GLOSSARY

Below are examples of key terms that may be used in the EIS.

Key term	Definition
1s to 7s	When referring to ore and stockpiles indicates the amount of extractable uranium in the ore (grade). At Ranger, 1s indicates the lowest grade (waste) and 7s indicates the highest grade ore.
Aboriginal Areas Protection Authority	An independent statutory organisation established under the Northern Territory Aboriginal Sacred Sites Act. It is responsible for overseeing the protection of Aboriginal sacred sites on land and sea across the whole of Australia's Northern Territory.
Acid rock drainage	Also referred to as acid mine drainage. Is the outflow of acidic water from mining operations caused by the exposure of reactive sulfide-bearing minerals in rocks (e.g. pyrite) to atmospheric oxygen and water, and is often accelerated by microbiological activity.
Acid neutralisation capacity	Acid neutralisation capacity refers to the overall buffering capacity of, for example, a sediment or surface water – e.g. its ability to keep the pH stable as acid is added.
Additional annual load limit(s)	Additional annual load limit(s) are the additional load of constituents that can be released to the Magela Creek, above background levels.
Aggregate	Crushed and screened rock, typically 2's very low grade rock, that can be used as backfill material underground.
Air NEPM	National environment protection measure for ambient air quality.
Alimak	The Alimak system is a winch system similar to a conventional lift that can be used for emergency egress from the underground area. This type of system is used extensively in road tunnel construction.
Ammonium diurinate	The bright yellow solid that forms in the precipitation circuit at Ranger (often known as yellowcake).

Key term	Definition
ANFO	Ammonium Nitrate - Fuel Oil Solution: A free flowing mixture of porous Prilled Ammonium Nitrate and Fuel Oil formulated to be oxygen balanced for use in dry blast holes.
Aqueous ammonia	Used to control pH within the solvent extraction circuit.
Alligator Rivers Region	The Alligator Rivers Region comprises an area of approximately 28,000 km^2 and includes the catchments of the West, South and East Alligator Rivers, extending east into Arnhem Land and south into the Gimbat and Goodparla pastoral leases. The world heritage listed Kakadu National Park is located within the Alligator Rivers Region.
as low as reasonably achievable	Abbreviated to ALARA. As low as reasonably achievable, economic and social factors being taken into account.
as low as reasonably practicable	Abbreviated to ALARP. The exposure of workers and others to asbestos must be eliminated or otherwise kept as low as reasonably practicable, and in all circumstances must be kept below the National Exposure Standard.
attenuation (of sound)	Reduction of sound energy - particularly in reference to the installation of sound absorbing materials or barriers to reduce sound levels emitted to the environment.
Australian Atomic Energy Commission	The Australian Atomic Energy Commission is a statutory body of the Australian government. The AAEC was established in 1952 and attained a statutory basis on 15 April 1953 when the Atomic Energy Act (1953) came into effect. In 1981 parts of the Commission were split off to become part of CSIRO, the remainder continuing until 1987, when it was replaced by the Australian Nuclear Science and Technology Organisation (ANSTO).
Backfill	A paste composed of a mixture of tailings from the processing plant, aggregate (crushed very low grade ore), cement and water - used to provide ground support in mined out parts of the mine.
Backfill plant	New equipment planned for installation that will include tailings filtration, aggregate stockpiles, cement silos and a batching unit for the production of a paste for delivery underground to backfill void spaces.
Backs	The term used to describe the roof of the underground mine drive.

Key term	Definition
Belt filter	A plant component that dewaters a slurry through the application of a vacuum to the bottom of a drainage belt carrying uniformly distributed slurry. The vacuum draws the liquid contained in the slurry through a filter cloth into a collection pan, leaving a filter cake or lower moisture content.
Beneficiation	Separation of the valuable material of an ore from the waste material, prior to further processing.
Brine	A rejects stream (salt solution) derived from the treatment of process water via the brine concentrator.
Carbon dioxide equivalent	Abbreviated to $CO_{2\text{-}e}$. A measure, using carbon dioxide (CO_2) as the standard. Used to compare the global warming potentials of the different greenhouse gases.
Cased borehole	A cased borehole that has been sleeved with a pipe.
cemented tailings paste aggregate fill	Comprises a mixture of tailings, aggregate and cement made into a paste that is delivered underground to backfill stopes at the completion of mining.
Centrifugal force	A force that causes an object moving in a circular path to move out and away from the centre of its path.
Computable general equilibrium	Computable general equilibrium models are a class of economic models that use actual economic data to estimate how an economy might react to changes in policy, technology or other external factors.
Contaminants of potential concern	Contaminants of potential concern included magnesium (Mg), uranium (U), manganese (Mn), radium (^{226}Ra), total ammonia as nitrogen (TAN), nitrate as nitrogen (NO_3-N), total phosphate (total-P), and polonium (^{210}Po).
Crosscut	A horizontal opening driven across the course of a vein or structure, or in general across the strike of the rock formation; a connection from a shaft to an ore structure.
Crushing and screening plant	Unit of plant, either fixed or mobile, used to crush and screen material to meet a desired size fraction.
Cuddy	A small area or "room" excavated off the side of the underground mine workings where equipment or material can be stockpiled – e.g. a stockpile cuddy.

