy mineral sand mining operations, Department of Environment Regulation, Contaminated Sites Division (Draft, 2012)

number of samples that tested positive for the presence of pyrite suggests that the issue is manageable at the site.

The Delegated Officer therefore considers that the risk of further ASS disturbance by mining activities at the site, leading to acid mine drainage, causing long-term impacts on the environment at a local level (Moderate) is Unlikely, resulting in a combined risk rating of Moderate.

Consequence: Moderate.
Likelihood: Unlikely.
Risk Rating: Moderate.

Regulatory Controls

The Delegated Officer is satisfied the Licence Holder has adequately identified the pyrite content and distribution in sediments across the site, has in place an acceptable dewatering strategy, and a strategy for preventing or minimising acid drainage from both the direct and indirect (i.e. groundwater drawdown from dewatering) disturbance of ASS. In order to formalise the requirement of managing the risk of ASS, the management measures listed in the *Controls* section have been conditioned in the licence.

In addition, conditions have been added to the licence to formalise the requirement for monitoring of groundwater quality in the vicinity of the mine voids and areas identified as being at higher risk of being affected by groundwater drawdown during mine dewatering.

On the basis of the sensitive receptors identified in the ASSMP and the relative mobility of a number of chemical constituents that may be present at elevated concentrations under the geochemical conditions that are likely to be present in treated groundwater, the following parameters have been included in the groundwater quality monitoring suite for the site: cadmium, zinc, selenium, uranium, arsenic, cobalt, chromium, and mercury. Uranium is included as a potential chemical toxicant.

Note: management of Naturally Occurring Radioactive Materials (NORMs) is regulated by the Department of Mines, Industry Regulation and Safety.

Residual Risk

The likelihood of acid mine drainage occurring is not expected to change with the above regulatory controls imposed through the licence. The residual risk rating is therefore Moderate.

Consequence: Moderate.
Likelihood: Unlikely.
Risk Rating: Moderate.

Emissions & Monitoring

A4 Point source emissions to surface water

The projected water balance of the mine indicates the operational water requirements will exceed the volume of water collected from mine dewatering, rainfall and stormwater runoff, and that additional process water will be required from production bores. The possibility for surplus water is therefore likely to be only as a result of direct rainfall.

In the unlikely event that all water storages are at full capacity and prolonged heavy rainfall occurs within the pit catchment area, the applicant proposes to undertake a controlled discharge of water rather than have the process water pond overflow in an uncontrolled manner. Based on the assumption that all storages (i.e. mine voids, process water pond, SEPs and drains) are at capacity and a 1:100 year 72 hour storm event occurs, it is conservatively estimated that up to 228,000 kL of site runoff may require offsite discharge.

A primary discharge point has been nominated that is central to the WCP, to allow overflow from the process water pond into a constructed channel off the premises and into an existing paddock drain on the west of Sues Rd, before reaching an existing roadside drain. A secondary discharge point has been nominated on the eastern flank of the mine for when mining occurs in the area, and there is no capacity in the drop-out pond or process water pond and when it is not possible to gravity feed water to the process water pond. An additional secondary discharge point has also been nominated on the western flank of the mine, and discharge will occur into an existing ephemeral drainage line.

Groundwater abstraction for processing or mine dewatering requirements will be managed in accordance with the Yoongarillup Mineral Sands Project Groundwater Operating Strategy (GOS) (July 2016), regulated under the *Rights in Water and Irrigation Act 1914*. Although the GOS has a focus on monitoring and managing the potential impacts of the groundwater abstraction activity on the local groundwater resource and native vegetation, it also includes the monitoring of any offsite discharges.

Emission Risk Assessment

Emission Description

Emission: The offsite discharge of mine water. Any water that would be discharged off the mine could include a mixture of groundwater, surface inflow, direct rainfall, SEP and sand tails returns and surface water runoff collected from the mine, and has the potential to be turbid in nature (due to the presence of fines).

The volume of water will vary depending on the capacity of the process water pond and return water lines at the time of the rainfall event, and depending on the amount of water to be discharged at that time. Discharge will not occur until specific water quality control criterion set by DWER is met.

Impact: As discussed in previous sections, there are no surface water systems of significance (e.g. rivers, creeks, etc.) in proximity to the mine. The existing paddock drains and roadside drains are highly modified surface water systems that are ephemeral in nature, and contain little to no ecological values that can be potentially impacted from changes in water quality.

