ARAFURA RESOURCES LIMITED

2014

NOTICE OF INTENT AMENDMENT

NOLANS PROJECT

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Contents

Introduction

Arafura Resources Limited (Arafura) is proposing to develop "Nolans Rare Earth Project" (the Project) located approximately 135km north west of Alice Springs, Northern Territory (NT). The Project is targeting a fluorapitite mineral deposit containing numerous rare earth elements at Nolans Bore.

Project activities include construction, mining, processing, rehabilitation and decommissioning of a rare earth mine, and associated infrastructure. Planning and project feasibility has progressed over a number of years and new information about the mineral deposit, processing technologies, beneficiation, economics and site conditions has been developed.

In March 2008, Arafura submitted a Notice of Intent (NOI) (Arafura and GHD 2008) to the former NT Department of Natural Resources Environment and the Arts (NRETA) for consideration under the *Environmental Assessment Act 1982* (EA Act). NRETA referred the project for assessment under the EA Act at the level of an Environmental Impact Statement (EIS), and issued EIS guidelines for the Project.

In August 2008, a referral under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) was submitted to the former Department of Environment Water Heritage and Arts. The Minister declared the project a "controlled action" under controlling provisions section 21 and 22A of the Act relating to a "nuclear action".

Planning of the project continued throughout 2010 and 2012, and extensions to the timeframe of the EIS guidelines were sought and granted by the relevant NT environmental department.

The project has now moved into the Definitive Feasibility Study (DFS) phase. In September 2014, *Nolans Development Report* (Arafura Resources Limited) was released, and now environmental assessment of the Project is planned to ramp up.

In accordance with the Section 14A "Procedure where proposed action altered" under the NT *Environmental Assessment and Administrative Procedures* under the EA Act, Arafura submits this document to notify the NT Environment Protection Authority (EPA) of changes to the project from that presented in the NOI (2008).

This document outlines key changes to the project components (proposed 2014) compared to project components presented in the 2008 NOI, including subsequent changes to the potential environmental risk profile.

A description of the proposed change of action, mine and associated infrastructure in 2008 compared to 2014 is presented in Section 2.

Proposed Action Altered

This section provides an overview of the project components proposed in 2008 in comparison with the proposed components in 2014.

Overview of Proposed Action 2008

In 2008 the project comprised a single site including the following three key components:

1. Development of a new mining operation and onsite beneficiation;
2. Transportation of beneficiated ore to the railhead on the Adelaide - Darwin rail line; and
3. Processing residues transfer to, and storage at, the mine site.

An NOI discussed aspects of the proposed mine development including mining, storage, loading and transportation of radioactive ore to the railhead and back to the mine site following processing (offsite),

residue storage, and a heavy vehicle wash down facility. Various aspects of the project underwent feasibility and options assessment including:

- Mine footprint and mining methodology;
- Transport options in relation to a mine access road and haul road and rail siding for transportation of beneficiated ore to the plant and residue back to the mine site;
- Location, source and volume of water supply i.e. a deep, high yielding aquifer in the Ti Tree Basin and potable water production at the Aileron Roadhouse;
- A workers accommodation facility; and
- Processing technologies in South Australia.

Detail is provided in the *Notice of Intent for Nolans Project – Mine* (Arafura and GHD 2008).

Overview of Proposed Action 2014

Since 2008, process and engineering development work has continued to be undertaken on the Nolans Project, and changes to the proposed activities and options have resulted. The Nolans site now comprises three key sites based on activity type (Figure 1 and Figure 2):

1. Mine Site – mining and a concentrator plant for comminution (to break into smaller parts) and beneficiation (to improve physical or chemical properties of ore) circuits;
2. Processing Site - RE intermediate extraction (extraction processing units, a sulphuric acid plant, process residue storage facilities (RSFs), evaporation ponds and other infrastructure to support the operation including a workers village); and
3. Borefield area to the south west, in the Southern basins area (water supply).

The Project's 2008 off-site Processing Plant has changed from a single plant to a split configuration i.e.

RE Intermediate extraction plant on the Nolans Site (producing an rare earths concentrate); and

RE Separation Plant constructed and located within an established chemical precinct at an **offshore** location (at this stage assumed to be USA Gulf Coast although other locations with similar advantages are also under consideration) to produce rare earths oxides from the concentrate.

The RE Separation Plant will be subject to a separate approvals process and is excluded from the scope of this amendment.

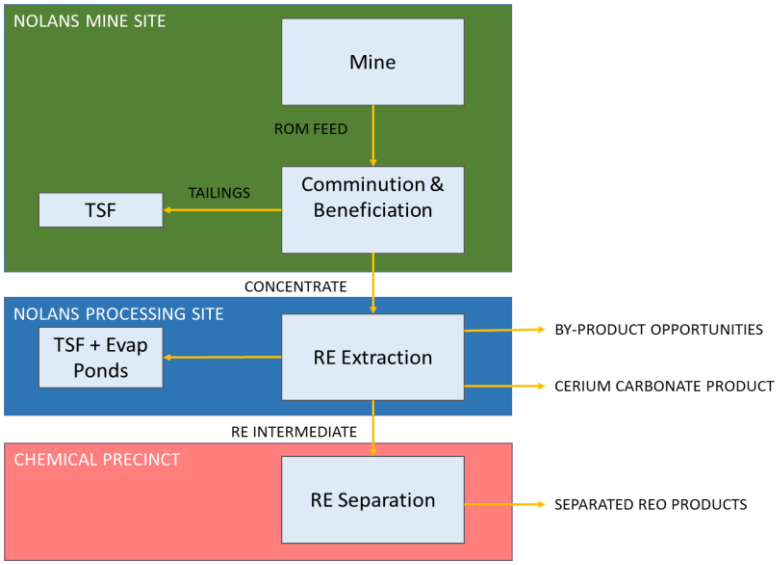


Figure 1 2014 Nolans project configuration (Source: Arafura 2014)

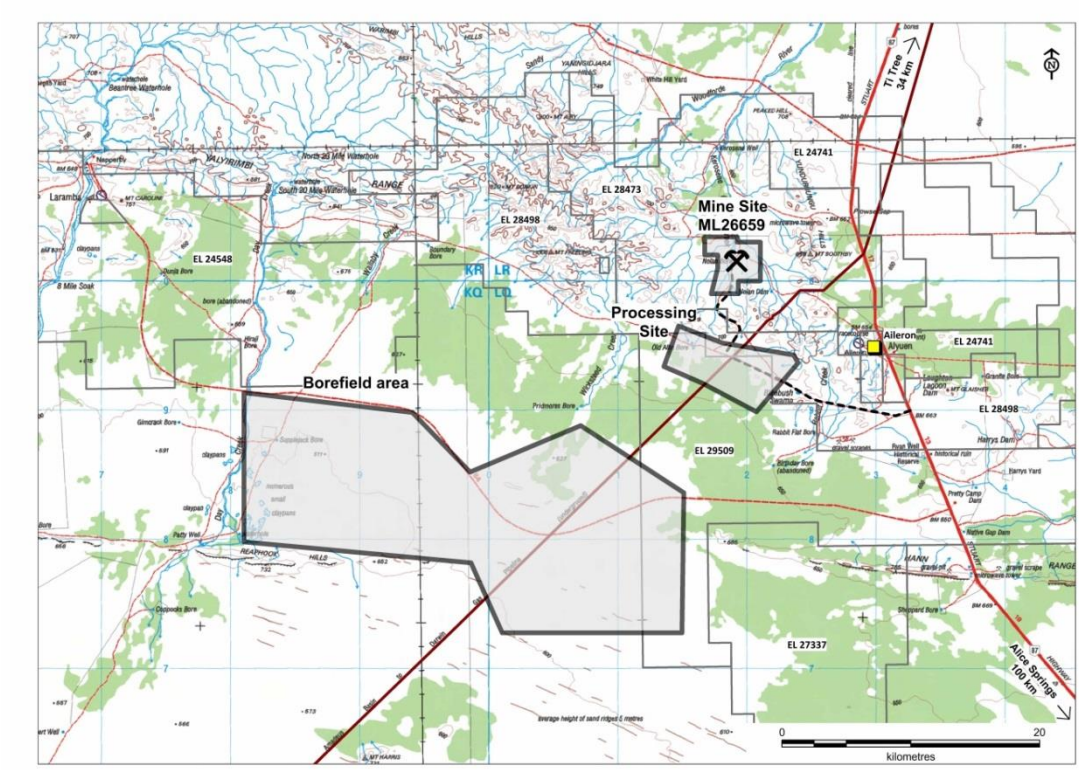


Figure 2 Nolans Site 2014 (Source: Arafura 2014)

Arafura propose to develop the following key project infrastructure at the Nolans site, NT (Figure 3):

Site access roads, comprising:

Access road from the Stuart Highway (intersection with Stuart Highway approximately 5 km south of the Aileron Roadhouse access road) (Figure 3 Option 6);

Access road and service corridor between the Processing Site and the Mine Site;

Access road and service corridor to the accommodation village; and

Access track and service corridor to the borefield area.

Site buildings, comprising:

Administration building;

Concentrator control rooms and operations centre;

Concentrator maintenance workshop and warehouse;

Concentrator reagents store;

Dangerous goods storage;

RE Intermediate Plant control room and operations centre;

RE Intermediate Plant maintenance workshop and warehouse;

RE Intermediate Plant reagents and product warehouse;

Sulphuric Acid Plant;

Laboratory;

Security building;

Medical and emergency services centre; and

Heavy and light vehicle wash station and weighbridge.

