Government of Western Australia
Department of Environment Regulation

Decision Document

Environmental Protection Act 1986, Part V

Licensee: Iluka Resources Limited

Licence: L5646/1994/10

Registered office: Level 23, 140 St Georges Terrace
PERTH WA 6000

ACN: 008 675 018

Premises address: Eneabba Mineral Sands Mine
Brand Hwy
ENEABBA WA 6518
Being part of tenements AM70/2667 and M70/879

Issue date: Thursday, 26 March 2015

Commencement date: Wednesday, 1 April 2015

Expiry date: Thursday, 30 January 2031

Decision

Based on the assessment detailed in this document the Department of Environment Regulation (DER), has decided to issue an amended licence. DER considers that in reaching this decision, it has taken into account all relevant considerations and that the amended 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 DER has assessed and determined the application and provides a record of DER's decision-making process and how relevant factors have been taken into account. Stakeholders should note that this document is limited to DER'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 proponent's responsibility to ensure they have all relevant approvals for their Premises.

2 Administrative summary

Administrative details		
Application type	Works Approval ☐ New Licence ☐ Licence amendment ☒ Works Approval amendment ☐	
Activities that cause the premises to become prescribed premises	**Category number(s)**	**Assessed design capacity**
	8: Mineral sands mining or processing	18,600,000 tonnes per annual period
	63: Class I inert landfill site	5,000 tonnes per annual period
Application verified Application fee paid	Date: N/A Date: N/A	
Works Approval has been complied with Compliance Certificate received	Yes☐ No☐ N/A☒ Yes☐ No☐ N/A☒	
Commercial-in-confidence claim	Yes☐ No☒	
Commercial-in-confidence claim outcome		
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: Managed under Part V ☐ Assessed under Part IV ☐
Is the proposal subject to Ministerial Conditions?	Yes☐ No☒	Ministerial statement No: EPA Report No:
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 assessment sets out DER's decision making in relation to an amendment to Licence L5646/1994/10, issued to Iluka Resources Ltd (Iluka) for the Eneabba Mineral Sands Mine (Eneabba). The amendment relates to a proposal to dispose monazite material with acid sulfate soils (ASS) characteristics from the Narngulu Mineral Separation Plant (NSMP) at the site, and incorporates an environmental review of the on-site acitvities and update to the current licence format.

Eneabba is a large scale, low grade heavy mineral sands mine located on the northern Swan Coastal Plain, approximately 280 km north of Perth. It is predominantly located on ecologically fragile Crown land in an area characterised by low rainfall and sandy soils. The Newman Concentrator is located adjacent to the Eneabba town site (population 118), with several rural receptors within proximity to the tenement boundary which is spread across 22,000 ha. The mining operation is subject to the *Mineral Sands (Eneabba) Agreement Act 1975*, which was ratified to promote the development of the heavy mineral sands industry in the Mid West region.

Mining operations are delineated as the North Mine and South Mine, and are currently in an idle condition, with all production activity at the North mine ceasing in March 2013. Ore remains to be mined in the area given the right economic conditions. Approvals are currently being sought to develop and mine a new deposit, IPL North, which is located immediately east and south of the Eneabba town site; however the recommencement of mining is ultimately dependent on favourable market conditions.

The Part V licence for the site remains valid and this is the first formal review following the cessation of production. As such, conditions have been included to regulate current on-site activities, which consist of: rehabilitation works, maintenance, environmental monitoring and the disposal of monazite material from the NMSP at the Eneabba Monazite Disposal Pit (EMDP).

During 2015, the NMSP began processing non-magnetic heavy mineral concentrate (HMC) originating from ore mined at the Tutunup South mine, located near Busselton. This ore has been shown to have an elevated net acidity exceeding DER management criteria[1], hence the material has been classified as Potential ASS (PASS). At present there is approximately 2,000 tonnes of monazite PASS being stored at the NMSP, pending approval for disposal at the EMDP, with the potential for a further 3,000 tonnes to be produced over the next 6 months. Iluka proposes to manage this material via disposal and lime treatment in the EMDP.