The existing roadside drains join the Vasse River approx. 6 km downstream. Once discharged, water will move through ephemeral drainage lines (paddock drains) north of the mine, where water is likely to sit until it evaporates. Paddock drains are separate to major diversion drains in the region, therefore it is unlikely for any water discharged from the mine to reach the Vasse River.

Controls: The mine water circuit has been developed such that only enduring rainfall events will trigger the need for water release from the nominated discharge points.

To manage the potential for impacts on the receiving environment, the Licence Holder will test excess water prior to discharge and adhere to the water quality criteria set by DWER. If excess water does not meet discharge criteria, discharging will cease until measures are implemented to improve water quality.

In addition, diversion drains will be constructed to ensure stormwater does not flow into the mining area and potentially impede the natural surface water flows.

Risk Assessment

Given the highly disturbed nature of the receiving environment, the likely consequence of environmental values being impacted from the offsite discharge of potentially turbid mine water would be minor off-site impacts at a local scale (Minor). The likelihood of this consequence occurring is Unlikely (not expected to occur), with a combined risk rating of Moderate.

Consequence: Minor.
Likelihood: Unlikely.
Risk Rating: Moderate.

Regulatory Controls

Conditions have been imposed on the licence to specify the authorised discharge points for mine water discharges, meaning that any discharge to a location other than the specified sites may not provide a defence against potential offences of causing pollution/environmental harm. Monitoring of ambient surface water quality both upstream and downstream of the discharge point(s) is required during periods of flow and discharge – DWER will review this data annually and introduce discharge criteria (i.e. limits) if determined to be warranted.

Residual Risk

The likelihood of environmental values being impacted from the offsite discharge of potentially turbid mine water is not likely to change with the above regulatory controls imposed through the licence. The residual risk rating is therefore Moderate.

Consequence: Minor.
Likelihood: Unlikely.
Risk Rating: Moderate.

A5 Emissions to land

Apart from the mining overburden, most of the waste arising from the mining and primary processing of mineral sands is in the form of oversize material (rocks, etc.), sand tailings and clay fines. For the Yoongarillup mine, oversize material will be backfilled into mine voids or re-used on internal roads; clay fines will be thickened and pumped to SEPs for solar drying, before being disposed into mine voids; and sand tailings will either be disposed directly back into mine voids or stored in a sand tails SEP until disposal.

During the dry periods, dried clay tails will be removed from the SEPs and placed in-pit with sand tailings. Where possible, co-disposal of tailings will be undertaken during mining whereby the clay tails are disposed with the sand tails into the pit voids to provide a more heterogeous distribution of soil particle sizing and to improve the hydraulic conductivity and permeability of the returned soil profile.

Wastes generated from secondary processing at the Picton Mineral Separation Plant will be returned to the mine site to be mixed with clay fines for burial to the mine void. Wastes from the MSP include: the final tails streams of ilmenite, leucoxene and zircon; oversize (scats); sand tailings; clay fines; and airborne dust collected from the baghouse. The monazite-rich material, a naturally occurring radioactive material (NORM), will be captured in the middlings product stream and stored at the Picton site for export. As such, radionuclide concentrations within the tailings to be returned to the mine site will be kept below 1 Bq/g. Regulation of NORM is the responsibility of the Department of Mines and Petroleum.

Emission Risk Assessment

Emission Description

Emission: Process tailings and unrecovered heavy mineral. Waste tailings from secondary processing at the Picton MSP will be added to the tailings stream, which may contain low level NORMs (below the range 140 – 180 ppm Th and U).

Waste tailings comprise the coarse-grained (typically quartz sand) and fine-grained (typically silt-sized clay material) solid material remaining after the HMC has been separated from the mined ore, respectively, slurried with process water to facilitate transfer. The approximate total amount of sand and clay tailings from the mine is 1,190,000 bank cubic meters (BCM), which will all be reburied in the mine voids yielded during the life of mine.

Impact: The primary environmental impacts from disposal relates to the potential for changes to groundwater levels outside the pit, through mounding of groundwater below and adjacent to the pit, altering flow gradients and directions; changes to aquifer characteristics through altering aquifer permeability and flow patterns; and changes to groundwater chemistry from seepage, potentially impacting on other groundwater users.

The SEPs are designed to allow seepage flow through the tailings; tailings water quality will be generally different to the ambient groundwater quality. If the tailings water quality is worse than ambient, seepage can deteriorate the groundwater quality of aquifers around the pit.