Borefield and raw water supply pipeline to the Processing Site and Mine Site;

Potable water supply and sewage treatment;

Offtake gas pipeline;

Accommodation village (based on a 400 person requirement); sewage treatment plant;

Concentrate slurry pipeline, filtrate return and water pipelines and pumps between Concentrator and RE Intermediate Plant;

Power supply from gas and steam turbine-generators;

Power distribution including overhead lines, High Voltage (HV) switch-gear and transformers from the RE Intermediate Plant to the Concentrator, accommodation village and borefield;

Tailings Storage Facilities (TSFs); and

Residue Storage Facilities (RSFs).

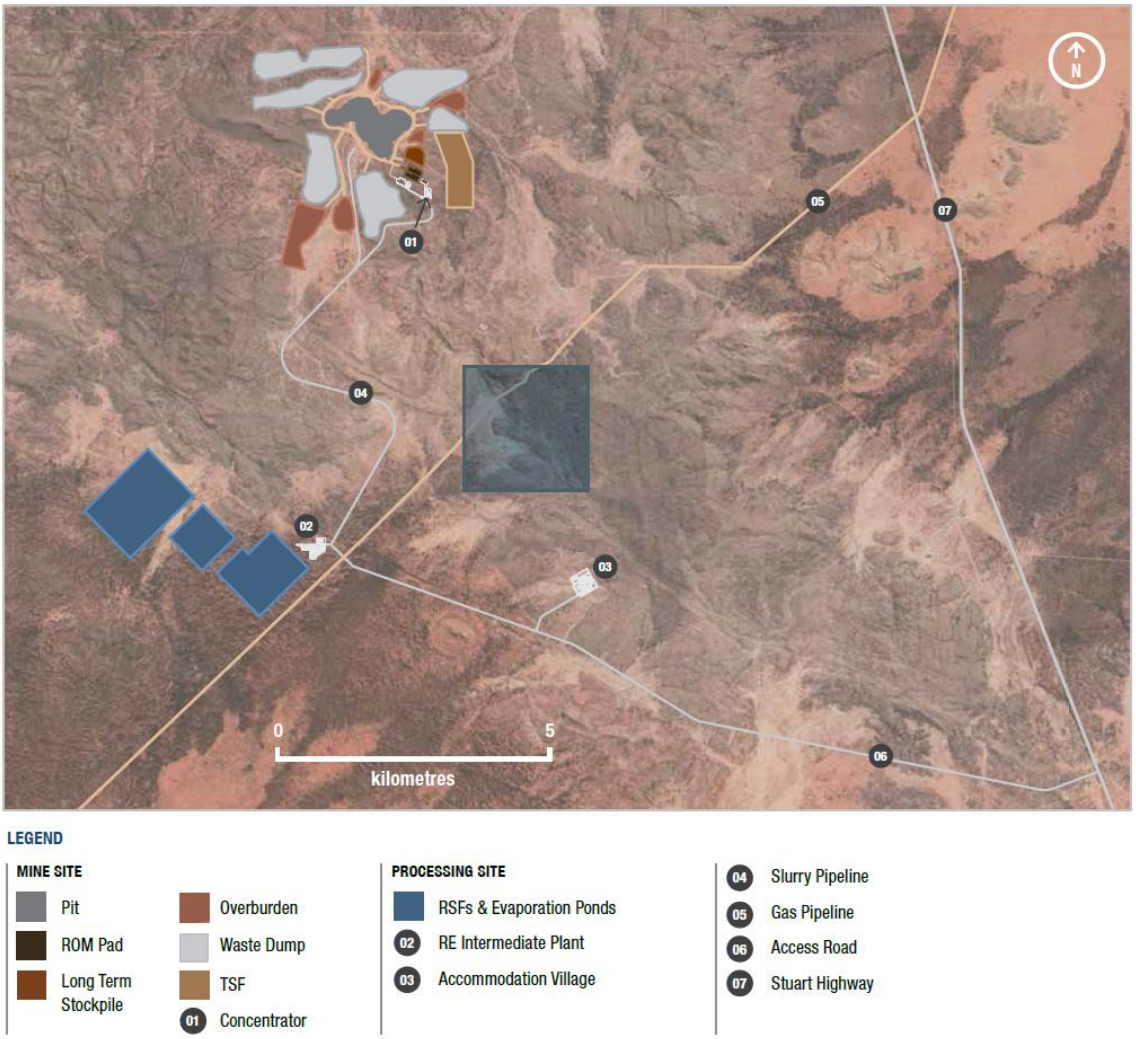


Figure 3 Concept Site Layout (2014) (Source: Arafura 2014)

Comparison of Proposed Development 2008 to 2014

A summary of the proposed development 2008 compared to the proposed development 2014 is provided in Table 1.

Specific details of the design of other, relatively minor project components have changed since 2008 such as design of crib rooms, fencing and heavy vehicle washdown areas etc. Details of the changes are considered minor and therefore not discussed in detail in this Section 14A report, Amendment to NOI.

Table 1 Proposed Key Developments 2008 Compared to 2014

Key Project Component	2008 NOI	2014 /change
MINING		
Rare Earth Mine	✓	✓
Conventional drill and blast mining	✓	✓
Alternative – continuous surface mining	✓	✗
Campaign mining	✓	✗
Selective mining	✗	✓
Pit optimisation	✗	✓
Life of Mine (LOM)	20 years	+40 years
Beneficiation Plant onsite	✓	✓
Comminution (crush, grind) and beneficiation	✓	✓
Jig plant gravity separation	✓	✗
Wet magnetic separation and flotation	✗	✓
Tailings co-disposal within mine waste rock dump	✓	✗
Beneficiation waste to a Tailing Storage Facility (TSF)	✗	✓
Waste Rock Dumps (WRD)	✓	✓
PROCESSING		
Post beneficiation plant /processing plant at Whyalla	✓	✗
RE Intermediate Plant at Nolans Processing Site	✗	✓
RE Separation Plant in Offshore Chemical Precinct	✗	✓
Pre-leach process	Hydrochloric acid	Sulphuric acid
Sulphuric acid plant on site	✗	✓
Chlor alkilai plant and HCL recycle unit	✓	✗

Key Project Component	2008 NOI	2014 /change
PROCESSING cont…		
Produce sodium hydroxide and HCL on site	✓	✗
Import sodium hydroxide and HCL for use	✗	✓
Chemical storage facility	✗	✓
Bunded secure Residue Storage Facility (RSF)	✓	✓
Separate water leach, neutralisation and phosphate RSF	✗	✓
TRANSPORT		
Ore concentrate haulage to processing plant at Whyalla	✓	✗
Mine haul road and rail siding	✓	✗
Transport of process residue from Whyalla to the mine site	✓	✗
Beneficiated ore transported from site in kibble systems	✓	✗
Transport of reagents >350,000t to the Whyalla processing site (e.g. 400,000t calcium chloride)	✓	✗
Transport of 350,000t of raw materials/reagents to the Nolan's Processing site	✗	✓
Transport of small tonnage of RE Intermediate product to port in bulk bags contained in conventional storage containers	✗	✓
Measurable radioactivity of outbound mineral concentrate product 400 Becquerel's per gram (Bq/g)	✓	✗
Measurable radioactivity of outbound rare earths concentrate product anticipated 1-5 Bq/g	✗	✓
ASSOCIATED INFRASTRUCTURE, UTILITIES and SERVICES		
Accommodation village	Aileron Roadhouse	400 person camp EL 28498
Gas supply from pipeline	✓	✓
Kerosene Camp Creek Diversion	✓	✓
Minor Creek Diversion, (Nolans Creek)	✗	Option being considered
Desalination Plant / Reverse Osmosis (RO) Plant	✓	✓
Upgrade to Aileron Airstrip	✓	✗
Water supply from Ti Tree Basin groundwater resource	✓	✗

Key Project Component	2008 NOI	2014 /change
ASSOCIATED INFRASTRUCTURE, UTILITIES and SERVICES cont		
Water supply from Borefield - Burt and eastern Whitcherry basins (herein referred to as the "Southern basins") to the southwest of the Mine Site	✗	✓
Injecting reverse osmosis wastewater to aquifer	✓	✗
Sewage treatment at mine site	✓	✗
Sewage treatment at Nolans Processing Site adjacent to the RE Intermediate Plant	✗	✓
Concentrate slurry pipeline – transfer mineral concentrate from Concentrator to RE Intermediate Plant	✗	✓
Offtake gas pipeline	✓	✓
Gas turbine power plant onsite (approximately 12 Megawatts (MW))	✓ at mine site	At RE Intermediate Plant
Sulphuric acid plant feeds steam to generate power (6-8MW)	✗	✓
High Voltage (HV) power lines from RE Intermediate Plant to site users (approx. 30km of overhead lines)	✗	✓
Size of pit	✗	✓Approximately double
Water demand	✓	✓Increased
Power demand	✓	✓increased
Volume of chemical storage	✓	✓increased

Description of New Project

A detailed description of project development is provided in Attachment A – *Nolans Development Report* (Arafura 2014). Descriptions of the new project components provided in the following sections are sourced from the Nolans Development Report (Arafura 2014).

Land Tenure

The Nolans Bore deposit is located on land held by Waite River Holdings Pty Ltd under the "Aileron" Perpetual Pastoral Lease. Arafura holds secure title over the deposit under EL 28473.

Since 2008, the mineral resource has approximately doubled and project requirements have altered, resulting in an expanded footprint to include the borefield and chemical processing at the RE Intermediate Plant. As a result, additional ML applications on EL 28473, EL 28498 and EL 29509 are being prepared to accommodate an expanded footprint.

The borefield and access corridor is enabled under the *Mining Management Act* by virtue of an Access Authority, although at this time Arafura has prepared an application under the *Water Act* to secure access to the newly discovered groundwater resource. Arafura is working with the relevant authorities to

finalise the application process. There may be a requirement for a separate Indigenous Land Use Agreement (ILUA) covering access to the borefield area.

Nolans Mine Site

Knowledge of material types and their metallurgical performance along with reduced operating costs have improved pit optimisation outcomes and enhanced mine production schedules.