DER has assessed this proposal and determined it to be more favourable to have the monazite buried in a clearly identified location rather than being spread and diluted over an area. This however, has the potential to create a number of hazards that need to be managed, including leaching and exposure of radon emissions. The proposed management of this material is considered acceptable on the provision the risk of impacts to groundwater is minimised and the risk of post-disposal disturbance is minimised.

Should mining and processing recommence, the primary emissions and discharges of concern include fugitive dust from continuous (24/7) operations, the disposal of concentrated monazite from the NMSP (containing naturally occurring radioactive material) in the EMDP, and to a lesser extent, noise emissions. All these emissions are managed in accordance with management plans, with noise and dust continuously monitored with real-time monitoring. A robust groundwater monitoring program is in place to monitor for changes in groundwater levels (mounding) from historical mine voids and previously contaminated areas. Environmental radiation surveys are conducted to measure radioactivity levels in groundwater and ambient dust from an occupational exposure perspective; however additional conditions have been added to the licence to expand this to include environmental receptors and pathways that may lead to public exposure. Minimal complaints have been recorded as a result of mining operations during Iluka's tenure at this site.

[1] *Treatment and Management of Soils and Water in Acid Sulfate Soil Landscapes*, Department of Environment Regulation (2015).

4 Decision table

All applications are assessed in line with the *Environmental Protection Act 1986*, the *Environmental Protection Regulations 1987* and DER'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**
General conditions	No conditions	**Operation** Emission Description *Emission:* Contamination of stormwater with hydrocarbons, dissolved and suspended solids from operational areas. *Impact:* The discharge of contaminated stormwater into the environment can result in a reduction of fresh groundwater quality and surface water quality. *Controls:* Hydrocarbons stored on-site for maintenance are stored and bunded in accordance with AS1940. The maintenance area contains a containment apron, the washdown bay has a drive-in sump and oil-water separator. Any stormwater falling within operational areas is expected to quickly infiltrate due to the predominantly sandy nature of the surface soils and their corresponding high infiltration rates. Risk Assessment *Consequence*: Minor. *Likelihood:* Rare. *Risk Rating:* Low. Regulatory Controls No conditions required on the licence. The risk of stormwater runoff from operational areas is low to nil. Stormwater falling within operational areas will be contained within the operational area, and given the porous nature of the soil, will likely immediately infiltrate. Residual Risk *Consequence:* Minor. *Likelihood:* Rare. *Risk Rating:* Low.	
Premises operation	L1.2.1 – L1.2.3	**Operation** Emission Description	

DECISION TABLE			
Licence section	**Condition number**	**Justification (including risk description & decision methodology where relevant)**	**Reference documents**
		Emission: Uncontrolled releases of clay fines, sand tailings and process water. Clay fines and sand tailings are the fine-grained solid materials remaining once the valuable heavy minerals have been removed from the HMC. Clay fines are typically silt-sized, in the range from 0.001 to 0.06 mm; whilst sand tailings typically comprise the non-valuable quartz beach sands. Some process waters, particularly tails return water, can become turbid if containing a high percentage of these fine-grained materials. Leachate contaminated with hydrocarbons from bioremediation of soils. *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. During extreme rainfall events, there is risk of uncontrolled discharge from overflow of sand and clay/slimes tails into the Arrowsmith River and Eneabba Creek. Seepage into groundwater will occur due to the unlined nature of the mine voids. *Controls:* The conventional tailing method is co-disposal of the sand and clay/slimes tails into discrete basins that include mined out voids, cells within operating pits (with in-pit walls separating the co-disposal from the mining face) and external TSFs. This method is designed to allow a high percentage of the water to infiltrate to groundwater. Process water is contained within a HDPE-lined dam which is designed not to overtop. Where slurry pipes cross roads/water features they will be fully welded with secondary containment. The type of secondary containment will be risk assessed to ensure it is fit for purpose. <u>Risk Assessment</u> *Consequence*: Moderate. *Likelihood:* Possible.	