Key term	Definition
dB(A)	The symbol used in acoustics to measure sound pressure level. The "A weighting" is the most commonly used of a family of logarithmic curves relating to the measurement of sound pressure level of low-level sounds.
Development	The underground work carried out for the purpose of reaching and opening up a mineral deposit. It includes shaft sinking, crosscutting, drifting and raising.
Djalkmarra land application area (and extension)	The Djalkmarra land application area was commissioned in 1997 and covers and area of 18 ha across a tract of sparse native woodland north of the Pit 3 access road. The Djalkmarra land application area extension was commissioned in 1999 and covers an area of 20 ha, east of Djalkmarra land application area. Both land application areas currently receive polished pond water.
Electrical conductivity	Abbreviated to EC. Electrical conductivity is a measure of how well a material accommodates the transport of electric charge.
Emergency egress	A means of exit that people can access safely in an emergency
Environmental Impact Statement	Abbreviated to EIS. An environmental impact statement details the anticipated environmental effects of a development on the environment, based on detailed studies. The aim of the EIS process is to reduce, offset or prevent significant negative environmental impacts of a development. Essentially, the EIS is the formal response by a proponent to government environmental assessment legislation and is made available to the public for comment. The final EIS forms the basis on which regulatory decision makers consider the ensuing environmental impacts when deciding whether to proceed with a project.
Environmental Requirements	The Ranger Environmental Requirements are attached to the s.41 Authority and set out Primary and Secondary Environmental Objectives which establish the principles by which the Ranger operation is to be conducted, closed and rehabilitated and the standards that are to be achieved.
Exploration decline	The sloping development drive from the surface into the Ranger 3 Deeps underground mine. At the surface, the decline begins at the portal.
Flocculant	A chemical added to a thickener to assist in agglomeration and settling of solid particles within the thickener.

Key term	Definition
Footwall	The wall or rock on the underside of a vein or ore structure.
Geocentric Datum of Australia	Abbreviated to GDA. GDA is the latest Australian coordinate system, replacing the Australian Geodetic Datum (or AGD).
Georgetown Billabong	The statutory surface water monitoring point for Georgetown Billabong, which is located downstream of Corridor Creek and the Corridor Creek wetland filter.
Geographic information system	Abbreviated to GIS. A system designed to capture, store, manipulate, analyse, manage, and present all types of geographically referenced data.
Geotechnics or geotechnical	The branch of engineering concerned with the study of soil and rock properties. In the mining context, key issues are associated with rock strength and ground support requirements.
Hanging wall sequence	Consists of schists composed of muscovite, biotite, quartz, hematite, garnet, and/or magnetite. The hanging wall sequence is intersected by numerous thin quartz and amphibolite intrusions, and by a single, thick (20-30 m) amphibolite sill near its base. Shear and/or brecciated zones are found throughout the unit.
Hard Showstopper	As part of the best practicable technology assessment an option (alternative) can have a Hard Showstopper allocated to it where it was clear from the initial assessment that the option is unacceptable and therefore required no further assessment is required and the option is not progressed. This might occur, for example, if an initial assessment demonstrated that adoption of the option could result in intrusion on a sacred site.
Hydro-cyclone	A plant component that uses centrifugal force to separate solids from liquids in a slurry.
Incremental	Term typically used to define the total Project contribution associated with a particular environmental aspect, e.g. emissions associated with power generation. Cumulative emissions are therefore the combination of existing Ranger mine operations and incremental contributions.
Indicated resource	Resource defined in sufficient detail to develop a mine plan and estimate the economic viability of the deposit; less well defined than measured resource.

Key term	Definition
Inferred resource	A resource where quantity and grade is estimated based on limited geological evidence and sampling, and has a lower level of certainty.
Jabiru East land application area	An area of 52 ha on the old Jabiru East town site. The areas are operated during daylight hours and receive polished pond water or permeate.
Jumbo	A drill rig used underground for creating development drives.
Land Application Area	Abbreviated to LAA. An area on the RPA used as an evapotranspiration-based disposal method for both polished and unpolished pond water from the constructed wetland filters and, more recently, permeates from the water treatment plants. However, irrigation of unpolished pond water ceased at the end of 2009. The concept of land application is to retain metals and radionuclides in the near- surface parts of the soil profile.
Land disturbance permit	An ERA permit required prior to undertaking any work on the RPA that may lead to surface/ground disturbance. This includes surface disturbance with, for example, ground breaking machinery including: grading, bulldozing, scraping, trenching, tree clearing, slashing, clearing with tractor or bobcat bucket, backhoe operations, track widening or maintenance.
Leach	To remove soluble components from a solid by the action of contact (via mixing) with a liquid.
Long lived alpha activity	Abbreviated to LLAA. The presence, generally in airborne dust, of any of the alpha emitting radionuclides in uranium ore, except for the short lived alpha emitting radon decay products.
Lower mine sequence	The lower mine sequence consists primarily of carbonate, with interbedded schist and chert. The lower carbonate appears to have been recrystallised during metamorphism to a magnesian marble, while the upper carbonate is an impure dolomite with interbedded chlorite schist and patches of massive chlorite. In some locations, portions of both carbonates have been replaced by chert. The lenticular schist consists of quartz, chlorite, and sericite, and is at most a few metres thick. Uranium mineralisation in the lower mine sequence occurs in the lenticular schist and massive chlorite.