Resource

In 2014, the Nolans Bore deposit is approximately twice the size it was in 2008. Material types are listed in Table 2 and depicted in Figure 4. The Nolans Bore deposit is about 1500 m in length and about 1000 m wide at its widest point. It extends below 250 metres drilled depth across large parts of the deposit. Apatite, allanite and monazite are the most abundant RE-bearing mineral species. In addition to REs, the deposit has elevated concentrations of calcium, phosphorous, thorium, uranium, strontium and fluorine.

Table 2 Nolans Bore Material Types

Style	Material Type	Description	Proportion
Apatite MT123	1	Cream/green apatite	17%
	2	Brown apatite	7%
	3	Brown apatite with kaolin and/or clay	21%
Calcsilicate MT456	4	Apatite and allanite	9%
	5	Apatite, allanite and calcsilicate	44%
	6	Apatite, allanite, and calcsilicate with kaolin and/or clay	2%

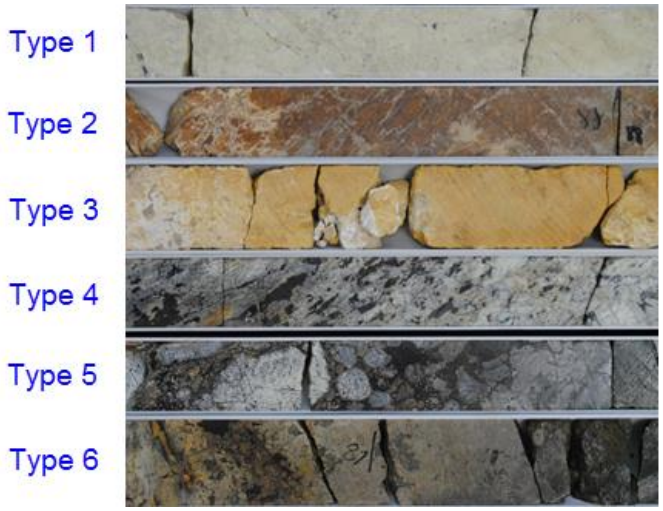


Figure 4 Nolans Bore Material Types (Intervals show grade from 3.1% to 8.0% REO)

As per the 2008 project, the Nolans Mine site will handle radioactive material. Arafura will include a system of control and supervision in certain areas as part of the radiation management process. The existing radiation management plan (RMP) will be expanded to include the planned mining and processing operations and be included in the EIS. Arafura regards this process as an integral step

towards mining, as all naturally occurring radioactive material (NORM) that exceeds 1 Bq/g must be identified and managed once it is mined.

It is intended that the waste rock generated from the mining process will be characterised and modelled to determine its physical, geochemical and the radioactivity level of the material. The model will be generally based on broad geological units because we understand the distribution of the elements in both the orebody and the surrounding waste rock. Three broad categories will be used to delineate and classify this material based on the level of radioactivity i.e.

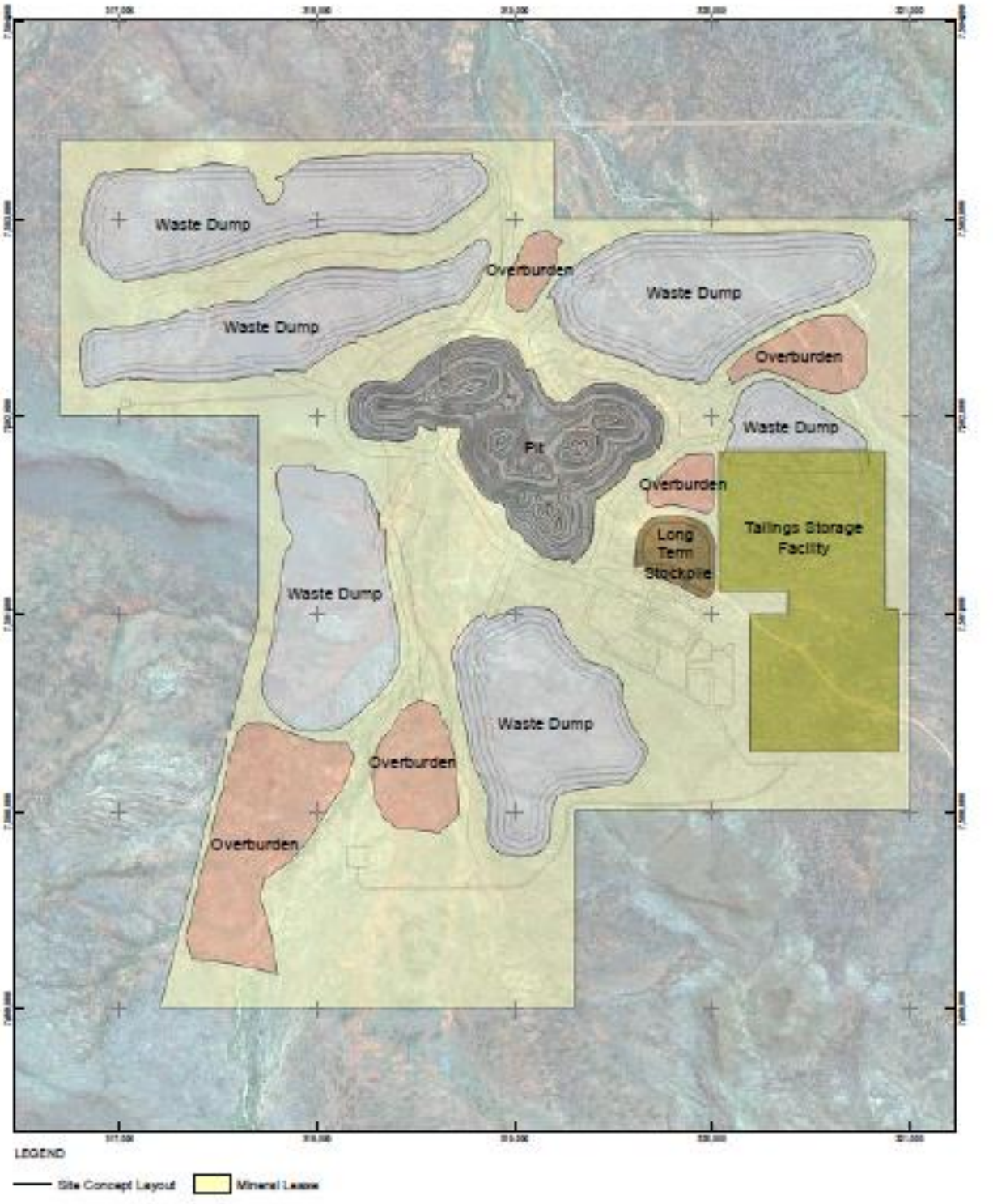
- <1Bq/g
- >1-<5Bq/g and
- >5Bq/g.

It is proposed, where practicable, that the lowest classification material will be used as the outer layer in the construction of waste dumps. The second category will be dumped inside this material and the highest category will be encapsulated within the waste rock dump. To provide some regional context to this material, it should be noted that in and around the Nolans region there are many natural occurrences where background radioactivity levels (NORM) in the rocks are in the >1-<5Bq/g range category.

Mine Footprint

The footprint of the mine site infrastructure has significantly increased. The ML boundary, used as an approximate indication of the mine site area (2014), is 1,400 hectares. The mine site concept boundary in 2008 was much smaller.

The new mine site concept layout (Figure 5) is based on the larger mineral resource therefore a larger pit, additional waste rock dumps to accommodate greater volumes of material mined, tailings storage facilities, and consideration of existing environmental conditions such as sacred sites, drainage lines and creeks, topography and proximity to other infrastructure requirements.


Waste Dump
Waste Dump
Overburden
Waste Dump
Overburden
Waste Dump
Pit
Overburden
Long Term Stockpile
Tailings Storage Facility
Waste Dump
Waste Dump
Overburden
Overburden
LEGEND
Site Concept Layout
Mineral Lease
Paper Size A4
Arafura Resources Limited
Nolans Rare Earth Project
Mine Site Concept Layout (2014)
Figure 5

Pit Optimisation and Life of Mine

Pit optimisation studies have generated schedules showing a mine life of 25 years based on measured and inferred resources. There is a large additional indicated resource therefore Life of mine is potentially greater than 40 years.

A series of pit shells has been produced and detailed pit design will be completed for the DFS.

A strategic mining schedule for the measured and inferred optimisation scenario is based on a maximum overall mining rate of 10 Million tonnes per annum (Mtpa) to produce an average of 900,000 tonnes of plant feed each year.

The LOM optimisation scenario is based on a maximum overall mining rate of 10 million tonnes per annum to produce an average of 1.0 million tonnes of plant feed each year.

Mining Method

It is intended that the proposed mining operation will still use conventional drill and blast and open-pit mining using truck and excavator mining methods. Selective mining will target ore types in the deposit including:

- Apatite mineralisation for the first 7-9 years of operation, which will achieve twofold RE upgrade of around 85% RE recovery; and then
- Calcsilicate mineralisation will be processed during subsequent years that can be upgraded to a similar level but at a lower RE recovery with minimal modifications to the beneficiation flowsheet.

Concentrator

Run of Mine (ROM) material will be fed to the beneficiation circuits. These circuits will include staged crushing, grinding circuits, wet magnetic separation and flotation circuits (Figure 6). The Concentrator produces phosphate bearing and RE bearing concentrate in a slurry that will be pumped via a high density polyethylene (HDPE) pipeline to the RE Intermediate Plant.

Based on beneficiation test work, the concentrate grade will be increased from 4.2% to 7.2% TREO. The revised concentrate grade has been standardised and used as a common input to all modelled scenarios.