Controls: The method for pit backfilling the land to be rehabilitated back to pre-mining land use includes:

- Hydraulically returning sand tails/co-disposed tailings into previously mined voids to within 1 m of the final rehabilitation surface;
- Final backfilling with solar dried clay fines and clayey overburden, removed from advancing pit development, to within 1 m of the final surface;
- The void is then capped with sub-soil and topsoil.

Groundwater monitoring will be carried out in bores located both up- and down-hydraulic gradient of the mine voids, to detect and manage potential impacts from changes in groundwater levels and groundwater quality. Internal monitoring triggers will be defined for each monitoring site (based on drawdown and mounding thresholds), and are designed to indicate substantial deviation from expected or predicted impacts or to provide an early warning of an impact that hasn't been predicted.

The monitoring data will be used to update the groundwater model and re-forecast predicted impacts, and will provide an early warning system in order for the applicant to undertake investigations and, if necessary, to execute management interventions to prevent unacceptable impacts.

Risk Assessment

The likely consequence of groundwater impacts from tailings seepage would constitute a potential or actual alteration of the environment, with off-site impacts at a local level (Moderate). The likelihood of this consequence occurring is Possible (could occur at some time), with a combined risk rating of Moderate.

Consequence: Moderate.
Likelihood: Possible.
Risk Rating: Moderate.

Regulatory Controls

Conditions have been included on the licence to specify the authorised mine voids for ongoing disposal of tailings. Ambient groundwater monitoring conditions have been included on the licence, to

measure the operational performance of the tailings disposal activity, and to enable early detection and proactive management in accordance with the GOS.

Residual Risk

The likelihood of groundwater impacts from tailings seepage will remain unchanged with the above regulatory controls applied. The residual risk rating is therefore Moderate.

Consequence: Moderate.
Likelihood: Possible.
Risk Rating: Moderate.

A6 Fugitive emissions (dust)

Dust generated from mining operations has the potential to impact on the health, welfare and amenity of local residents and users of Sues Rd, impact on the health of animals and deposit on surrounding native vegetation.

Sources 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 tracks; and the crushing, screening, loading and transportation of ore.

Emission Risk Assessment

Emission Description

Emission: Dust, or total suspended particulate matter (TSP) is comprised of coarse particulate matter (CPM), which is generally comprised of particles greater than 10 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 development and operation of mineral sands mines is CPM, being comprised of unprocessed mineral oxide particles.

Impact: Dust emissions can be harmful to human health and the environment. The type and size of a dust particle determines how harmful the dust is. The possible harm is mostly determined by the amount of dust in the air and length of exposure. Dust particles small enough to be inhaled (PM_{10} or $PM_{2.5}$) may cause irritation of the eyes, coughing, sneezing, and asthma attacks. Dust in the form of CPM can cause nuisance and affect aesthetic values.

The South West region experiences a mild Mediterranean climate with hot/dry summers and mild/wet winters. The prevailing winds are from the east in the mornings, and south/south-west in the afternoons. In the winter months, strong westerly and north-westerly winds are prevalent.

There are 26 farm houses located within 2.2 km of the premises boundary. Four are located on the premises boundary, within 600 m of the proposed mine voids, and are considered to be the most susceptible to dust impacts. In addition Sues Rd, being a primary distributor[7] road, runs through the premises and is considered a sensitive land use.

A public submission on the works approval application advised the local area is subject to excessive winds throughout times of the year, and that some residents in close proximity already suffer from asthma and hay fever and that dust from the mine may exacerbate this. In addition, concerns were raised about the potential for dust to impact on local amenity (hanging out washing, entertaining outdoors, etc.), and concerns about the response time of the applicant to resolve excessive dust when receptor is being/has already been impacted. Issues raised during the works approval assessment and DWER's response are included in Appendix B.

[7] Road hierarchy for Western Australia, Main Roads Western Australia

Controls: In addition to the standard use of water carts for dust suppression, the Licence Holder will manage dust through a number of mechanisms including:

- Covering stockpiles, noise bunds and pond embankments with fine clay solution or water bound polymer-based dust suppressants;
- Minimising the number and size of stockpiles;
- Maintaining HMC stockpiles between 5 – 9 % moisture content;
- Use of full height shade cloth attached to fencing that separates mining operations from the State Forest to the south, to prevent dust impacts from the mine affecting State Forest native vegetation.

Monitoring of ambient air quality will be ongoing over the life of mine, to validate the performance of the dust control measures. Monitoring for TSP will be undertaken monthly from September to March, at up to four locations around the mine. Monitoring for PM_{10} at two locations, alternating at either end of the operation and relative to the operation and meterological conditions at the time, will be conducted on a monthly basis during the summer months. PM_{10} dust monitoring will be undertaken continuously over the 24 hours period in real time, and alarm triggers will be integrated into the system to warn operators of possible exceedances.