Key term	Definition
Magela creek downstream	Abbreviated to MG009. MG009 is Ranger downstream statutory or compliance surface water monitory point. It is located on the Magela Creek, downstream of Ranger operations.
Magela Creek upstream	Abbreviated to MCUS. MCUS is the upstream statutory surface water monitoring point, located on the RPA.
Magela land application area (and extension)	Abbreviated as MLAA and MLAA ext, respectively. The MLAA and MLAA ext were the oldest land application areas on the RPA, commissioned in 1985 and 1994, respectively. The MLAA was decommissioned in 2007 and rehabilitation trails have commenced. The MLAA ext has not been in operation for several years.
Maximum operating level	Refers to the maximum water level that the tailings dams is authorised to operate.
Measured resource	Resource estimated to a high level of confidence and which can support detailed mine planning and final evaluation of the economic viability of the deposit.
Micro filtration reverse osmosis	A process where raw water is filtered through a micro-membrane that allows water to pass through but which retains ionic substances such as salt.
Mineral reserve or ore reserve	A mineral deposit from which it is economically and technically feasible to extract a valuable mineral.
Nephelometric Turbidity Unit	Abbreviated as NTU: a unit measuring the opacity or muddiness caused by particles, etc.
Net acid generation	The net acid generation procedure is used to confirm if acid generation is possible in the potentially acid forming material identified by the acid-base account. The net acid generation result is indicative of the potential for a material to produce acid after a period of exposure and weathering. It also provides a direct assessment of the potential for acid formation.
Net acid producing potential	A parameter of acid-base accounting that indicates whether a particular material is acid generating or acid consuming. This parameter is obtained from the difference between the maximum potential acidity and acid neutralisation capacity. Positive net acid producing potential values are indicative of materials that have the potential to produce acidity while negative net acid producing potential values are indicative of the potential of the materials to neutralise acids.

Key term	Definition
Nitrogen oxides	Abbreviated as NO_x. A group of highly reactive gasses known as "oxides of nitrogen". Nitrogen dioxide (NO_2) is the recognised indicator for the remainder of the group. NO_2 is known to contribute to fine particle pollution and have adverse effects on the respiratory system. NO_x are pivotal to the formation of tropospheric ozone (O_3).
Non-acid forming	Non-acid forming refers to geologic materials with a relatively high acid neutralising capacity. These rocks are chemically stable and will not generate any by-products which could impact on the environment.
Non-mineral waste	Liquid and solid wastes primarily derived from materials that have been used to support mining and mineral processing activities. These wastes include oils, tyres, scrap steel, batteries and domestic/office rubbish. These are collected, separated, recycled and treated according to ERA's existing non-mineralised waste management plan.
Notice of Intent	A Notice of Intent is the initial notification of a proposed action to the designated Minister. The Notice of Intent provides essential details on the proposed action to assist in determining the potential level of environmental impact and the subsequent level of regulatory assessment that may be required.
OPSIM	The operational water balance model for the Ranger uranium mine. OPSIM is a trademark of Water Solutions Pty Ltd, the owner and licensor of the OPSIM™ software.
Ore drive	A tunnel constructed to access the ain ore producing areas of a mine.
Ore sorter	Existing Ranger infrastructure which recovers uranium from low grade ore materials by separating mineralised fragments from non-mineralised fragments using radiation detectors and air jets
pH	The measure of the acidity of a solution. Solutions with a pH less than 7 are said to be acidic and solutions with a pH greater than 7 are said to be basic or alkaline.
Pit 1	The mined out pit of the Ranger #1 orebody, which is used as a tailings repository. Mining in Pit 1 commenced in May 1980 and was completed in December 1994 after recovering 19.78 million tonnes of ore at an average grade of 0.321 %.

Key term	Definition
Pit 3	The current operating pit at Ranger to shell 50 specifications. Open cut mining of orebody #3 commenced in July 1997 and ceased in November 2012.
Pit 3 under fill	Pit 3 is currently being backfilled with waste rock and low grade mineralised rock to form a base for the placement of tailings into the Pit and provide a storage area for brines produced from the treatment of water with the Brine Concentrator.
Processing	Processing is the mining term to describe all phases of the ore treatment from milling through to the final product packaging of uranium oxide.
Radon	A radioactive, colourless, odourless gas that naturally forms from the radioactive decay of uranium.
Radon decay products or radon progeny	The short lived radioactive decay products of radon-222. This includes the decay chain up to, but not including, lead-210, namely polonium-218 (sometimes called radium A), lead-214 (radium B), bismuth-214 (radium C) and polonium-214 (radium C′).
Ranger Project Area	Abbreviated as RPA. The Ranger Project Area means the land described in Schedule 2 to the Commonwealth *Aboriginal Land Rights (Northern Territory) Act 1976*.
Ranger operational mine area or mine footprint	Refers to the area of the RPA within the immediate vicinity of Pits 1 and 3, which has undergone intensive modification attributed to mining activties and infrastructure, as shown in Figure 2-18.
Retention Pond 1	Abbreviated as RP1. One of four retention ponds used to provide sediment control, dilution and storage of pond and managed release waters. RP1 provides approximately 390 megalitres of storage under normal conditions. RP1 also provides sediment control and dilution prior to passive release into the environment across a control weir and spillway.
Retention Pond 2	Abbreviated as RP2. One of four retention ponds used to provide sediment control, dilution and storage of pond and managed release waters. RP2 provides approximately 1,150 megalitres of storage. It is the primary distribution point to all pond water disposal facilities and contains seepage water and runoff from mineralised stockpiles.