DECISION TABLE			
Licence section	**Condition number**	**Justification (including risk description & decision methodology where relevant)**	**Reference documents**
		Risk Rating: Moderate. Regulatory Controls Conditions have been included in the licence to: • specify the authorised infrastructure on the premises for the containment of tailings, process water and hydrocarbon-contaminated soils and the minimum infrastructure requirements; • require adequate safeguarding of pipelines carrying tailings, slurries of ore and process water 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. Risk Assessment *Consequence*: Moderate. *Likelihood:* Unlikely. *Risk Rating:* Moderate.	
	L1.2.4 – L1.2.6	**Operation** Conditions have been included in the licence to: • specify the authorised waste types for disposal on the premises; • specify the authorised disposal sites on the premises for inert wastes (Depot Hill – Jennings Concentrator site) and NMSP monazite (Eneabba Monazite Disposal Pit); and • specify the minimum cover requirements for disposed wastes. DER's assessment and decision making regarding the proposal to dispose of monazite, and monazite with ASS characteristics in the Eneabba Monazite Disposal Pit are detailed in Appendix A1.	
Emissions general	L2.1.1	Descriptive limits have been set through conditions 1.2.4 & 2.3.1 of the licence and therefore condition regarding recording and investigation of exceedances of limits has been included.	
Point source emissions to air including monitoring	No conditions	**Operation** No significant point source emissions to air are expected or authorised during operation of the mine. No specified conditions relating to point source emissions to air or the monitoring of these emissions have been added to the licence.	
Point source emissions to surface water including	No conditions	**Operation** Dewatering is not required and there are no routine discharges of process water to the environment. No other significant point source emissions to surface water are expected or authorised during operation of the mine. No specified conditions relating to point source emissions to surface water or	

DECISION TABLE			
Licence section	**Condition number**	**Justification (including risk description & decision methodology where relevant)**	**Reference documents**
monitoring		the monitoring of these emissions have been added to the licence.	
Point source emissions to groundwater including monitoring	No conditions	**Operation** No significant point source emissions to groundwater are expected or authorised during operation of the mine. No specified conditions relating to point source emissions to groundwater or the monitoring of these emissions have been added to the licence.	
Emissions to land including monitoring	No conditions	**Operation** No significant emissions to land are expected or authorised during operation of the mine. No specified conditions relating to emissions to land or the monitoring of these emissions have been added to the licence.	
Fugitive emissions	L2.3.1 – L2.3.3	**Operation** Conditions have been included in the licence to: • require the implementation of fugitive dust management in accordance with the measures specified in part 4 of the Eneabba Dust Management Plan; • impose a measurable limit at the monitoring point reference AQ1 (Eneabba Town Site TEOM) for PM_{10} emissions of 50 µg/m^3 (24-hour average); and • provide for an exemption of compliance with the limit where exceedances are not attributed to operations on the premises. DER's assessment and decision making are detailed in Appendix A3.	DER Guidance Statement: *Setting Conditions* (October 2015) Eneabba Dust Management Plan (June 2009)
Odour	No conditions	**Operation** Odour is not expected from the operation of a mineral sands mine. No specified conditions relating to odour emissions or the monitoring of these emissions have been added to the licence.	
Noise	No conditions	**Operation** <u>Emission Description</u> *Emission:* Noise from fixed plant (Newman wet concentrator, pumps, etc.) and heavy machinery during mining operations (scrapers, dozers, trommels, etc.). Ambient noise in the vicinity of the mine has been previously assessed in 2006, 2007 and 2011. Previous noise logging indicated that underlying background noise levels in the vicinity of the Eneabba town site are relatively low. *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	*Environmental Protection (Noise) Regulations 1997* (Noise Regulations)