Risk Assessment

During morning easterly winds throughout most of the year, the two closest receptors on the western boundary are considered to be the most susceptible to impacts from fugitive dust whilst mining activities are occurring in the mine blocks west of Sues Rd (i.e. mine blocks 14 – 25). The State Forest, which is situated between the mine and these residences, will provide some protection from the impacts of fugitive dust.

During the afternoon prevailing westerly winds throughout the summer months, the closest receptors to the north-east of the mine are considered to be the most susceptible to impacts from fugitive dust whilst mining activities are occurring in the mine blocks east of Sues Rd (i.e. mine blocks 2, 4 – 11).

The risk assessment of fugitive dust can be broken into the impacts of TSP and PM_{10} emissions, and relevant operational scenarios (normal/abnormal operating conditions).

- TSP emissions (normal operating conditions)

  The consequence of TSP impacting on sensitive receptors located off-site or on Sues Rd would be of nuisance value (minor reversible impacts), causing local concern and complaints (Minor). The likelihood of this consequence occurring during mining operations under normal operating conditions is Possible, with a combined risk rating of Moderate.

  Consequence: Minor.
  Likelihood: Possible.
  Risk Rating: Moderate.

- TSP emissions (abnormal operating conditions)

  The likelihood of this consequence occurring under abnormal operating conditions (e.g. strong summer winds) is Likely (will probably occur), with a combined risk rating of Moderate.

  Consequence: Minor.
  Likelihood: Likely.
  Risk Rating: Moderate.

- PM_{10} emissions (normal operating conditions)

  The consequence of PM_{10} emissions impacting on sensitive receptors located both off-site or on Sues Rd would be exposure to a hazard with short-term adverse health effects (requiring treatment) and impact to amenity for short periods (Moderate). The likelihood of this consequence occurring during mining operations under normal operating conditions is Unlikely, with a combined risk rating of Moderate.

Consequence: Moderate.
Likelihood: Unlikely.
Risk Rating: Moderate.

- PM_{10} emissions (abnormal operating conditions)

  The likelihood of this consequence occurring under abnormal operating conditions (e.g. strong summer winds) is Possible (could occur), with a combined risk rating of Moderate.

  Consequence: Moderate.
  Likelihood: Possible.
  Risk Rating: Moderate.

Regulatory Controls

Amenity (dust) was identified as a key environmental factor by the EPA in its assessment[8] of the proposal. Ministerial conditions have not been set in Statement 1030 on advice from DWER that dust emissions can be regulated, monitored and enforced under Part V Division 3 of the EP Act.

A high level of regulatory control is required through the licence as there are a number of receptors (residences) within 1 km of the proposed mine pits, and there is the potential for the receptors to be impacted during strong easterly and south-westerly wind conditions.

Conditions have been included on the licence to formalise dust mitigation measures listed in the Yoongarillup Environmental Dust Management Plan (August 2016), including the continuous monitoring of TSP and PM_{10} emissions during the summer months.

Given the proximity to sensitive receptors (including Sues Rd), ambient air quality criteria (i.e. limits) have been deemed necessary for the protection of human health and to provide assurance over the effectiveness of dust management at the site during mining operations. As such, limits for TSP (nuisance value) and PM_{10} (human health) have been imposed at the north-east and north-west corners of the premises, as these are considered to be the appropriate locations for representing the level of impact to receptors from mining operations during the prevailing seasonal winds.

The limit for TSP has been determined using reference to the Kwinana EPP[9], which is considered by DWER to be an equivalent standard for ambient air quality at all sand mining and related operations where an environmental standard does not exist for the subject area. Given the location and distance to receptors, the Area B standard (260 µg/m^3, 24-hour average) is considered the most relevant.

The limit for PM_{10} has been determined using reference to the Air NEPM[10] for particles as PM_{10} (50 µg/m^3, 24 hour average). Although DWER does not consider the Air NEPM to be an appropriate regulatory standard, it is considered to be an equivalent standard in the absence of an environmental standard for the subject area.

The provision for an exceedance of the specified limits has also been included on the licence, in the event of an exceedance an appropriate investigation is undertaken and proof can be provided to demonstrate the exceedance is not attributed to operations on the premises.

Residual Risk

With the above regulatory controls imposed through the licence, the residual risk rating of TSP and PM_{10} emissions impacting on sensitive receptors or on Sues Rd under all operating conditions is Moderate.