Key term	Definition
Reference level	Abbreviated as RL: Denotes a specific elevation relative to mean sea level and is regularly used to identify the height or depth of plant or mine infrastructure – e.g. the height of the tailings dam, depth of the operating pit (Pit 3).
Rheology	Flow and deformation properties (of the backfill).
Rock bolts and cable bolts	Long anchor bolts used to stabilise the underground mine areas.
Run of mine	Run of mine refers to the raw material that is delivered from the mine and prior to treatment of any sort. Pertains to ore just as it is mined.
Saturated zone	The portion of the sub-surface wherein most of the pores are filled with groundwater. The saturated zone lies below the water table.
Secondary containment	A collection system that facilitates rapid containment of spillages.
Soft Showstopper	As part of the best practicable technology assessment an option (alternative) will have a Soft Showstopper allocated to it if a rank equal to 1 or 2 was attributed to any criterion involving occupational health and safety issues, off-site environmental protection issues, or cultural issues. The recording of a Soft Showstopper against an option does not necessarily rule out that option; however, it indicates that performance of the option against the particular criterion would need to be reviewed and improved before the option could be considered acceptable.
Straddle-packer hydraulic testing	Hydraulic testing of a section of a borehole that has been isolated by two inflatable packers
Shotcrete	An all-inclusive term for both wet mix and dry mix version of concrete. Shotcreting is "the spraying of concrete via air or hydraulic pressure."
Sievert	The sievert is the unit of absorbed radiation dose, taking into account the differing biological effects of different types of radiation.
Stope	An excavation, typically of large dimensions, created by long-hole drill-and-blast techniques when ore is mined; an ore production area.
Sulfur oxides	Abbreviated as SO_x. Sulfur oxides are compounds of sulfur and oxygen molecules of which sulfur dioxide (SO_2) is the predominant form found in the lower atmosphere. Anthropogenic sources of SO_x are produced by burning fuels containing sulfur – e.g. fossil-fuel combustion, smelting, etc.

Key term	Definition
	Exposure to sulfur oxides has been linked to health disorders and environmental harm.
Tailings dam	Surface dam used to hold tailings at Ranger. Commonly referred to as "tailings storage facility or TSF" in other ERA material. The tailing dam is one of currently two tailings storage facilities at Ranger, the other being Pit 1.
Tramp metal	Unwanted pieces of metal (in an ore stockpile).
the Project	Refers to the Ranger 3 Deeps underground mine project.
U_3O_8	The most stable form of uranium oxide and the form most commonly found in nature. Uranium oxide concentrate is sometimes loosely called yellowcake. It is khaki in colour and is usually represented by the empirical formula U_3O_8. Uranium is normally sold in this form.
Unable-to-Evaluate (UTE)	A UTE status is given to options identified during the Best Practicable Technology (BPT) analysis where insufficient information is available to allocate a rank to a criterion associated with the option. UTEs result in actions being developed to address the lack of knowledge and to ensure that sufficient information is made available for evaluation of the option prior to completion of the assessment.
Upper mine sequence	The upper mine sequence consists largely of quartz-biotite or chlorite schist. Where uranium mineralisation has occurred in the Deeps Fault zone, the schist has been altered to chlorite schist, chlorite biotite schist, and graphitic schist. The upper mine sequence is penetrated by numerous thin pegmatite and quartz intrusions, most less than 1 m thick. Shear and/or brecciated zones are found throughout the unit. Carbonaceous bands (metamorphosed shales) occur in some parts of the upper mine sequence. The upper mine sequence contains minor carbonate lenses of uncertain continuity. The lower upper mine sequence, originally deposited as fine mudstone with interbedded silts and fine arenites, is dominated by chlorite schist, while the upper upper mine sequence, originally deposited as a coarse, impure arenite, contains more quartz-(biotite)-chlorite schist. Uranium mineralisation is concentrated in the lower upper mine sequence, below the base of the arenite.
Vadose zone	The portion of the sub-surface that lies between ground surface and the saturated zone.

Key term	Definition
Ventilation district(s)	A section of the underground mine workings that are all connected to the same primary ventilation circuit, having a single return air raise with surface fans. There are four ventilation districts, south, central, north and far north.
Ventilation raise	A vertical opening used to either deliver fresh air into the mine or exhaust air from the mine. Termed fresh air raise or return air raise respectively.
Ventilation stack	The surface infrastructure on top of each ventilation raise.
Waste rock	The mineral waste produced in the mine but is stockpiled due to its low grade i.e. material which does not enter the processing plant. For example, 1s waste rock is typically material that has a grade of less than 0.02% U_3O_8; 2s waste rock (or low grade ore) is typically material that has between 0.02% and 0.12% U_3O_8.
weathered zone	Near surface rock that has been altered through weathering processes over time.
% w/w	Weight for weight: The weight of one component as a percentage of the total weight.
µS/cm	Microsiemens per centimetre are the unit of measure used to quantify electrical conductivity.