DECISION TABLE			
Licence section	**Condition number**	**Justification (including risk description & decision methodology where relevant)**	**Reference documents**
		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. *Controls:* Noise controls include: • restricting certain machines on night shift and weekends; • modifying machines to reduce noise (e.g. reversing beepers); • cladding of noisy equipment (e.g. pumps and parts of mining units); • constructing earthern bunds between the mine and receptors. Risk Assessment *Consequence*: Moderate. *Likelihood:* Possible. *Risk Rating:* Moderate. Regulatory Controls The risk of noise emissions impacting on nearby receptors is deemed to be Moderate (given the distance to the Eneabba town site); however noise has not been identified as an issue at this site during past operations. As such, DER does not consider noise to be significant enough to warrant site specific conditions on the licence and emissions can be adequately regulated through the provisions of the Noise Regulations. Residual Risk *Consequence*: Moderate. *Likelihood:* Possible. *Risk Rating:* Moderate.	
Monitoring general	L3.1.1 – L3.1.4	**Operation** Conditions have been applied 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 Licensees.	
Monitoring of inputs and outputs	No conditions	**Operation** Monitoring of inputs and outputs are not required to adequately manage emissions from the Premises during operation. No specified conditions relating to the monitoring of inputs and outputs have been added to the licence.	

DECISION TABLE			
Licence section	**Condition number**	**Justification (including risk description & decision methodology where relevant)**	**Reference documents**
Process monitoring	L3.2.1	**Operation** A condition has been included in the licence to require monthly monitoring of the volume and location of monazite concentrate disposed on the Premises. This information is required to demonstrate compliance with condition L1.2.4.	
Ambient quality monitoring	L3.3.1	**Operation** Table 3.3.1 has been included in the licence to require fortnightly monitoring of ambient surface water quality in the Eneabba Creek whilst flowing, to monitor the quality of surface water entering and exiting the site and to detect any impacts from minesite runoff. This is the continuation of the existing monitoring program. Table 3.3.2 requires monitoring of groundwater quality across the Premises, to monitor for potential impacts from leaching of the monazite disposal pit, impacts of tailings dam mounding, and from historical contamination areas. Table 3.3.3 requires continuous monitoring of ambient air quality at the Eneabba town site (PM_{10}) and depositional dust (TSP) at locations near receptors (e.g. Brand Hwy), and environmental radiation surveys along the mine site boundary and areas identified as having potential annual radiation exposure in excess of natural background radiation levels.	
Meteorological monitoring	No conditions	**Operation** Meteorological monitoring is not required to adequately manage emissions from the Premises during operation. No specified conditions relating to meteorological monitoring are required to be added to the licence.	
Improvements	L4.1.1 – L4.1.2	**Operation** IR1 – submission of an Environmental Radiation Management Plan (Refer Premises Operation). IR2 – installation of a “no dig” barrier around the Monazite Disposal Pit (Refer Premises Operation). IR3 – fence off the Monazite Disposal Pit (Refer Premises Operation).	
Information	L5.1.1 – L5.1.3 L5.2.1 – L5.2.3 L5.3.1	**Operation** Conditions relating to minimum record keeping requirements have been included in the licence. Submission of an annual environmental report including a description of activities undertaken during the reporting period and a summary of all monitoring undertaken, including an appraisal against previous monitoring data, has been included. A notification condition for breaches of licence limits has also been included.	
Licence Duration	N/A	The licence is due to expire in March 2020. In accordance with DER Guidance Statement: *Licence Duration* (May 2015), the expiry of the amended licence has been extended to align with the first of the two relevant tenements to expire, being tenement M70/879 (30 January 2031).	DER Guidance Statement: *Licence duration* (May 2015)