- TSP emissions (normal operating conditions)

  Consequence: Minor.
  Likelihood: Unlikely.
  Risk Rating: Moderate.

[8] EPA Report 1552 (July 2015)

[9] *Kwinana Environmental Protection (Kwinana)(Atmospheric Wastes) Policy 1999*

[10] National Environment Protection (Ambient Air Quality) Measure, National Environment Protection Council (1998)

- TSP emissions (abnormal operating conditions)

  Consequence: Minor.
  Likelihood: Possible.
  Risk Rating: Moderate.

- PM_{10} emissions (normal operating conditions)

  Consequence: Moderate.
  Likelihood: Unlikely.
  Risk Rating: Moderate.

- PM_{10} emissions (abnormal operating conditions)

  Consequence: Moderate.
  Likelihood: Possible.
  Risk Rating: Moderate.

A7 Noise emissions

Noise emissions from mining operations have the potential to impact on nearby residents, affecting their health by increasing stress levels and decreasing their amenity.

During operations, noise will be generated from the operation of mobile equipment and fixed plant for mining and processing activities. The works approval assessment is based on mining, screening and processing of ore occurring continuously (24 hours per day); however at this stage the Licence Holder does not intend on conducting operations outside of normal day time working hours (7:00am – 7:00pm, Monday to Saturday).

The Licence Holder has modelled the noise impact of the proposed operations using SoundPlan, which the Delegated Officer accepts as a suitable model. The selection of input data and assumptions made have been reviewed and accepted as presenting reliable conclusions on the predicted noise levels and compliance with the assigned levels at noise sensitive receptors under all likely scenarios.

Emission Risk Assessment

Emission Description

Emission: Noise from mining equipment (fixed and mobile), processing and transport activities. The main source of noise will be mobile equipment (scrapers, dozers, front-end loaders, trucks, etc.). Mining and ore processing is proposed 24 hours per day, seven days per week.

The NIA indicates that noise compliance during some operational scenarios will be marginal. The Licence Holder has proposed several control measures to address the potential for noise non-compliance (listed in *Controls* section).

Impact: Noise emissions 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 population 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.

The closest receptor on the western boundary of the premises is considered to be the most susceptible to noise impacts, with the Noise Impact Assessment predicting the potential for noise non-compliance at this receptor during native vegetation clearing works in mine blocks 24 & 25 (scenario 3a) and easterly wind conditions.

A public submission on the works approval application has expressed concerns about the noise impacts of the mine, based on opinion the mine is too close to receptors, and that the noise modelling is flawed and should not be relied upon. All issues raised were considered by the Delegated Officer (see Appendix B1).

Controls: In addition to the standard mine site noise mitigation measures (e.g. silencers on exhaust systems, broadband reversing alarms, restriction of nosiest machinery in worst case wind conditions, preventative maintenance schedules, employee education, etc.), the Licence Holder has committed to the following noise control measures during mining operations, as listed in the ENMP:

- Establishing amenity agreements with adjacent landowners;
- Conducting real-time monitoring of noise emissions of the system established under the works approval;
- Implementing the recommendations of the Noise Impact Assessment:
  - 6.5 m high noise bund is in place along the western edge of mine block 25;
  - 5.5 m high noise bunds are in place along the north and eastern edges of mine block 2;
  - Topsoil stockpiles are located on the outside of pits to act as noise bunds and range in height from 2.5 to 4 m;
  - Overburden removal only occurs during day time (Mon-Sat) and overburden fleet and ore fleet do not operate simultaneously in the same pit at any one time;
  - Cat 980H front end loaders (Lw 102.8 dB(A)) or better (quieter) will be used;
  - One silenced 8" diesel dewatering pump operates at one pit at any one time;
  - The mining unit will be located within the mining pit, below the natural ground level;
  - The water cart only operates when required;
  - Construction of additional 3 m noise bunds within the paddock areas west of Sues Rd;
  - A 2 m noise bund adjacent to the pit dewatering pump;
  - Increased height of the wall of SEP06 from 3 m to 6 m;
  - Increased height of the wall of SEP08 from 3 m to 5 m; and
  - Temporary noise bunds 2.5 m high within pits 7 & 8;
- Review weather conditions and plan alternative operations/ cease operations when NE, E and SE winds occur (i.e. whenever the wind is blowing towards the closest receptors on the western boundary;
- Relocate equipment if noise monitoring indicates exceedances of the assigned noise levels, and shut down operations if this fails to bring noise levels back into compliance;
- Utilise supplementary feeder at the feed preparation plant to continue production without the operating mining unit;
- From a line south down the eastern boundary of mining blocks 20 and 21 and south through mining block 24, will be operated during day time hours only (7 am – 7 pm); and
- Prior to clearing taking place, formal discussions will be undertaken with the western residents to develop a plan for mitigating potential amenity impacts during the period of clearing.