ABBREVIATIONS AND ACRONYMS

*** Denotes that the entry is listed in the glossary**

Abbreviation/ acronym	Description
ABS	Australian Bureau of Statistics
AEP	Annual Exceedance Probability
ALARA	as low as reasonably achievable*
ALARP	as low as reasonably practicable*
ANFO	Ammonium Nitrate - Fuel Oil Solution*
ANSTO	Australian Nuclear Science and Technology Organisation
ANZECC	Australian and New Zealand Environment and Conservation Council
ARI	Average Recurrence Interval
ARPANSA	Australian Radiation Protection and Nuclear Safety Agency
ARRAC	Alligator Rivers Region Advisory Committee
ARRTC	Alligator Rivers Region Technical Committee
ASNO	Australian Safeguards and Non-Proliferation Office
BoM	Bureau of Meteorology
BPT	Best practicable technology
CSIRO	(Commonwealth) Scientific and Industrial Research Organisation
dB(A)	decibels with an "A weighting filter"*
EC	electrical conductivity*
EIS	environmental impact statement*
EMP	environmental management plan(s)
EPA	(Northern Territory) Environmental Protection Authority
EPBC Act	(Commonwealth) Environment Protection and Biodiversity Conservation Act 1999
ERA	Energy Resources of Australia Ltd
ERISS	Environmental Research Institute of the Supervising Scientist
GAC	Gundjeihmi Aboriginal Corporation
GDA	Geocentric Datum of Australia*
GIS	geographic information system*
IAEA	International Atomic Energy Agency
ICRP	International Commission on Radiological Protection
LAA	Land Application Area*
MC009	Ranger downstream statutory surface water monitory site
MCUS	Ranger upstream statutory surface water monitoring site
MG001	Magela Creek gauging station 001
MNES	matters of national environmental significance

Abbreviation/ acronym	Description
MTC	Minesite Technical Committee
NEPM	National Environment Protection Measures
NLC	Northern Land Council
NT	Northern Territory
OPSIM	The operational water balance model for the Ranger uranium mine. OPSIM is a trademark of Water Solutions Pty Ltd, the owner and licensor of the OPSIM™ software.
OSS	Office of the Supervising Scientist
$PM_{2.5}$	$PM_{2.5}$ is particulate matter 2.5 micrometers or less in diameter. $PM_{2.5}$ is generally described as fine particles. By way of comparison, a human hair is about 100 micrometres, so roughly 40 fine particles could be placed on its width.
PM_{10}	PM_{10} is particulate matter 10 micrometers or less in diameter.
PPE	personal protective equipment
Q1 – (2,3,4)	Quarter calendar year (e.g. Q1 = Jan, Feb and Mar)
RL	Reference Level
RPA	Ranger Project Area*
RP1	Retention Pond 1* - also denotes other retention ponds used on site – e.g. RP2, RP3, RP6
RP2	Retention Pond 2*
SIA	Social impact assessment
SIMP	Social impact management plan
SSD	Supervising Scientist Division
TDS	total dissolved solids
TPWC Act	*Territory Parks Wildlife Conservation Act 2000*
TSP	total suspended particulate matter
UTE	Unable-to-Evaluate*

CHEMICAL SYMBOLS AND FORMULAE

*** Denotes that the entry is listed in the glossary**

Ca	calcium
$CaCO_3$	calcium carbonate
Cl	chloride
CO_2	carbon dioxide
$CO_{2\text{-}e}$	carbon dioxide equivalent*
Fe	iron
Fe_2O_3	iron (III) oxide
HCO_3	bicarbonate
HNO_3	nitric acid
H_2S	hydrogen sulfide
H_2SO_4	sulfuric acid
K	potassium
Mn	manganese
Mg	magnesium
N	nitrogen
NH_4^+	ammonium
NO	nitric oxide
N_2O	nitrous oxide
NO_2	nitrogen dioxide
NO_3^-	nitrate
NO_2^-	nitrite
NO_x	nitrogen oxides*
NO_3-N	nitrate as nitrogen
O_3	ozone
P	phosphorus
PO_4	phosphate
^{210}Po	polonium 210
^{226}Ra	radium-226
Rn	radon-222
SO_2	sulfur dioxide
SO_4	sulfate
SO_x	sulfur dioxides*
total-P	total phosphate
U	uranium
^{234}U	uranium-234