5 Advertisement and consultation table

Date	Event	Comments received/Notes	How comments were taken into consideration
8/01/2016	Proponent sent a copy of draft instrument (v1)	Tailings infrastructure has been dismantled and removed and tailings dams have been dry for 2 years. Monthly inspections are therefore considered unwarranted	The intent of this condition was to continue to provide an authorisation/defence for tailings transfer around the site and disposal if/when operations recommenced. As all tailings infrastructure has been removed, this condition can be removed
		Inert waste generated at Narngulu MSP is also disposed on the premises, as stipulated in the radiation management plan	The intent of this condition is to prevent acceptance of third party waste i.e. operating a commercial landfill. The condition will be updated to include reference to Iluka Mid West Operations
		Up to 50,000 tpa of monazite has been disposed in the monazite pit; up to 25,000 tpa of monazite from North Capel is also being proposed for disposal	Limit has been increased to 75,000 tpa
		The grounds for including an activity level limit on the monazite to be disposed is requested, as Iluka consider activity level to make little difference in terms of management requirements	Radiological risk is being reviewed by DER and until such time that a final policy position on the matter has been determined, this condition will be removed
		Inert waste is also disposed to the 120ASA pit (approved under the existing licence)	Table has been updated to include this location
		ANSTO testwork demonstrates monazite is not leachable, therefore limiting rainfall infiltration is not required	This requirement has been removed from the draft
		Sulfate is not currently required to be analysed at the Eneabba creek	This requirement has been removed from the draft
		Radiation monitoring is currently reported to DMP. It is requested this report be submitted to DER instead of a separate report	As the monitoring is the same, the DMP report will be acceptable
		TEOM units are used for dust monitoring, not high volume samplers	Table has been updated to reference TEOM units
		Update to the RMP will be completed by May 2016	Table has been updated to reference May 2016 submission date
		RCWA approval requires a 5 m cap over the monazite material upon closure, thus a “no-dig” barrier is not	This requirement has been removed from the draft

Date	Event	Comments received/Notes	How comments were taken into consideration
		required	
		Installation of a perimeter fence would only be possible upon site closure, once the pit has been capped	This requirement has been removed from the draft
		Annual environmental reporting date is 15 March	AER reporting date has been updated to 15 March
15/02/2016	Proponent sent a copy of draft instrument (v2)	Suggest replacing the definition for 'Narngulu Tails' to 'Monazite Concentrate', as this product/waste includes monazite from North Capel	Definition amended to reflect Monazite Concentrate
		The process water ponds are not lined and the risk of groundwater contamination is low; therefore the requirement to line these ponds is not warranted	This requirement has been removed from the draft
		There is no scientific rationale for including a limit of radioactivity for monazite as a basis for controlling risk of groundwater contamination by radionuclides, and monitoring since 1994 validates this	Radiological risk is being reviewed by DER and until such time that a final policy position on the matter has been determined, this condition will be removed
		Reporting date for updated RMP requested to be aligned with the DMP submission on 18 June 2016	Table has been updated to reference 18 June 2016 submission date
07/04/2016	Proponent sent a copy of draft instrument (final)	Nil.	N/A.

6 Risk Assessment

Note: This matrix is taken from the DER 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(a) Disposal of monazite from the Narngulu Mineral Separation Plant

Monazite, a heavy phosphate mineral containing rare earth elements including small amounts of thorium (Th) and uranium (U), is produced as a by-product at the NMSP. Due to the presence of Thorium- and Uranium-238 (U^{238}), this mineral is classified as a naturally occurring radioactive material (NORM). All monazite generated at the NMSP, regardless of the origin of the ore, is currently transported 150 km south for disposal in a designated area on the premises, the Eneabba Monazite Disposal Pit (EMDP).

Emission Risk Assessment

Emission Description

Emission: Disposal of NORM (monazite waste) in the EMDP, being an historic mined out void that has been designated by Iluka for the discrete disposal of this waste from the NMSP. The radiation level of this material is around 30 – 40 Bq/g, with approximately 20,000 tonnes disposed per year.

Impact: Contamination of groundwater from radionuclide mobilisation due to decreasing pH as a result of declining rainfall. Potential restrictions on post-closure land use due to radiation levels.

Controls: The EMDP has been selected due to its separation to groundwater (approximately 5 m below the pit floor). The pit floor has been compacted to further minimise the risk of seepage. The floor has a 3° gradient and stormwater falling within the pit is collected in a clay-lined sump.

Risk Assessment

Groundwater levels are approximately 5 m below the base of the pit floor and no dewatering has occurred in the area; so this depth is expected to be fairly stable and therefore groundwater is not expected to significantly interact with material in the pit. Groundwater quality is slightly acidic to neutral, and contains limited buffering capacity. All bores downgradient of the pit display marginal evidence of ASS-oxidation; however this is considered to be representative of background conditions.

The consequence of groundwater contamination from radionuclide mobilisation would be a medium to long-term impact, with moderate health effects if environmental pathways lead to human exposure (Moderate). The likelihood of this consequence occurring under current operating conditions is Unlikely (not expected to occur), with a combined risk rating of Moderate.