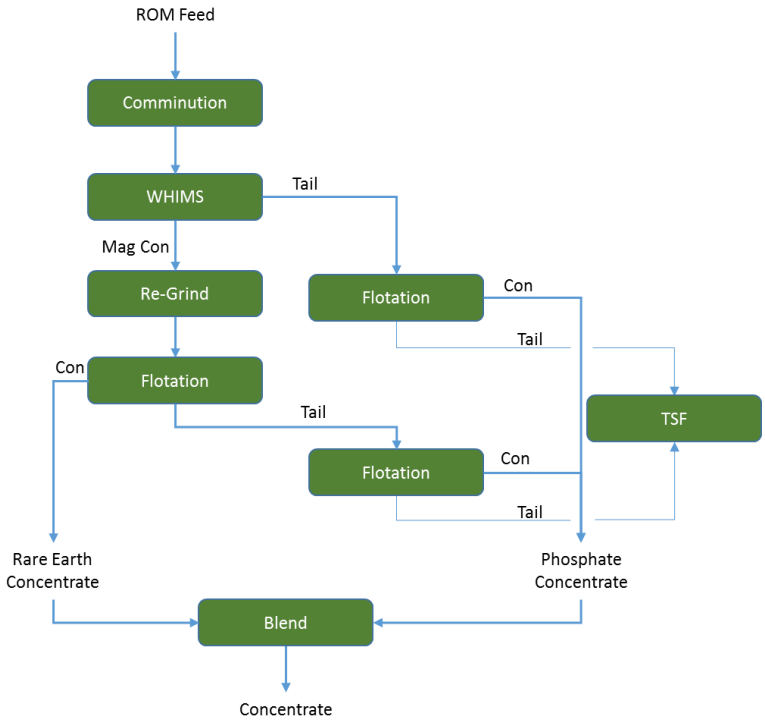


Figure 5 Beneficiation and Comminution

Creek Diversions

As presented in the 2008 NOI, a creek diversion off Kerosene Camp Creek was required around the pit and mine site infrastructure. It was anticipated that the creek diversion would not be required until after year three of the mining operation.

In 2014, Kerosene Camp Creek is still proposed to be diverted around the Pit. The proposed alignment and design will be undertaken as part of the DFS.

A second creek diversion may be required. A creek locally known as Nolans Creek, located in the north east of the Mine Site, may also need a minor diversion around the WRDs. The need, feasibility and design of the second creek diversion option will be considered as part of the DFS and EIS process. Data on flow and water quality from these creeks is being collected to assist in diversion design and impact assessment.

Processing Site

The Project's 2008 post-beneficiation flow sheet has changed from a single complex, intended to be located at Whyalla, to a split configuration comprising an RE Intermediate Plan at the Nolans Site and an offshore RE Separation Plant in an established chemical precinct capable of meeting the reagent demands of the separation process.

The RE Intermediate Plant is proposed to be located approximately eight kilometres south of the Nolans Mine Site over the surface water watershed within the Southern Basins catchment.

Sulphuric acid is now used instead of hydrochloric acid in the pre-leach circuit and the Project no longer includes a chlor-alkali plant and hydrochloric acid recycle. It is no longer necessary to produce sodium hydroxide and hydrochloric acid on site, and the reduced quantities required are now planned to be imported.

A greater volume of chemicals and reagents will be transported to, and stored at, the Intermediate Processing Site. Detailed logistics modelling indicates that the Project will have annual movements of

approximately 350,000 tonnes of in-bound raw materials to the Nolans Site, and these will predominantly be in the form of standard intermodal cargo.

The Processing Site hosts RE extraction processing units, a sulphuric acid plant, process residue storage facilities (RSFs), evaporation ponds and other infrastructure to support the operation. A range of options were assessed for mineral concentrate transfer and it was determined that the use of a slurry pipeline connecting the Concentrator to the RE Intermediate Plant was the optimum solution.

The RE Intermediate Plant comprises the following major processing facilities:

SAPL (Sulphuric acid pre-leach);

Sulphation and water leach;

DSP (double sulphate precipitation) and purification; and

RE chloride intermediate and cerium carbonate production.

The selected RE extraction flowsheet maximises recovery of the high revenue neodymium (Nd) and praseodymium (Pr) (NdPr) product stream.

The RE Intermediate Plant has several ancillary plants associated with it, such as a sulphuric acid plant, steam and power generation, and water treatment, as well as other infrastructure and services.

Design of a reagent / chemical storage warehouse and logistics storage areas is being undertaken as part of the DFS.

Process Description

Sulphuric Acid Pre-Leach

Concentrate is pumped from the Concentrator to the RE Intermediate Plant and following dewatering, is fed to the SAPL process stage. The SAPL process produces a solid feed, containing the majority of the REs, for the sulphation process. It also produces a pre-leach liquor containing the remaining REs, for use in the water leach process. The solid feed material from the SAPL is dewatered prior to being transferred to the sulphation process.

Sulphation (Acid Bake)

A low temperature acid bake process using concentrated sulphuric acid is used to sulphate the solid feed material and liberates the REs for subsequent processing and extraction. This low temperature process minimises the energy requirement for the sulphation process and also offers a broader range of processing technologies.

Water Leach

The sulphated material is leached with a mixture of pre-leach liquor, filtration wash filtrates and water. The water leach liquor (WLL) is processed to recover REs and the solid residues are neutralised in the acid neutralisation section prior to final on-site disposal in the water leach RSF.

Double Sulphate Precipitation

WLL produced in the water leach section passes to the double sulphate precipitation (DSP) stage. The addition of sodium sulphate in the DSP stage selectively precipitates the REs as a double sulphate salt. This is subsequently filtered and washed for further processing.

Liquor streams containing elevated levels of sodium sulphate are collected and evaporated for re-use in the DSP stage. Evaporation ponds are used to evaporate excess process fluids, and Arafura intends to design and manage the Nolans Site as a zero process water discharge facility.

The RE-depleted DSP filtrate is neutralised with carbonate and lime in a two stage impurity removal process to produce a thorium-rich residue and a phosphate residue that contains most of the uranium present in the Nolans ore. These residues will be stored and managed on-site in dedicated RSFs.

This is the section of the process that offers the potential for future uranium and phosphate co-product development, should the economics of these products improve.

Conversion to Hydroxide

The DSP solid salt is mixed with sodium hydroxide to convert it to a RE hydroxide solid. This solid is washed and dried prior to further processing. The drying stage is an important stage that serves multiple purposes. During the drying operation, in the presence of air, most of the cerium which is present as Ce3+ is oxidised to Ce4+. This assists subsequent separation from the other REs to produce a cerium carbonate product during intermediate-stage processing.

Hydroxide Dissolution

The dried RE hydroxide undergoes a selective re-leach with dilute hydrochloric acid to produce a mixed RE chloride liquor containing low levels of cerium. As the cerium is predominantly in the oxidised Ce4+ state it remains relatively insoluble in the solid phase during this selective re-leach process.

Intermediate Processing Products

The RE chloride liquor from hydroxide dissolution is treated with barium chloride to remove residual excess sulphates and subsequently crystallised as an RE intermediate feed for transport and further processing at the RE Separation Plant.

The cerium-rich solid from the hydroxide dissolution is treated to remove the residual thorium as a chemically stable precipitate and this precipitate is sent to the on-site neutralisation RSF. The cerium-rich liquor is precipitated by the addition of sodium carbonate to produce a cerium carbonate product.

The SAPL-DSP flowsheet is undergoing the final phase of testing prior to commencement of pilot testing and final feasibility.

Tailings and Residue Storage Facilities

Overview

Tailings and residue storage facilities at the Nolans Site retain the radionuclides from processing of Nolans ore.

A Nolans Site infrastructure engineering study (Knight Piésold, 2014) incorporates tailings and residues storage facilities that include:

- A flotation TSF adjacent to the Concentrator at the Mine Site, containing predominately unmineralised gangue minerals from the ore; and
- Separate water leach, neutralisation and phosphate RSFs, and evaporation ponds adjacent to the RE Intermediate Plant at the Processing Site.

The principal design objective of TSFs/RSFs is to minimise the environmental impact of the permanent and secure containment of waste residues and fluids generated by processing.

The following characteristics and parameters were considered in order to meet the design objective:

- Leachate collection and minimisation of seepage;
- Cost effective construction;
- Maximisation of tailings and process residue densities using the most appropriate deposition strategy;
- Ease of operation; and
- Rapid and effective rehabilitation.

The required storage capacity and footprint of each TSF/RSF is shown in Table 3.

Table 3 TSF/RSF Capacity and Area

Type	Storage Capacity (Mt)	Area (ha)	Number of Cells
Flotation Tails (mine site)	9.0	20	2
Water Leach Residue (intermediate plant)	7.2	25	2
Neutralisation Residue (intermediate plant)	11.9	33	2
Phosphate Residue (intermediate plant)	2.9	12	2
Evaporation Ponds (intermediate plant)	-	60	6

Flotation TSF

A TSF for flotation tails is proposed at the Concentrator.

The flotation TSF will comprise two cells, with the second cell replacing the first after a period of approximately ten years. Each facility requires a low permeability soil liner and the embankments will be constructed mainly from mine waste rock. Each cell will have a surface area of 20 ha and the final embankment height will be 25 metres.

Water Leach, Neutralisation and Phosphate RSFs

Water leach residue is a slow settling-type material and contains elevated levels of radioactive material. This RSF will be constructed using a HDPE/low permeability soil liner system, combined with basin drainage and a leakage collection and recovery system.

The configuration and construction methods for both the neutralisation and phosphate RSFs are similar to that described for the water leach RSF.

Excess Process Liquor Evaporation Ponds

Six evaporation ponds, each 10 ha in area and 2.5 metres deep, are required to concentrate the excess process liquor. All ponds will be lined with an HDPE liner. Flow from the process plant will be directed to one of the ponds for a period of several months, after which the flow will be directed to the next pond in sequence.