^{238}U	uranium-238
U_3O_8	uranium oxide*

ABBREVIATIONS AND SYMBOLS FOR UNITS OF MEASUREMENT

*** Denotes that the entry is listed in the glossary**

Unit of measure	Description
a	year (from Latin *annus* = year)
Bq	becquerel(s)
Bq/L	becquerel(s) per litre
°C	degree(s) Celcius
c	centi- (SI prefix = 0.01 or 10^{-2}, or one hundredth)
cm	centimetre
dB	decibels
dBA	decibels measured using the "A weighting filter"*
G	giga- (SI prefix = 1,000,000,000 or 10^{9}, or one billion)
GJ	gigajoule(s)
GL	gigalitre(s)
GWh	gigawatt hour(s)
g	gram(s)
g/L	gram(s) per litre
g/m^2	gram(s) per square metre
h	hour(s)
ha	hectare(s)
Hz	hertz
k	kilo- (SI prefix = 1,000 or 10^{3}, or one thousand)
kg	kilogram
kg/d	kilogram(s) per day
$kg/ha.a^{-1}$	kilogram(s) per hectare per annum
kg/m^3	kilogram(s) per cubic metre
kg/t	kilogram(s) per tonne
kHz	kilhertz
kL	kilolitre
km	kilometre(s)
km/h	kilometre(s) per hour
km^2	square kilometre
kt	1,000 metric tonnes
kW/h	kilowatt(s) per hour
kWh	kilowatt hour(s)
L	litre(s)

Unit of measure	Description
LA_{eq}	The average noise level over a certain time period
M	mega– (SI prefix = 1,000,000 or 10^6, or a million)
Mm^3	million cubic metres
ML	megalitre(s), equivalent to thousand cubic metres (1 ML = 1,000 m^3)
ML/a	megalitres per annum
m	metre(s)
m^2	square metre(s)
m^3	cubic metre(s)
m^3/s	cubic metre(s) per second
m	milli- (SI prefix = 0.001 or 10^{-3}, or one thousandth)
mBq/L	milli-becquerel(s) per litre
mg	millgram(s)
mg/L	milligram(s) per litre
mL	millilitres
mm	millimetre(s)
mm/h	millimetre(s) per hour
mol	mole
mSv	milliSievert A milliSievert is one thousandth of a Sievert (1000 mSv = 1 Sv)
Mt	million tonnes
Mtpa	million tonnes per annum
MW	megawatt is a unit of measuring instantaneous power that is equivalent to one million watts
MWh	megawatt hours
NTU	Nephelometric Turbidity Units*
pH	The measure of the acidity of a solution.* Solutions with a pH less than 7 are said to be acidic and solutions with a pH greater than 7 are said to be basic or alkaline.
P	peta- (SI prefix = 1,000,000,000,000,000 or 10^{15}, or one quadrillion)
PJ	petajoule(s)
ppb	parts per billion
ppm	parts per million
rpm	revolutions per minute
s	seconds
Sv	Sievert The sievert is the unit of absorbed radiation dose, taking into account the differing biological effects of different types of radiation.
t	tonne(s)
t/a	tonne(s) per annum
$tCO_{2\text{-}e}$	tonne(s) of carbon dioxide equivalent
T	tera- (SI prefix = 1,000,000,000,000 or 10^{12}, or one trillion)
TJ	terajoule
tph	tonne(s) per hour – ore throughput

Unit of measure	Description
%	percent
% w/w	weight for weight* The weight of one component as a percentage of the total weight.
µ	micro- (SI prefix = 0.000001 or 10^{-6}, or one millionth)
µg	microgram(s)
µg/L	microgram(s) per litre
µJ/m^3	microjoules per cubic metre
µm	microns
µS/cm	microsiemens per centimetre* (unit of measure used to quantify electrical conductivity)

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Stephen Pevely	ERA	Resource geology
Steve Green	JBS & G	EIS advisor
EIS document reviewers		
Andrea Sutton	ERA	Chief executive
James May	ERA	Chief financial officer
Alan Tietzel	ERA	External relations
Callan Harding	ERA	Business development

Person	Company	Role/Responsibility
Carl Kitchen	ERA	External relations
David Stark	ERA	Engineering
Greg Sinclair	ERA	Technical and major studies
Jody Clark	ERA	Tailings, water and closure engineering
Marc Smith	ERA	Human resources and community relations
Mark Nott	ERA	Prefeasibility study
Michelle Illes	ERA	Water science
Ping Lu	ERA	Ecology
Tim Eckersley	ERA	Mining and processing operations
Tom Wilcox	ERA	Legal
Technical Studies (Coordination)		
John Murphy	ERA	Mine engineer, drawings
Mark Nott	ERA	Prefeasibility study
Simon Kusabs	ERA	Mine design
Stephen Tysoe	ERA	Infrastructure design
Technical Studies (Consultants)		
Andrew Derrington	OzVent Consulting Pty Ltd	Ventilation modelling
Ed Gleeson	AMC Consultants Pty Ltd	Mining description
Specialist studies, workshops		
Air quality study		
Emir Kanalic	Pacific Environment Ltd	Air quality modelling
Mitch Kelly	Pacific Environment Ltd	Air quality modelling
Robin Omerod	Pacific Environment Ltd	Air quality modelling
Health, safety and radiation study		
Jim Hondros	JRHC Enterprises Pty Ltd	Health, safety and radiation
Phil Crouch	Papari Radiation Services	Radiation
Hydrogeology		
John Pickens	INTERA Incorporated	Groundwater modelling, project lead
Cheng Cheng	INTERA Incorporated	Groundwater modelling
Bill Linderfelt	INTERA Incorporated	Groundwater modelling
Dennis Fryar	INTERA Incorporated	Groundwater modelling
John Sigda	INTERA Incorporated	Groundwater modelling
Randy Arthur	INTERA Incorporated	Geochemical modelling
Richard Beauheim	INTERA Incorporated	Hydro testing
Dale Bowman	Hydroresolutions	Hydraulic testing
David Chase	Hydroresolutions	Hydraulic testing
Michael Fort	Hydroresolutions	Hydraulic testing
Randall Roberts	Hydroresolutions	Hydraulic testing
Noise and vibration		
Nathan Archer	SLR Consulting Australia Pty Ltd	Noise and vibration, project lead