The Delegated Officer notes the sound power level quoted for the Cat 980H front end loader in the September 2016 NIA of 102.3 dB(A) is substantially lower than manufacturer's specification of 108 dB(A) and the sound power level quoted for the same equipment in the assessment submitted with the PER (April 2015), of 109.9 dB(A). The consultant for the applicant advised that 108 dB(A) is the noise limit for this type of equipment under the EU standard[11], however the actual sound power level should be much lower. The Delegated Officer notes the standard sound power level of this machine is 112 – 113 dB(A)[12], and even with an optional low sound attachment (reducing to 107 – 109 dB(A), the quoted sound power level may be too low.

[11] EU Directive 2005/88/EC

[12] 980H Wheel Loader Specifications –Caterpillar (2014)

Risk Assessment

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 mineral sands mining, 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/ consistent throughout the life of mine as the mine path progresses.

During day time operations, noise emissions from the mine are predicted to comply with the assigned levels at nearby noise sensitive receptors under most operational scenarios and worst case weather conditions with the abovementioned controls in place. As discussed above, the only noise non-compliance is predicted at the closest receptor on the western boundary of the mine during the removal and relocation of native vegetation and topsoil in mine blocks 24 & 25 using a bulldozer, excavator and trucks. The Licence Holder has also modelled the same scenario using quieter equipment (i.e. carry graders), which predicts marginal compliance at the closest receptor. The Delegated Officer notes this mining scenario is expected to occur over a maximum two week period, and the Licence Holder has committed to undertaking formal discussions with the closest receptor about mitigating amenity impacts during this short period.

Should the Licence Holder commence night time operations, noise emissions from the mine are predicted to comply with the assigned levels at nearby noise sensitive receptors under all operational scenarios and worst case weather conditions with the above mentioned controls in place. However, the Delegated Officer notes the existing background noise levels are low, being a rural agricultural area, and that any significant increase in noise emissions from background levels (even if deemed to be compliant with the Noise Regulations) may impact on the amenity of local residences, particularly where it disturbs sleep at night.

The consequence of noise emissions exceeding the assigned noise levels at noise sensitive premises during mining operations, at any one time, could potentially result in a significant impact on amenity, causing concern and complaints (Moderate). The likelihood of this consequence occurring under worst case conditions is therefore Possible (could occur), with a combined risk rating of Medium.

Consequence: Moderate.
Likelihood: Possible.
Risk Rating: Medium.

Regulatory Controls

Operational noise was identified as a key environmental factor by the EPA in its assessment of the proposal[13], however ministerial conditions were not imposed in Statement 1030 on advice from DWER that noise emissions can be regulated, monitored and enforced under Division 3, Part V of the EP Act.

In consideration of the above, the Delegated Officer has determined that controls are required on the licence in order to protect the amenity of nearby residents from noise impacts associated with the mining operation, including:

- Ensuring that mining operations comply with the prescribed standard for noise emissions, as set out in Regulation 7 of the Noise Regulations, at all times;
- Ensuring proactive management of noise emissions in high risk operational scenarios, i.e. operations are adjusted to avoid noise non-compliance situations; and
- Formalising commitments made by the applicant in the PER and works approval application.

Conditions have therefore been added to the licence to formalise noise mitigation measures listed in the ENMP, including the continuous monitoring of noise emissions on the boundary, at locations representative of the closest receptors.

[13] EPA Report 1552 (July 2015)

Noise monitoring

Under the works approval, two noise monitoring locations were established – in the vicinity of the north-west boundary of the Premises, in a location readily accessible to the Licence Holder and representative of the noise levels received at the closest noise sensitive premises to the west of the mine, and in the vicinity of the north-east boundary of the Premises, in a location readily accessible to the Licence Holder that can be used to predict the noise levels being received at the closest noise sensitive premises to the north/east of the mine.

As the receptors on the western boundary of the mine are considered to be at the highest risk (of impact), the monitoring location on the western boundary (AN1) includes a trailer-mounted noise monitoring system to supply continuous real-time data to the mine site, to allow real-time monitoring of noise emissions at this location. Parameters to be measured at this location have been stipulated in the licence as the $L_{AS\ 90,\ 30min}$, $L_{AS10,\ 30min}$ and $L_{Aeq(20Hz\text{-}500Hz),\ 30min}$.