After approximately 20 months, during which time the liquor concentrates through evaporation, the remaining brine in the cell is pumped to the neutralisation RSF in order to limit the accumulation of precipitate in the evaporation ponds. The cell is then available to re-enter the production cycle and receive excess process liquor.

Traffic and Transport

Beneficiated ore will no longer be required to leave the site for processing. This results in a simplification of logistics i.e. no need for a haul road and rail siding for concentrate haulage, no need for dedicated rolling stock and specialised containers for concentrate transport, no need for loading, unloading and washing systems for concentrate and residue containers; and a significant reduction in hazardous and dangerous goods movements (i.e. radionuclides). However, the volume of raw materials/reagents transported to the Nolans site has increased.

Site Access Roads

In 2008, a range of transport options were undergoing feasibility assessment including:

- Mine access roads (3 options);
- Mine haul roads (3 options); and
- Transportation of beneficiated ore by road and/or rail to the processing plant.

The 2014 project includes Site access roads, comprising:

- Access road from the Stuart Highway;
- Access road and service corridor between the Processing Site and the Mine Site;
- Access road and service corridor to the accommodation village; and
- Access track and service corridor to the borefield.

Access roads for the Nolans Site include a site access road from the Stuart Highway to the Processing Site, and an access road from the Processing Site to the Mine Site. Preliminary road designs have been prepared using parameters based on their intended use and routes selected to avoid or minimise disruption to topographic features and/or Aboriginal heritage sites.

With the exception of certain sections of the concentrate slurry pipeline, all services including power, water, sewerage and communication will run within the access road corridors.

Access to the raw and potable water borefield will be by defined and established 4WD track corridors so as to minimise environmental interference. The borefield service corridor to the raw water collection pond will include a high voltage overhead power lines in addition to raw and potable water pipelines.

Reagent Transport

Detailed logistics modelling indicates that the 2014 Project will have annual movements of approximately 350,000 tonnes of in-bound raw materials to the Nolans Site that were not included in the 2008 Project for the Nolans site. Reagent movements contemplated at that time for the Whyalla processing site were

in excess of these volumes. All intended freight movements will predominantly be in the form of standard intermodal cargo. Arafura has engaged with major operators and service providers to:

- Understand compliance systems with regard dangerous goods transport legislation and national heavy vehicle accreditation systems (NHVAS).
- Ensure access to the required infrastructure to incorporate the most efficient solutions for cargo movements.

Sulphur and Sulphuric Acid

The RE Intermediate Plant demand for sulphuric acid will be serviced by an on-site sulphur burning acid plant. Inbound sulphur will be procured on the international sulphur market and it is proposed that bulk shipments be containerised in Darwin for ease of transport by rail and road to Nolans via Alice Springs. Historically the Port of Darwin has handled solid sulphur shipments and the Arafura is working with the Darwin Port Corporation to finalise the optimal location for a transfer facility.

Sulphuric acid will be required both for the start-up of the acid plant and during the initial stages of ramp-up until consumption rates justify the commencement of on-site acid production. To this end, Arafura is working with the owners and the operators of the bulk tank facility at the Port of Darwin to facilitate handling of internationally sourced concentrated sulphuric acid via existing infrastructure.

Calcium Carbonate

Arafura has identified several potentially sizeable carbonate (marble and calcrete) sources at surface within about 30 kilometres of Nolans on land over which it maintains exploration and development rights. However, on site calcium carbonate sources for the LOM will not be considered at this stage or as part of this approval process. If, in the future (beyond the date of assessment of the EIS), development a calcium carbonate source/quarry is considered feasible, it would be subject to separate project approvals.

Caustic Soda and Hydrochloric Acid

Caustic soda will be procured on the international market and delivered in bulk to Darwin for subsequent transfer to International Standards Organisation (ISO) tank containers. Hydrochloric acid will either be delivered in bulk to Darwin for subsequent transfer to ISO tank containers, or direct from suppliers in ISO tank containers. This dedicated fleet of ISO tank containers will be transported on standard rail and road intermodal services between Darwin and the Nolans Site.

Other Raw Materials and Reagents

Other inbound raw materials and reagents will also be containerised and transported using the aforementioned intermodal services. This maximises the use of standard services while maintaining flexibility and minimising cost. Sourcing of other critical raw materials will include a matrix of local, regional, national and international suppliers in order to manage the supply related risk.

Key relationships have been established with major suppliers of soda ash from North America, as well as specialist chemical suppliers from China. Where feasible and practical, Arafura has established relationships with potential local suppliers of lime and other minor reagents.

Out-Bound Cargo

Out-bound rare earth product cargos from the Nolans Site will utilise existing road and rail capacity in addition to Port infrastructure. The products from the RE Intermediate Plant will be packed in bulk bags and transported in standard shipping containers via Darwin and international shipping routes. The RE intermediate product will be shipped via standard existing container freight routes to the offshore RE Separation Plant. The cerium carbonate product will be shipped to customers by similar means.

A significant change since 2008 is that Arafura is no longer proposing to transport radioactive ore or plant process residues.

Water Supply

In 2008, groundwater was proposed as the source of water supply to the mine site and initial studies were subsequently focused on the Ti Tree Basin as the intended source.

Further studies have subsequently been undertaken and groundwater for the Nolans project is now likely to be sourced from the eastern Whitcherry Basin (or Southern Basins). This newly discovered aquifer system is outside the Ti Tree Basin water control district and contains limited other competing groundwater users.

The demand for raw water for the Nolans Site lies in an expected range of 4.5 GL initially, rising to around 6.2 GL per annum after several years. This includes a minor demand for potable water. Work is ongoing to reduce this requirement.

Arafura anticipates that the raw water demand for potable uses can be supplied from the central part of the proposed Southern basins borefield area via a dedicated transfer pipeline to a treatment facility at the RE Intermediate Plant.

Power Demand

Power demand is estimated to be in the order of 18.5 Mega Watts (MW) and this will be provided by gas fired on-site generation (approximately 12.5 MW) and cogeneration from the sulphuric acid plant using excess heat (approximately 6 MW). Power will be generated at the RE intermediate plant and transmitted to the mine and accommodation village by HV power lines. Options to power the borefield are also being evaluated.

Accommodation Village

In 2008, the accommodation village and facilities were proposed near Aileron Roadhouse, when the likely employee numbers were more modest at around 150 people. With the expanded project, it is now proposed that a 400 person village will be located approximately 5km east of the Processing Site. Any potential short term additional accommodation requirement would utilise existing accommodation at Aileron Roadhouse.

Environment Risk Profile

Key Risks (2008)

A review of the 2008 NOI and EIS Guidelines identified the following potential key risks:

Management of mine waste water and waste rock and tailings management, and rehabilitation;

Supply, management and protection from contamination of water resources; and in particular impacts on recharge to the Ti Tree basin, including potential impacts due to contamination of surface water;

Long term capacity for waste storage facilities to prevent leakage of hazardous wastes;

Radiation hazards for workers, the public and the environment; including transport related risks of road and rail transport of radioactive ore between the mine site and the processing facility, and in returning process waste material to the mine site; and

Managing Community Perceptions, with regard to mining of a radioactive ore, transportation of radioactive ore to a processing facility (potentially in Darwin), and long-term, on-site, safe management of radioactive tailings.

Changes in the Risk Profile

The environmental risk assessment included in the 2008 NOI has been reviewed and updated to include new potential environmental risks resulting from the proposed altered action. To allow easy comparison of the new risks (or risks that are no longer relevant), a copy of the updated risk assessment from 2008 is provided in Appendix B. New risks and comments are in blue font and risks that are no longer relevant are in strikethrough font. Comments have been added, to provide further explanation where relevant.

With regard to the key risks, the proposed altered action (2014) is likely to impact on the Project risk profile as discussed below, however it is believed the existing EIS guidelines (EPA 2012) adequately address the key risk areas to be addressed in the EIS.

Waste rock and tailings management and rehabilitation

The mine site footprint has expanded, including the pit, waste rock dumps and tailings storage facilities. The likelihood of impact associated with this infrastructure may increase, but these are not new risks; and consequences to soil, water, biodiversity etc. largely remain unchanged.

Management of mine waste water and process waste water

Additional mine waste water associated with a larger mine footprint may increase the likelihood of an environmental impact, but not the consequences. It is intended that all available groundwater from the mining operation will be used in the beneficiation process and for general mine requirements. Any excess would be pumped to the Intermediate Processing Plant.

The addition of processing at the Nolans Site (rather than at an interstate site) introduces the additional need to manage process waste water on the mine site. This is not a new risk, in that process tailings from interstate were to be returned to the mine site in the 2008 project, but these are now planned to be stored at the intermediate plant site, which is in a different surface water catchment, and not in the Ti Tree Basin. Ongoing test work is being carried out by Arafura to determine appropriate long term management and storage of mine and process waste. Evaporation ponds and residue storage facilities are included in the processing site footprint.

Supply, management and protection of water resources

The likelihood of potential impact on groundwater recharge in the Ti Tree basin has been reduced given the proposal in the 2014 project to develop the Southern Basins borefield as the project water source.

The potential risk of impact to water resources arising from contamination as a result of mine waste and/or process waste still exists, although the likelihood of contamination is reduced:

by the proposed location of these facilities over shallow basement rocks, and

through the chemical composition and stability of waste rock.

Biodiversity

The likelihood of potential impacts on biodiversity may increase marginally, given a larger project footprint, and in particular, the larger footprint of the mine site in an area which may provide habitat for the black footed rock wallaby.

Transportation of dangerous goods

Risks associated with the transport of radioactive, beneficiated ore to the processing plant, and transport of process tailings back to the mine, have been removed as radioactivate material will no longer be transported offsite.