Person	Company	Role/Responsibility
John Cotterill	SLR Consulting Australia Pty Ltd	Technical acoustics
Paul Turyn	SLR Consulting Australia Pty Ltd	Noise monitoring
Social Impact Assessment and Community Consultation		
Bill Kruse	Banarra	Project director
Richard Boele	Banarra	Managing director
Catriona Peterson	Banarra	Project lead
Christine Crispin	Banarra	Analysis lead
Claire Tucker	Banarra	Field team
Špela Berlec	Banarra	Desktop analysis
Frank Vanclay	University of Groningen	Peer review
Murray Garde	-	Anthropologist and linguist
Traffic study (and traffic risk workshop attendees)		
Nicole Conroy	GHD Pty Ltd	Environment, study lead
Alex Holmes	GHD Pty Ltd	Ecology
Chris Hall	GHD Pty Ltd	Traffic and transport
Helen Flynn	GHD Pty Ltd	Risk consultant
Matthew Weir	GHD Pty Ltd	Risk consultant
Brad McDougall	Chemtrans	Operations
David Haynes	Kalari Pty Ltd	Quicklime supplier
David van Heerden	Shell Company of Australia	Transport, supply and distribution
Garry Fischer	Northern Territory Department of Transport	Network operations
Geoff County	Orica Chemicals Pty Ltd	Supply chain
Neil Ketteringham	ERA	Supply coordinator
Shaun Stewart	Direct haul	Health, safety and environment
Steve Bartlett	ERA	Contractor management and commercial
Vittorio Bianco	Orica Chemicals Pty Ltd	Product specialist
Vegetation and fauna study		
Sarah Smith	Eco Logical	Project Manager
Maria Kraatz	Eco Logical	NT Manager
Andrew Buick	Eco Logical	Environment
Anja Zimmermann	Eco Logical	Vegetation
Ian Dixon	Eco Logical	Vegetation
Ranid May	Eco Logical	Fauna
Robert Browne-Cooper	Eco Logical	Fauna
Sarah Dalgleish	Eco Logical	Vegetation
Steve Dimitriadis	Eco Logical	Web application
Vivian Hamilton	Eco Logical	Spatial analysis
BPT and risk assessment – workshop		

Person	Company	Role/Responsibility
Arthur Johnson	EnradOz	Strategic advisor, review
William Danaher	RMI Pty Ltd	Risk facilitator, analysis, reporting
Amy Lamb	Rio Tinto	Test work and processing
Bruce Foster	Rio Tinto	Environment
Catherine Turyn	Rio Tinto	Environment
Claire Tucker	Banarra	Field team
Daniel McIntyre	ERA	Spatial science, environment
Ed Gleeson	AMC Consultants Pty Ltd	Mining description
Glenn Woodrow	ERA	Environment
Jim Hondros	JRHC Pty Ltd	Health, safety and radiation
Jody Clark	ERA	Tailings, water and closure engineer
John Murphy	ERA	Mine engineer, drawings
Lachlan Wilkinson	JBSG	EIS advisor
Larissa von Gerhardt	ERA	Communications, design
Linda Pugh	ERA	Environment
Luci David	ERIAS Group	Environment, technical editing
Mark Nott	ERA	Prefeasibility study
Michelle Iles	ERA	Water science
Mike Jones	ERIAS Group	Water, technical editing
Nicole Jacobsen	ERA	Community relations and cultural heritage
Peter Anderson	ERA	EIS Project management
Ryan Gordon	ERA	Operations engineer
Sarah Smith	Eco Logical	Ecologist, project lead
Sharon Paulka	ERA	Radiation and closure
Simon Kusabs	ERA	Mine engineer
Stephen Booth	ERA	Hydrology
Stephen Pevely	ERA	Resource geologist

LIST OF CONTRIBUTORS

Person, Qualifications	Experience / Consultancy Website[1]	Company	Role / Responsibility
EIS study coordination and document preparation			
Peter Anderson, BSc(Hons), PhD	15 years metallurgical research, 4 years regulatory approvals	ERA	EIS Project management
Daniel McIntyre BSc(Hons)	10 years environmental science (research, mining and approvals)	ERA	Spatial science, environment
Glenn Woodrow MEnv.Mgt	7 years environmental science	ERA	Environment
Larissa von Gerhardt BBus	5 years in communications	ERA	Communications, design
Linda Pugh BSc	9 years mining industry, 8 years corporate and regulatory reporting and statutory approvals	ERA	Environment
Nicole Jacobsen BSc	11 years in water science, communities and social performance	ERA	Community relations and cultural heritage
Sharon Paulka BAppSc	24 years environmental radioactivity, radiation protection in uranium mining, regulatory approvals and environmental, safety and health management	ERA	Radiation and closure
Bruce Foster BSc Forestry (Hons), PhD	30 years mine site environmental management, regulatory approvals and mine developments	Rio Tinto	Environment
Catherine Turyn BEnSc (Env.Mgt)	11 years in environmental industry	Rio Tinto	Environment
Luci David BSc(Hons)	18 years in environmental and social assessment, permitting and management of resource projects Information on ERIAS Group can be found at: www.eriasgroup.com	ERIAS Group	Technical editing
Michael Jones MAppSc	25+ years in environmental and social assessment, permitting and management of resource projects	ERIAS Group	Technical editing

[1] Information of the companies undertaking the impact assessment studies can be found at their respective websites. This information typically includes the qualifications and experience of key contributors.