The $L_{AS\ 90,\ 30min}$ measure was selected as it allows for monitoring of (internal) target levels over a shorter period of time, i.e. 30 minutes. The Delegated Officer encourages the Licence Holder to establish internal target levels that would trigger management actions, rather than allowing noise levels to result in straight-forward non-compliance with the Noise Regulations at the receptor. The noise monitoring equipment being used by the Licence Holder can be setup to record and display the $L_{AS\ 90}$ over 30 minute levels, which the Delegated Officer considers will allow for a faster response to a potential noise non-compliance (if internal target levels are exceeded). To achieve a similar result with the $L_{AS\ 10}$ over 4 hours criterion would require the full 4 hour period to pass before a level can be determined. In addition, the $L_{AS\ 10}$ parameter over 4 hours will be far more susceptible to more intermittent extraneous noises (e.g. bird twirts, vehicles passing by, etc.) resulting in false triggers and longer analysis process.

As noise from mining operations will vary significantly over time, the $L_{Aeq(20Hz\text{-}500Hz),\ 30min}$ measure was selected to provide the A-weighted equivalent continuous sound pressure level over 30 minutes within the one-third octave frequency bands in the range of 20 Hz to 500 Hz. These frequencies are considered to be the most prominent (and likely the most annoying) for the plant to be used on the mine, and this will assist in establishing if the mine is the dominant noise source.

Residual Risk

Even with the above noise controls in place, the likelihood of noise during mining operations causing concern and complaints to nearby residents remains Possible (could occur at some time), and the residual risk rating is Moderate. The Delegated Officer notes this risk can be further minimised if supported by amenity agreements.

Consequence: Moderate.
Likelihood: Possible.
Risk Rating: Moderate.

Appendix B

B1 Summary of public submission 1

Comment	DWER Response
The submitter has raised concerns about the acceptability of the proposal, given: - The two closest receptors are well within the minimum separation distance recommended in EPA Guidance Statement No.3; and - The Noise Impact Assessment predicts noise non-compliance at the two closest receptors during 3 of the 6 modelled scenarios.	- EPA Guidance Statement No.3 provides general guidance on separation distances and also provides for site-specific assessment of emissions within separation distances. In this instance, site-specific assessment of noise emissions from the mine predicts that operations will comply with the Noise Regulations, if the proposed controls are adopted. - The Noise Impact Assessment predicts compliance with the Noise Regulations (albeit borderline in some scenarios) for all mining scenarios, if the proposed controls are adopted. Scenario 1 pertains to mine construction works, which are exempted from the Noise Regulations. Scenario 3 has been updated (3a) to predict marginal day time compliance following the installation of a 6.5 m noise bund, and if operations cease during easterly wind conditions. Scenario 4 predicts marginal night time compliance with the 6.5 m noise bund in place.
The submitter has raised concerns about the following aspects of the proposal in terms of noise: - The annoyance factor of the mine in terms of background noise in a quiet rural area; - The reliability/accuracy of the noise assessment, given it uses a generic computer model with data supplied by Doral, and does not appear to consider the site specific environment of the local area; - The effectiveness of empty sea containers for noise bunding; - Noise and light impacts from machinery and lighting with respect to the pumps on the solar evaporation ponds; - Checks and balances on the proposed complaints management process; and - Being impacted during the period after a non-compliance is identified and measures are taken to bring noise back into compliance.	- The Noise Regulations take the factor of background noise levels into consideration (known as an influencing factor). The Delegated Officer acknowledges that noise impacts on amenity may still exist in areas with very low levels of background noise, even if the assigned levels are being met. One of the EPA's objectives in EPA Guidance Statement No. 13 is that industries are to ensure that impacts are reduced as low as reasonably practicable. In the case of this proposal, it may be accepted that it is not reasonably practicable for the applicant to reduce its noise emissions to a level significantly below the assigned noise levels at the closest receptors, due to the nature and scale of the operation and the short separation distance. - The Delegated Officer has examined the reliability of the noise modelling. SoundPlan 7.4 with CONCAVE algorithm is a widely used and accepted computer software package for modelling environmental noise. The Delegated Officer considers the inputs of the modelling, such as topographical information, meteorological data, the major equipment items and their sound power levels, and the operational scenarios, are all site-specific to this application. - The Delegated Officer considers that sea containers can provide very high noise attenuation, regardless of if they are empty or not. Sea containers have been widely used as temporary noise barriers in many applications (e.g. the 'Big Day Out' music festival). - The applicant has advised there will be no lights or night-time operations on the