There is a significantly increased requirement for the transport of reagents and materials to site associated with intermediate plant processing to the Nolans site, although the proposed route (limiting transport though Alice Springs) and upgraded quality of the Stuart Highway reduces this risk. The transport of the various reagents required for the intermediate plant is heavily regulated and the level of risk well understood. With increased traffic there is an increased likelihood of an incident leading to an environmental or social impact i.e. impact on public safety and/or the environment, however there are a number of controls that can be implemented to reduce the likelihood of such an event.

Processing plant emissions to air

The rare earths are hosted in apatite (phosphate mineral) and will require a leach process to liberate them, hence the sulphuric acid leach process. Significant quantities of acid are required and an acid plant has been included in the processing site.

Air emissions will be modelled and the appropriate control measures incorporated into engineering design of plant (e.g. scrubbers) to mitigate these.

Radiation hazards for workers, the public and the environment

Radiation hazards associated with the project will now be limited to the Nolans site.

Risks associated with the transport of radioactive ore concentrate to the processing plant, and transport of radioactive process tailings back to the mine, have been removed by siting the intermediate processing at the Nolans site.

Risks associated with radiation hazards for workers and the environment in the vicinity of the mine site are well understood, and significant datasets have been collected at the site during site activities in recent years. Risk of exposure to radiation is related to duration of exposure. This risk will be managed via a range of control measures (e.g. complying with Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) requirements, radiation monitoring, restricted access) and Arafura has engaged the services of highly recognised radiation specialists who will assess the potential impacts and advise appropriate management protocols and processes required to address this risk. This is not a new risk and has been successfully evaluated during project development.

Public perception of, and concern about, the project risks

The proposed altered action significantly reduces the likelihood of public exposure to radioactive material, given that radioactive material will no longer be removed from the Nolans site.

The significant increase in the size of the Project may exacerbate the perception of risks relating to long term on site safe management and storage of project process residues and tailings. The general issue of community perception of risk associated with radioactive material has not changed since the 2008 NOI.

ATTACHMENT A: *Nolans Development Report* (Arafura 2014)

An electronic copy of the Nolans Development Report is located at

http://www.arultd.com/images/media/files/Reports/ARAFURA_Nolans-Development-Report_2014_Sept.pdf

ATTACHMENT B:
Updated Environmental Risk Assessment Profile

Environmental Risk Assessment

The same risk assessment process utilised in 2008 was utilised for the 2014 risk assessment to allow easy comparison of the project updates.

Each impact is rated in terms of the level of severity of the potential impact (the impact rating). The key for each rating used within the impact assessment is defined in **Table 4**, **Table 5** and **Table 6**

Table 4 Likelihood/Consequence Matrix

Likelihood	Consequence				
	Insignificant	Minor	Moderate	Major	Extreme
Almost Certain	S	S	H	H	H
Likely	M	S	S	H	H
Possible	L	M	S	H	H
Unlikely	L	L	M	S	H
Rare	L	L	M	S	S

Table 5 Likelihood Criteria

Likelihood	Percent of Occurrence	Description for percent of Occurrence
Almost Certain	90 – 100%	Event occurs ten times a year during construction or operation
Likely	51 – 90%	Event occurs once each year during construction or operation
Possible	11 – 50%	Less than 50 % chance of event occurring each year during construction or operation
Unlikely	1 – 10%	Less than 10 % chance of event occurring each year during construction or operation
Rare	0 – 1%	Less than 1 % chance of event occurring each year during construction or operation

Table 6 Consequence Criteria

Consequence	Consequence Classification		
	Community	**Public and Workforce Safety**	**Environment**
Extreme	Extreme negative media coverage/NTG intervention	Death or permanent incapacitation	Catastrophic site impact / high local impact / moderate external impact / serious long-term cumulative effect
Major	Significant negative media coverage / formal council intervention	Major injury / illness	High site impact / moderate local impact / minimal external impact / minor long-term cumulative effect
Moderate	Critical media coverage / formal council request for information	Lost time incident (LTI)	Moderate site impact / minimal local impact / possible long term cumulative effect
Minor	Number of community complaints above expected average	Minor injury / illness	Minimal site impact / easily controlled
Insignificant	Number of community complaints at expected average	No injury / illness	No impact

Table 7 Management Response Required

Rating		Response Required
H	High	Requires further investigation and the development of specific strategies to address the issue. Should be considered as “Don’t Proceed” issue unless specific strategies have been developed to bring level of risk to acceptable
S	Significant	Requires the development of specific strategies
M	Moderate	Generally requires the development of specific action plans
L	Low	Generally document and accept or manage as normal part of project management

Table 8 Construction Phase Risk

Reference Number	Activity	Hazard Source	Impact	Likelihood	Consequence	Risk	Mitigation Measures	Residual Likelihood	Residual Consequence	Residual Risk	Comments
1	Construction Vehicle Movement (general)	Leak of petrol, oil or other liquid from earth moving vehicles	Petrol, oil or other liquids entering water system or contaminating soil around mine site	Almost certain	Minor	Significant	◗ Spill kits ◗ Hydrocarbon spill management plan ◗ Regularly serviced vehicles ◗ Trained operators	Possible	Minor	Moderate	
2		Fuel spill during refueling or incorrect onsite storage of fuel	Hydrocarbons can contaminate water bodies and soil	Possible	Minor	Moderate	◗ Spill kits ◗ Construction refueling and storage of fuel management plans ◗ Hydrocarbon spill management plan ◗ Staff training	Possible	Minor	Moderate	
3		Noise from construction equipment	Affecting nearby workers and local flora and fauna	Possible	Minor	Minor	◗ Regularly serviced vehicles ◗ Well maintained equipment ◗ Construction noise management plans ◗ Staff training ◗ ~~Community consultation plan~~	Unlikely	Insignificant-Minor	Low	Community consultation plan not relevant to onsite workers. Potential noise impacts on nearby workers will be included in the construction noise management plan
4		Air emissions	Air emissions can contribute towards local air pollution	Likely	Insignificant	Low	◗ Construction air management plans ◗ Regularly serviced machinery ◗ Staff training	Possible	Insignificant-Minor	Low-Moderate	
5		Dust emissions from vehicle movements and other construction operations	Short term reduction in local air quality leading to radiation contamination from dust if inhaled to people and effects on local ecology	Almost Certain	~~Major~~ Moderate	High	◗ Dust management plans ◗ Compliance with conditions within Development Approval ◗ Vehicular speed limits enforced ◗ Staff training ◗ Radiation management plans	Likely	Insignificant	Moderate	Duration of exposure will be short term
6		Consumption of fuel	Diesel is a fossil fuel. The mining and consumption of fossil fuels contribute to global warming	Almost Certain	Insignificant	Low	◗ Use vehicles that are regularly serviced ◗ Staff training	Unlikely	Insignificant-Minor	Low	
7		Increased traffic on surrounding roads during construction	Impacts to tourists and other road users affected by increased traffic	Likely	Moderate	Significant	◗ Traffic management plans ◗ Community consultation and awareness program	Possible	Insignificant-Minor	Low-Moderate	

Reference Number	Activity	Hazard Source	Impact	Likelihood	Consequence	Risk	Mitigation Measures	Residual Likelihood	Residual Consequence	Residual Risk	Comments
							◗ Trained staff				
8		Crash between construction vehicle and another road vehicle	Sustained injury or death to one or more of the drivers/passengers	Rare	Extreme	Significant	◗ Traffic management plans ◗ Community consultation and awareness program ◗ Staff training ◗ Licensed drivers ◗ Emergency response plan	Rare	Extreme	Significant	
9	General Construction	Loss of containment of spoil from trucks	Spoil loss during truck movements may cause air quality degradation (radiation) and loss of resource	Likely	Moderate	Significant	◗ Dust management plans ◗ Conditions within Development Approval ◗ Radiation management plan	Unlikely	Minor	Low	
*New Risk		Transport of large modular plant sections along public roads	Short term, localised impacts on other road users	Likely	Moderate	Significant	◗ Traffic management plans ◗ Community consultation and awareness program	Possible	Moderate	Significant	
10		Cultural heritage	Disturbance of cultural heritage items or places	Possible	Moderate-Major	Significant-High	◗ Construction heritage management plans ◗ Heritage site investigations ◗ Clearly defined areas ◗ Trained staff	Rare	Moderate-Major	Moderate-Significant	
11		Project Employment	Increased employment and generation of income	Almost certain	Positive	N/A	◗ Employment and training programs	N/A		N/A	
12		~~Fuel or chemical spill~~ Natural or man-made fire	Fire causing habitat loss or pollution	Possible	Moderate	Significant	◗ Spill kits ◗ Trained staff ◗ Emergency response plans ◗ Hydrocarbon spill management plan ◗ Construction environmental management plans	Unlikely	Moderate	Moderate	
13		~~Fuel or chemical spill~~ Natural or man-made fire	Fire causing death or injury to personnel	Possible	Extreme	High	◗ Spill kits ◗ Trained staff ◗ Hydrocarbon spill management plan ◗ Emergency response plans ◗ Construction environmental management plans	Rare	Extreme	Significant	