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

Regulatory Controls

Currently regulation of mining involving NORM in WA is managed through several different agencies, with a focus on protection to workers and public health. A common misconception is that once protection of workers and public health is established, protection to the environment is also assumed; however there is a significant risk that environmental pathways and receptors are not adequately addressed to this regard.

The Radiation Management Plan for the site does not adequately address environmental pathways or environmental impact. An improvement condition has been added to the licence to require the development of an Environmental Radiation Management Plan, which addresses these aspects in greater detail.

In order to place operating boundaries around the disposal activity, conditions have been added to the licence to specify the authorised discharge location, being the EMDP, and an annual tonnage limit of 75,000 tonnes. A condition has also been added to require the immediate covering of disposed monazite with a low permeability material to limit rainfall infiltration through the material.

Residual Risk

With the above regulatory controls imposed, the residual risk rating of groundwater contamination from radionuclide mobilisation is Moderate.

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

A1(b) Disposal of monazite with ASS characteristics

At present there is approximately 2,000 tonnes of monazite material with ASS characteristics being temporarily stored at the NSMP. This material originates from non-magnetic HMC mined at the Tutunup South mine near Busselton, and has been processed through the NMSP. It is estimated that at worst case, a further 3,000 tonnes may be produced over the next 6 months. Disposal of monazite material is restricted to the EMDP under the site's Radiation Management Plan; and approval is being sought to dispose of this material at the EMDP given its ASS characteristics.

Emission Risk Assessment

Emission Description

Emission: Disposal of NORM (monazite waste) with ASS characteristics in the EMDP. Two samples have been analysed from the current stockpile of 2,000 tonnes. The first analysis indicates an elevated total potential acidity (TPA) that is predominantly inorganic and/or metal speciated, and does not trigger the DER action criteria[2] of 0.03 %S. The second sample indicated both an elevated TPA and the presence of total actual acidity (TAA) in the form of pyritic acidity, with a resultant net acidity exceeding the DER action criteria.

Acidity is predominantly in the form of inorganic and/or metal speciated acidity; however given the presence of pyritic material all currently stockpiled material will required active management and treatment for ASS.

Impact: Contamination of groundwater from radionuclide mobilisation due to decreasing pH as a result of ASS. Potential restrictions on post-closure land use due to radiation levels. Potential for radioactive isotopes of radium to leach from acidifying soil into groundwater where they may cause groundwater contamination and a potential off-site source of radon gas.

[2] *Treatment and Management of Soils and Water in Acid Sulfate Soil Landscapes*, Department of Environment Regulation (2015).

Controls: An ASS management plan has been developed for the proposal, and the following control measures are outlined:

- Upon arrival at the EMDP the material will be stockpiled on a limestone pad (constructed in-pit) that incorporates a 300 mm thickness with perimeter bunding;
- Lime addition shall be undertaken at a rate of 3 kg of lime sand (ENV factor of 92%) per tonne using a conservative safety factor of 1.5;
- Validation testing to confirm lime treatment is adequate; and
- The existing groundwater monitoring program will be expanded to include additional parameters at bores EM78 and new bores EM90 and EM91 (installed September 2015).

Risk Assessment

Groundwater levels are approximately 5 m below the base of the pit floor and no dewatering has occurred in the area; so this depth is expected to be fairly stable and therefore groundwater is not expected to significantly interact with material in the pit. Groundwater quality is slightly acidic to neutral, and contains limited buffering capacity. All bores downgradient of the pit display marginal evidence of ASS-oxidation; however this is deemed to be representative of background conditions.

The consequence of groundwater contamination from the disposal of ASS material would be a medium to long-term impact, with potential or actual alteration of the environment (Moderate). The likelihood of this consequence occurring is Unlikely (not expected to occur), with a combined risk rating of Moderate.