	solar evaporation ponds. - DWER is the regulatory agency that will deal with noise complaints. A condition of licence will require an effective complaints management system. - The impact period will depend on how quickly the potential noise non-compliance event can be detected and how quickly the remedial actions can be taken. Controls will be imposed on the licence to require noise monitoring with real-time data transmission at the furthest extent of the operations and relative to the nearest residents, which should allow the applicant to avoid noise non-compliance situations.
The submitter has raised concerns about the following aspects of the proposal in terms of water: - The reliability of predicted impacts on the local groundwater resource as the data used is from 1936 reports and rainfall is much less now; - Impacts on the local groundwater resource in terms of quality and quantity due to the water requirements of the mine.	These matters will be regulated by DWER under the RIWI Act.
The submitter has raised concerns about the following aspects of the proposal in terms of dust: - The closest receptors are the most susceptible to dust impacts including dust accumulation on roofs, contamination of rainwater supplies, the ability to hang out washing, outdoor entertaining, etc.; - Construction occurring during summer, i.e. the driest possible months; - The downtime between Doral identifying high dust levels and action being taken; and - Health impacts on the closest receptors, whom already suffer from asthma and hay fever.	- The Delegated Officer has determined the risk of impacts from fugitive dust on nearby receptors requires a high level of regulatory control. The controls are consistent with commitments made by the applicant in the PER, which are considered by the Delegated Officer to be appropriate, and if adopted, should prevent impact on amenity such as those listed in the submission. - The risk of impacts from fugitive dust has been assessed under worst case weather conditions, i.e. dry and windy conditions. The applicant will be required to conduct regular monitoring of environmental performance, and demonstrate compliance with air quality criteria. - The impact period will depend on how quickly the high dust level event can be detected and how quickly the remedial actions can be taken. Controls will be imposed on the licence to require noise monitoring with real-time data transmission at the furthest extent of the operations and relative to the nearest residents, which should allow the applicant to avoid noise non-compliance situations. - Controls imposed on the licence target both human health and nuisance dust levels.

The submitter has raised concerns about the following aspects of the proposal in terms of other matters: - Impact of lighting on sleeping patterns; - Impacts on the structural integrity of the closest dwellings from vibration; - Damage to resident's gardens/crops/trees from wildlife escaping the State Forest; - Decrease in property values; - Increased risk of dieback in the State Forest; - Risk of disturbing acid sulfate soils; - The life of mine being extended further beyond the current 3 year timeframe; - Road safety on Sues Rd; and - Emergency exits due to the closure of Goulden Rd (west).	- A control will be imposed on the licence to require outdoor lighting to comply with AS 4282 – *Control of the obtrusive effects of outdoor lighting*. - DWER has no regulatory role with respect to structural integrity of dwellings, damage to vegetation from native animals or property values. - Under MS 1030, the applicant is required to prepare a forest management plan for clearing/mining in the State Forest. The plan, which includes management of dieback, is to be prepared in consultation with the Department of Parks and Wildlife, and must be approved prior to ground disturbing activities. - Based on the information provided in the ASS management plan, the Delegated Officer had determined the risk of ASS disturbance by mining activities at the site is low (Refer to Appendix A4 – Acid Sulfate Soils). - MS 1030 does not permit the applicant to exceed the authorised extent of the proposal as defined in the application. The applicant advises there are no plans at this stage to extend the life of mine beyond the current projected life of 3 years. - The applicant has submitted a Traffic Management Plan to Main Roads WA regarding the realignment of Sues Rd. - The applicant has submitted a Traffic Management Plan to the City of Busselton regarding Goulden Rd west. The applicant advises it is committed to assisting neighbours by escorting them through the mine site, if required in the event of an emergency.

B2 Summary of public submission 2

Comment	DWER Response
The submitter has raised concerns on the use of polyacrylamide-based flocculants, including: - There is scientific literature that indicates acrylamide can disseminate into surface and/or groundwater from the use of polyacrylamide flocculants in mineral processing; - The composition of the material to be left on-site should be properly ascertained, disclosed and subject to human health and environmental risk assessment to confirm the site will not be a source of harm or classified as a contaminated site that could potentially subject the site to land use restrictions; and - Acrylamide should be included on the groundwater monitoring suite.	- As a precautionary measure a condition will be imposed in the works approval requiring quarterly monitoring of acrylamide in groundwater. - The issue will also be addressed in the operating licence.