Reference Number	Activity	Hazard Source	Impact	Likelihood	Consequence	Risk	Mitigation Measures	Residual Likelihood	Residual Consequence	Residual Risk	Comments
14		~~Fuel or chemical spill~~ Natural or man-made fire	Fire causing damage to infrastructure	Possible	Major	High	◗ Spill kits ◗ Trained staff ◗ Emergency response plans ◗ Hydrocarbon spill management plan ◗ Construction environmental management plans	Rare	Moderate	Moderate	
~~15~~	~~Construction alongside Aileron Roadhouse and Aileron Homestead~~	~~Disturbance (limited access) to commercial area~~	~~Loss of business, limited access and general inconvenience~~	~~Likely~~	~~Moderate~~	~~Significant~~	~~Traffic management plans~~ ~~Community consultation~~ ~~Construction panning (hours of operation)~~	~~Unlikely~~	~~Insignificant~~	~~Low~~	Risk 15 is no longer relevant. Construction of an accommodation village is now proposed at Nolans Site.
16	Chemical ~~Waste~~ Management	Fuels and oils not stored correctly	Contamination of soil and groundwater	Likely	Moderate	Significant	◗ Spill kits ◗ Trained staff ◗ Emergency response plans ◗ Hydrocarbon spill management plan ◗ Construction environmental management plans	Unlikely	Minor	Low	
17		General construction waste not properly disposed of	Impacts to local fauna	Unlikely	Minor	Low	◗ Construction environmental management plans ◗ Waste disposal strategy	Rare	Minor	Low	
18	Removal of Vegetation	Removal or damage to terrestrial vegetation beyond approved clearance area	Vegetation impacted causing damage to local ecology and causing project delays	Likely	Moderate	Significant	◗ Ecological site investigations ◗ Obtaining correct approvals ◗ Construction environment management plans ◗ Minimal vegetation to be cleared ◗ Trained staff	Unlikely	Moderate	Moderate	
19		Removal or damage to terrestrial vegetation beyond approved clearance area	Habitat loss or fragmentation impacting on threatened fauna or cultural values	Possible	Moderate	Significant	◗ Ecological site investigations ◗ Obtaining correct approvals ◗ Construction environment management plans ◗ Trained staff ◗ Minimise disturbance and access to key areas ◗ Avoidance of riparian zones ◗ Implement appropriate habitat	Unlikely	Moderate	Moderate	

Reference Number	Activity	Hazard Source	Impact	Likelihood	Consequence	Risk	Mitigation Measures	Residual Likelihood	Residual Consequence	Residual Risk	Comments
							buffer zones				
20		Clearing or vehicular movement through weed colonised areas	Spread of weeds and potential to increase local area fuel loads	Almost certain	Moderate	Significant	◗ Construction weed management plan ◗ Site weed investigations ◗ Wash-down areas ◗ Staff training	Unlikely	Moderate	Moderate	
21	Excavation of soil at water crossings	Disturbance of banks causing erosion and sediment runoff	Disturbance of diversion channels and subsequent impact to aquatic habitat	Likely	Moderate	Significant	◗ Trained Staff ◗ Erosion and sediment control management plans ◗ Sediment erodibility investigations	Possible	Moderate	Significant	
22		Stockpiles of spoil stored on construction site	Erosion of stockpiles of spoil leading to loss of soil and potential impact on drainage channels ~~local water bodies (increased sedimentation and radiation)~~	Likely	Moderate	Significant	◗ Trained Staff ◗ Erosion and sediment control management plans ◗ Radiation management plan	Unlikely	Moderate	Moderate	There are no permanent water bodies on site.
23		Heavy rain event	Erosion and sediment runoff affecting water quality ~~affecting turbidity and increased radiation levels, potentially affecting aquatic ecology~~	Possible	Moderate	Significant	◗ Trained Staff ◗ Erosion and sediment control management plans ◗ Radiation management plan ◗ Sediment erodibility investigations ◗ Provision of temporary drains and catch drains, silt traps and other diversion measures	Unlikely	Moderate	Moderate	Potential exposure to radiation is addressed separately
24	Landform Disturbance	Diversion of creek(s)	Erosion and sediment runoff affecting water quality ~~affecting turbidity and increased radiation levels, potentially affecting aquatic ecology~~	Possible	Moderate	Significant	◗ Trained Staff ◗ Erosion and sediment control management plans ◗ Radiation management plan ◗ Sediment erodibility investigations ◗ Provision of temporary drains and catch drains, silt traps and other diversion measures	Unlikely	Moderate	Moderate	Potential exposure to radiation is addressed separately
~~25~~	~~Natural Event~~	~~Earthquake~~	~~Earthquake causing death or injury to personnel~~	~~Rare~~	~~Extreme~~	~~Significant~~	~~◗ Emergency response plan~~ ~~◗ Trained staff~~	~~Rare~~	~~Extreme~~	~~Significant~~	Not considered a practicable environmental risk.

Reference Number	Activity	Hazard Source	Impact	Likelihood	Consequence	Risk	Mitigation Measures	Residual Likelihood	Residual Consequence	Residual Risk	Comments
							◗ ~~Construction management plans~~				Design of infrastructure takes into consideration natural events.
~~26~~		~~Earthquake~~	~~Damage to infrastructure~~	~~Rare~~	~~Extreme~~	~~Significant~~	◗ ~~Emergency response plan~~ ◗ ~~Remedial protection works~~ ◗ ~~Trained staff~~ ◗ ~~Construction management plans~~	~~Rare~~	~~Extreme~~	~~Significant~~	Not considered a practicable environmental risk. Design of infrastructure takes into consideration natural seismic events.

Table 9 Operation Phase Risk

Reference Number	Activity	Hazard Source	Impact	Likelihood	Consequence	Risk	Mitigation Measures	Residual Likelihood	Residual Consequence	Residual Risk	Comments
Road and Service Corridors											
27	General Operations	Loss of containment in gas pipeline offtake from interference causing catastrophic failure	Large volumes of gas escaping from pipeline causing damage to other infrastructure	~~Unlikely~~ Rare	Major	Significant	◗ Leak detection system ◗ Regular inspections ◗ Operational management plans ◗ Emergency response plans ◗ Trained staff	Rare	Major	Significant	Plant site is located away from pipeline in accordance with strict controls that apply in and near the gas pipeline corridor
28		Slow leak from corrosion in pipe offtake	Gas from pipe potentially a fire risk	~~Unlikely~~ Rare	Major	Significant	◗ Leak detection system ◗ Regular inspections ◗ Operational management plans ◗ Emergency response plans ◗ Trained staff	Rare	Major	Significant	
29		Acts of terrorism/vandalism to pipeline	Range of impacts including loss of production, explosion	Rare	Extreme	Significant	◗ Limited access ◗ Regular inspections ◗ Security measures ◗ Emergency response plans	Rare	Extreme	Significant	
*New Risk		Leak in slurry pipeline from e.g. fatigue or vandalism	potential to contaminate soil and/or surface water	Unlikely	Moderate	Significant	◗ Limited access ◗ Pipeline containment ◗ Leak detection system ◗ Regular inspections ◗ Security measures ◗ Emergency response plans	Rare	Moderate	Moderate	
~~30~~	~~Procurement of Materials~~	~~Lifecycle of materials used for construction of gas pipeline offtake not appropriate~~	~~Life of gas pipeline offtake is brought forward due to a number of leaks and costly repairs caused by degrading pipe~~	~~Likely~~	~~Major~~	~~High~~	~~◗ Procurement plan~~ ~~◗ Materials fit-for-purpose~~	~~Unlikely~~	~~Moderate~~	~~Moderate~~	Gas offtake pipeline will be the responsibility of the gas company.
31		Limited lifespan of construction materials for roads in climatic conditions	Regular maintenance and repairs	Likely	Minor	Significant	◗ Regular inspections ◗ Operational management plans ◗ Materials fit-for-purpose	Unlikely	Minor	Low	
32	Vehicle Movement	Air emissions	Air emissions can contribute to local air pollution	Almost certain	Minor	Significant	◗ Air quality management plans ◗ Regularly serviced vehicles ◗ Staff training	Possible	Minor	Moderate	
33		Consumption of fuel	Diesel is a fossil fuel. The mining and consumption of fossil fuels contribute to global warming	Almost certain	Minor	Low	◗ Regularly serviced vehicles ◗ Staff training	Unlikely	Insignificant-Minor	Low	

Reference Number	Activity	Hazard Source	Impact	Likelihood	Consequence	Risk	Mitigation Measures	Residual Likelihood	Residual Consequence	Residual Risk	Comments
34		Increased traffic on surrounding roads during operation	Impacts to tourists and other road users affected by increased traffic	Likely	Moderate	Significant	◗ Traffic management plans ◗ Community consultation and awareness program ◗ Trained staff	Possible	Insignificant-Minor	Low-Moderate	
35		Crash between operational-use vehicle and another road vehicle	Sustained injury or death to one or more of the drivers/passengers	~~Rare~~ Possible	Extreme	Significant	◗ Traffic management plans ◗ Community consultation and awareness program ◗ Staff training ◗ Licensed drivers ◗ Emergency response plan	Rare	Extreme	Significant	
36		Spillage of chemical during transportation to/from site due to crash or incorrect transportation	Impacts could vary. Worst case would be chemical spill ~~thorium containing residue spill~~ causing injury or death to a member of the public~~, through radiation~~	Possible	Minor-Extreme	Significant-High	◗ Contractor management system for chemical haulage inbound and RE outbound ◗ Chemicals and product transported, according to national and state dangerous good legislation Emergency response plan ◗ Staff training	Rare	Extreme	Significant	Radioactive material will no longer be transported on/off site. The 2014 proposed project includes road transport of approximately 350,000t of reagents.
Mine Site											
37	General Operation	Spillage/leak of chemicals due to incorrect storage	Impacts from leaking chemicals could cause a number of impacts, from low risk health concerns to a major explosion causing death to one or more persons	Rare	Extreme	Significant	◗ Site-based management plan ◗ Development Approval conditions ◗ Chemicals stored according to MSDS requirements ◗ Staff training	Rare	Extreme	Significant	
38		Spillage of chemical during transportation between mine site and processing ~~to~~ site due to crash or incorrect transportation	Impacts could vary. Worst case would be spills of diesel causing fire or explosion, or contamination of soil	~~Possible~~ Unlikely	Minor	~~Significant-High~~ Low	◗ Site-based management plan ◗ Development Approval conditions ◗ Chemicals stored according to MSDS requirements ◗ Hydrocarbon spill management plan ◗ Staff training	Unlikely	Minor	Low	Transport of chemicals on the mine site will be from the processing site. The roads are private/internal roads. Onsite management plans will apply and transport will be under more controlled conditions, hence reduction in likelihood of risk.
*New risk		Exposure to radiation	Designated radiation worker exposed to radiation resulting in potential adverse health impact	Certain	Moderate	Significant	◗ Monitoring duration of exposure ◗ Rostering staff on and off (or into other areas of mine operation) to limit exposure to radiation ◗ Comply with Australian Radiation Protection and	Certain	Insignificant	Significant	Health impacts are related to duration of exposure to radiation. Strict regulatory industry guidelines and monitoring practices are