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

Regulatory Controls

A condition has been added to require management of monazite material with ASS characteristics in accordance with the ASS management plan developed specifically for this proposal. Section 5 of this plan provides details on analysis and testing, stockpile management and lime treatment, and validation testing, which has been assessed as being consistent with the DER ASS Guideline[3]. Disposal of this material is also limited to the EMDP in accordance with condition 1.2.5.

Complementary groundwater monitoring for pH, electrical conductivity, total dissolved solids, radionuclides (quarterly) and major ions (6 monthly) has been included in Table 3.3.2 for ambient groundwater quality monitoring for bore GQ29 (EM78) located down hydraulic gradient of the EMDP.

Residual Risk

With the above regulatory controls imposed, the residual risk rating of groundwater contamination from the disposal of ASS material is Moderate.

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

[3] *Treatment and Management of Soils and Water in Acid Sulfate Soil Landscapes*, Department of Environment Regulation (2015).

A2 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 the Brand Hwy, impact on the health of animals and deposit on surrounding native vegetation. Fugutive dust is likely to be generated 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 sand mines is CPM, being comprised of unprocessed mineral oxide particles.

There is risk of airborne radioactive particles from areas where monazite waste, being naturally occurring radioactive material (NORM) (i.e. mineral waste containing elevated levels of Thorium (Th^{232}) and Uranium (U^{238})) is currently, or has historically, been disposed.

Iluka continuously measures PM_{10} emissions at the Eneabba town site boundary from a public health perspective, in addition to nuisance dust conditions (TSP) via a network of depositional dust gauges around the mine site boundary, and environmental radiation surveys along the mine site boundary and areas identified as having potential annual radiation exposure in excess of natural background radiation levels. Results during the 2014 monitoring period provided the following:

- Average PM_{10} (24 hour average) ranged from 5 – 45 µg/m^3, with 5 exceedances of the National Environment Protection Measure for Ambient Air Quality (Air NEPM) for particles (50 µg/m^3, 24 hour average) that were determined not to be attributed to mine site operations;
- TSP measurements across 11 monitoring sites ranging from 0 – 13 mg/m^2/month, with no measurement exceeding 2 mg/m^2/month above the background reference level;
- Gross alpha activity levels across all monitored sites ranging from 1.2 – 5.7 Bq/m^3;
- Surface gamma radiation levels from 843 survey points at the monazite pit ranging from 0.09 – 15.74 µSv/hr (average 0.88 µSv/hr); and
- Surface gamma radiation levels from 2011 survey points around the premises boundary ranging from 0.006 – 0.246 µGy/hr.

Impact: Dust emissions can be harmful to human health and the environment. Elevated TSP levels can impact ambient environmental quality resulting in amenity impacts and can smother vegetation. PM_{10} or $PM_{2.5}$ can be drawn deep into the lungs causing human health impacts. Airborne radioactive particles may emit alpha, beta, gamma or neutron radiation. From a health perspective, the most dangerous airborne particles are the alpha emitters, which emit harmful ionising radiation. Inhalation, ingestion and external exposure of radioactive airborne particles can cause bone cancers and other bone abnormalities after long term exposure.

Controls: Measures to manage and control fugitive dust emissions during operations are outlined in the Dust Management Plan (June 2009). Key management strategies include:

- Minimising open areas exposed to wind erosion;
- Operating 2 dedicated water carts during dry, windy conditions and during summer months;
- Applying clay fines or oversize material to non-active stockpiles;
- Conducting topsoil stripping during suitable wind and weather conditions, and not more than 2 months before mining commences in the area;
- Re-establishing soil profile within 8 months;
- Ceasing non-essential mining operations during excessively windy conditions.

From a radiological perspective, monazite waste that is returned from the NMSP is covered with overburden cover material. The active tip face is maintained as small as possible to reduce wind dispersion, and is covered regularly with overburden.

Increased radioactivity levels have been observed surrounding (predominantly to the west due to prevailing easterly winds) both the yellow dam and monazite pits. Walk over surveys have identified readings up to 2,696 nSv/hr to the west of the yellow dam pit, and both these areas are classified as "controlled areas" in the site's Radiation Management Plan (May 2014). The elevated areas were identified through routine monitoring in 2005. The yellow dam pit was used for monazite tailings disposal in the 1990s and the assumption is that the material build-up occurred at that time and subsequently. It has been partly rehabilitated with radiation levels being remediated back to background levels. Windblown material was found to be between 0.5 – 2 m deep in the subject area, with excavated material pushed into the pit void and sprayed with a bituminous surface binding material.