Reference Number	Activity	Hazard Source	Impact	Likelihood	Consequence	Risk	Mitigation Measures	Residual Likelihood	Residual Consequence	Residual Risk	Comments
							Nuclear Safety Agency (ARPANSA) requirements				required and will be implemented.
*New risk		Exposure to radiation	Short-term exposure to member of public resulting in potential adverse health impact	Possible	Minor	Moderate	◗ Restricted site access (fencing and site communications) to limit uncontrolled access ◗ Comply with ARPANSA requirements	Rare	Insignificant	Low	Health impacts are related to duration of exposure to radiation. Uncontrolled access to site would be controlled by fencing, signage etc. and trespassers would be quickly identified and exposure would be short term, limiting likelihood and consequence.
39		Acts of terrorism/vandalism	Damage to equipment causing explosions or leak of hazardous chemicals causing injury or death to one or more staff	Rare	Extreme	Significant	◗ Site security ◗ Emergency response plan ◗ Staff training	Rare	Extreme	Significant	
40		Fuel/oil spill (backup generator)	Potential contamination to soil and groundwater	Possible	Moderate	Significant	◗ Operational management plans ◗ Appropriate bunding for generator ◗ Hydrocarbon spill management plan	Unlikely	Minor	Low	
41		Fire in plant areas	Plant fails due to overflow of fuel/chemicals	Rare	Major	Significant	◗ Operational management plans ◗ Emergency response plans ◗ Trained staff ◗ Firefighting equipment	Rare	Major	Significant	
42		Heavy rain event	Erosion and sediment runoff affecting water quality ~~affecting turbidity and increased radiation levels, potentially affecting aquatic ecology~~	Possible	Moderate	Significant	◗ Trained Staff ◗ Erosion and sediment control management plans	Unlikely	Moderate	Moderate	Water quality relates to numerous water parameters. Radiation risks discussed above
43	Waste Management	Slow leak ~~from corrosion~~ in septic/sewage pipes	Effluent from pipes potentially contaminating soil or groundwater	Unlikely	Minor	Low	◗ Leak detection system ◗ Regular inspections ◗ Operational management plans ◗ Emergency response plans ◗ Trained staff	Rare	Minor	Low	
44	Water Management	Infiltration from pit	Substances potentially contaminating soil or groundwater.	Likely	Moderate	Significant	◗ ~~Leak detection system~~ ◗ Develop a conceptual model and confirm numerically	Unlikely	Moderate	Moderate	Leak detection system not relevant or practicable

Reference Number	Activity	Hazard Source	Impact	Likelihood	Consequence	Risk	Mitigation Measures	Residual Likelihood	Residual Consequence	Residual Risk	Comments
							◗ Regular inspections ◗ Operational management plans ◗ Groundwater quality management plan ◗ Emergency response plans ◗ Trained staff				
*New Risk	Tailings management	Seepage from tailings	Tailings potentially contaminating soil or groundwater.	Possible	Moderate	Significant	◗ Design according to Australian National Committee On Large Dams (ANCOLD) guidelines ◗ Monitoring bores ◗ Embankment piezometers ◗ Embankment survey pins	Unlikely	Moderate	Moderate	
45	Vehicle Movement	Air emissions	Air emissions can contribute to local air pollution	Almost certain	Minor	Significant	◗ Air quality management plans ◗ Regularly serviced vehicles ◗ Staff training	Possible	Minor	Moderate	
~~46~~		~~Consumption of fuel~~	~~Diesel is a fossil fuel. The mining and consumption of fossil fuels contribute to global warming~~	~~Almost certain~~	~~Minor~~	~~Low~~	~~◗ Regularly serviced vehicles~~ ~~◗ Staff training~~	~~Unlikely~~	~~Insignificant-Minor~~	~~Low~~	
47		Increased traffic on ~~surrounding roads~~ public roads during operation	Impact to tourists and other road users affected by increased traffic	Likely	Moderate	Significant	◗ Traffic management plans ◗ Community consultation and awareness program ◗ Trained staff	Possible	Insignificant-Minor	Low-Moderate	
48		Crash between operational-use vehicle and another road vehicle	~~Sustained~~ injury or death to one or more of the drivers/passengers	Rare	Extreme	Significant	◗ Traffic management plans ◗ Community consultation and awareness program ◗ Staff training ◗ Licensed drivers ◗ Emergency response plan	Rare	Extreme	Significant	
~~49~~	~~Natural Event~~	~~Earthquake~~	~~Earthquake causing injury or death to personnel~~	~~Rare~~	~~Extreme~~	~~Significant~~	~~◗ Emergency response plan~~ ~~◗ Trained staff~~ ~~◗ Construction management plans~~	~~Rare~~	~~Extreme~~	~~Significant~~	
~~50~~		~~Earthquake~~	~~Damage to infrastructure~~	~~Rare~~	~~Extreme~~	~~Significant~~	~~◗ Emergency response plan~~ ~~◗ Remedial protection works~~ ~~◗ Trained staff~~ ~~◗ Construction management plans~~	~~Rare~~	~~Extreme~~	~~Significant~~	

~~51~~		~~Severe hailstorm event~~	~~Damage to infrastructure~~	~~Rare~~	~~Extreme~~	~~Significant~~	~~Emergency response plan~~ ~~Remedial protection works~~ ~~Trained staff~~ ~~Construction management plans~~	~~Rare~~	~~Extreme~~	~~Significant~~
Processing Site										
*New Risk	General Operation	Spillage/leak of reagents and/or chemicals due to failure or damage to storage containment	Impacts from leaking chemicals could cause a number of impacts from low to major localized risk health concerns	Possible	Minor to Extreme	Moderate to Significant	Design of a purpose built storage warehouse Site-based storage and handling management plan Development Approval conditions Chemicals stored according to MSDS requirements Staff training	Rare	Extreme	Moderate to Significant
*New Risk		Acts of terrorism/vandalism at the processing plant	Damage to equipment causing explosions or leak of hazardous chemicals or radioactive material causing injury or death	Rare	Extreme	Significant	Site security Emergency response plan Staff training	Rare	Extreme	Significant
*New Risk		Fuel/oil/chemical spill	Potential localised contamination to soil and groundwater	Possible	Moderate	Significant	Operational management plans Appropriate bunding for generator Hydrocarbon spill management plan	Unlikely	Moderate	Moderate
*New Risk		Fire in process plant areas	Plant fails and fuel/chemical/ process water is released	Rare	Major	Significant	Operational management plans Emergency response plans Trained staff Fire fighting equipment	Rare	Major	Significant
*New Risk	Waste Management	Air emissions	Emissions to air from processing (e.g. sulphuric acid leach) can contribute to local air pollution	Almost certain	Moderate	Significant	design of the plant to manage and mitigate potential impacts of these emissions on air quality	Possible	Moderate	Significant
*New Risk		Process water seepage or overtopping from residue storage facilities	Process water contaminating soil and/or groundwater	Possible	Major	High	Design according to ANCOLD guidelines Monitoring bores Embankment piezometers Embankment survey pins Radioactivity monitoring The Processing Site is positioned on shallow basement rocks, and this location results in	Unlikely	Major	Significant

						a much higher level of safeguard against potential leachate escape; and drilling indicates that the likelihood of groundwater below the Processing Site is low. ◗ Ongoing testwork to determine appropriate long term management and storage ◗ The level of radioactivity in each process stream is clearly modelled, including the forward growth and decay curves where decay chains have been chemically cleaved ◗ Arafura has successfully identified points in the process where decay chains are cleaved and the deportment of each significant contributor between the in-process phases.				
*New Risk	Processing of ore containing rare earths and radiative elements	Radiation hazards associated with processing	Certain	Major	High	◗ •Arafura has assembled a significant knowledge base in radionuclide deportment and radiation management that will be further developed and implemented as the Project moves through execution and into operations ◗ Monitoring duration of exposure ◗ Rostering staff on and off (or into other areas of mine operation) to limit exposure to radiation ◗ Comply with ARPANSA requirements	Certain	Insignificant	Significant	Health impacts are related to duration of exposure to radiation. Strict regulatory industry guidelines and monitoring practices are required and will be implemented.
*New risk	Exposure to radiation	Short-term exposure to member of public resulting in potential adverse health impact	Possible	Minor	Moderate	◗ Restricted site access (fencing and site communications) to limit uncontrolled access ◗ Comply with ARPANSA requirements	Rare	Insignificant	Low	Health impacts are related to duration of exposure to radiation. Uncontrolled access to site would be controlled by fencing, signage etc. and trespassers would be quickly identified and exposure would be short term, limiting likelihood and consequence.

*New Risk	Consumption of fuel	Diesel / gas is a fossil fuel. The mining and consumption of fossil fuels contribute to global warming	Almost certain	Minor	Low	◗ Regularly serviced vehicles ◗ Staff training	Unlikely	Insignificant-Minor	Low
*New Risk	Consumption of water	Water drawdown in the aquifer and impacts on groundwater quantity	Possible	Moderate	Moderate	◗ Bores will be distributed spatially across the bore field area to ensure the aquifer system is managed sustainably. ◗ Monitoring bores are established and a management framework has been proposed to monitor all impacts from the proposed borefield groundwater abstraction.	Possible	Moderate	Moderate