Risk Assessment – Normal operation

The consequence of TSP or PM_{10} emissions impacting on receptors located within the Eneabba town site or on the Brand Hwy would be minor reversible impacts, causing local concern and complaints (Minor). The likelihood of this consequence occurring under typical mining operations and the current non-operational status is Possible (could occur), with a combined risk rating of Moderate.

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

The consequence of human exposure to airborne radioactive particles could be medium to long-term impact with serious health effects (Major). The likelihood of this consequence occurring under typical mining operations and the current non-operational status is Unlikely (not expected to occur), with a combined risk rating of Moderate.

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

Risk Assessment – Abnormal operation

The likelihood of the consequence of TSP or PM_{10} emissions impacting on receptors located within the Eneabba town site or on the Brand Hwy under abnormal operating conditions (e.g. unfavourable meterological conditions) is Likely (occurs under most circumstances), with a combined risk rating of Moderate.

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

The likelihood of the consequence of human exposure to airborne radioactive particles under abnormal operating conditions (e.g. unfavourable meterological conditions) is Possible (could occur), with a combined risk rating of High.

Consequence: Major.
Likelihood: Possible.
Risk Rating: High.

Regulatory Controls

Continuous monitoring of ambient dust levels (PM_{10}) at an off-site location is an existing requirement of the licence for the protection of human health and to provide assurance over the effectiveness of dust management at the site. The monitoring location is sited on the eastern town site boundary of Eneabba, and monitors emissions under southerly to easterly winds, which are the predominant (morning) winds during the summer months.

The existing licence somewhat duplicates the Air NEPM, containing a 24-hour limit of 50 $\mu g/m^3$ at the receptor with an allowed exceedance of 5 days per year. This provision is to accommodate dust from natural events such as bushfires; however it is not considered appropriate for application as a regulatory standard (designed to protect human health). It is DER's preference to set monitoring requirements at a premises boundary; however as this location has already been well established, DER has elected to retain the existing monitoring program at this location due to its accessibility and proximity to a reliable power supply and for continuity of data.

The (recorded) impacts of fugitive dust from existing operations has been relatively minor, which in part is likely to be due to operations being well buffered from receptors by native vegetation. In summer months where there are strong prevailing winds from the east (mornings) and south-west (afternoons), the potential impacts to receptors will increase. As such, DER considers the existing PM_{10} limit at the Eneabba town site monitoring location to be warranted, as this has been assessed as an appropriate location for representing the level of impact to receptors from mining operations (i.e. on easterly and southerly winds). The continuation of the existing TSP monitoring program is also considered to be warranted in order to monitor for nuisance impacts to other receptors (e.g. Brand Hwy and travelling motorists, native vegetation, adjacent farmers).

Due to the risk rating of airborne radioactive particles, the existing environmental radiation monitoring program for dust activity (gross alpha) and surface gamma radiation levels has been added to the licence. This will enable DER to be kept informed with respect to the levels of radioactivity being observed downwind of the controlled areas and to ensure that adequate dust management practices are occurring on-site.

Residual Risk – Normal operation

With the above regulatory controls imposed through the licence, the residual risk rating of TSP or PM_{10} emissions impacting on receptors located within the Eneabba town site or on the Brand Hwy under normal operating conditions is Moderate.

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

With the above regulatory controls imposed through the licence, the residual risk rating of human exposure to airborne radioactive particles under normal operating conditions is Moderate.

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

Residual Risk – Abnormal operation

With the above regulatory controls imposed through the licence, the residual risk rating of TSP or PM_{10} emissions impacting on receptors located within the Eneabba town site or on the Brand Hwy under abnormal operating conditions is Moderate.

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

With the above regulatory controls imposed through the licence, the residual risk rating of human exposure to airborne radioactive particles under abnormal operating conditions is Moderate.

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