Person, Qualifications	Experience / Consultancy Website[1]	Company	Role / Responsibility
EIS contributors			
Alan Irving MAgrSc	30 years in environmental management, monitoring and impact assessment in the mining and minerals processing sector	Rio Tinto	Environment, EIS strategy
Alana O'Neill BE (Env)	4 years in environmental engineering	ERA	Hydrogeology
Amy Lamb MSc	18 years in mineral processing and metallurgical engineering	Rio Tinto	Metallurgical Test work
Ben McTavish BEnSc	3 years resource sector, 5 years environmental consulting	ERA	Environment
Carmen Dyer BEnSc	9 years in environmental science	ERA	Environment
Cherie Gellert MESM	7 years environmental science and management	ERA	Environment
David Parry BAppSc, PhD	30+ years in research, consultancy (chemistry and ecotoxicology); advice and evaluations in environmental management and impact assessment in mining and minerals processing	Rio Tinto	Environment
Elizabeth Sarneckis GDip Mining Eng	7 years in mining industry	ERA	Business development
Graeme Esslemont BSc (Hons) PhD	16 years in mining, consulting, natural resource management and research	ERA	Hydrology
Greg Rogers BAppSc (Hons)	27 years in exploration and resource geology	ERA	Resource geology
Lachlan Wilkinson M Env S, CEnvP IA Specialist	30+ years environmental planning, management and environmental impact assessment (state and federal government regulator and consultant) Information on JBS&G can be found at: www.jbsg.com.au	JBS&G	EIS advisor
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Mark Lewty B Forestry, PhD Botany	30+ years in forestry	ERA	Rehabilitation, ecology
Michelle Bush B.Env.Mgt(Hons), M. Min. Res. (Env)	10 years in environmental management in the mining industry	ERA	Environment
Pat Carrick	30+ years in cultural heritage and communities and working with local indigenous communities	ERA	Cultural heritage

Person, Qualifications	Experience / Consultancy Website[1]	Company	Role / Responsibility
EIS contributors (continued)			
Peter Lander BSc (Env), GDip (Sustainable Land Mgt)	17 years in environmental management	ERA	Environment
Stephen Booth MSc	40 years water resource supply and regulation, multilateral geoscience aid organisations, and consultancies (mining, environment, hydrogeology)	ERA	Hydrogeology
Stephen Pevely MSc mining geology	20+ years in underground and open cut mining geology and mineral exploration	ERA	Resource geology
Steve Green BAppSc (Physics)	25 years environmental management and regulatory approvals in mining and infrastructure, including radiation management in mining	JBS&G	EIS advisor
Thomas Marshall BE(Hons)	4 years running ERA's water balance model	ERA	Water Inventory modelling
EIS document reviewers			
Andrea Sutton BE (Chem) (Hons), GDip Economics	20 years in the resource industry	ERA	Chief executive
James May FCA	14 years finance roles in the energy and extractive resource sector	ERA	Chief financial officer
Alan Tietzel MBA	25 years in mining including 17 years in External and community relations, human resources, regional development	ERA	External relations
Callan Harding BE (Hons)MCom	10 years in resource industry projects and business analysis	ERA	Business development
Carl Kitchen BArts (English)	18 years in corporate affairs	ERA	External relations
David Stark BE(Hons) Electrical	20+ years in mining industry in various disciplines.	ERA	Engineering
Greg Sinclair BAppSc, PhD	25+ in resource sector	ERA	Technical and major studies
Jody Clark BEng	17 years in mining industry with focus on water, tailings and closure	ERA	Tailings, water and closure engineering
Marc Smith BBus, GradCertBusLaw	13 years in human resources (industrial relations, indigenous employment, training and development) and community relations	ERA	Human resources and community relations

Person, Qualifications	Experience / Consultancy Website[1]	Company	Role / Responsibility
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Mark Nott BE (Chem) (Hons), MEngSc, PhD	25 years in resource industry (technical research, project studies and production roles)	ERA	Prefeasibility study manager
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Tim Eckersley BSc	25+ years resource management, regulatory approvals and mine management	ERA	Mining and processing operations
Tom Wilcox LLB, BComm	10 years in legal practice	ERA	Legal
Technical studies (coordination)			
John Murphy BE (Mining)	30 years in underground and open cut production, planning and management	ERA	Mine engineer, drawings
Mark Nott	As above	ERA	Prefeasibility study
Simon Kusabs BEng	20 years in mine engineering	ERA	Mine design
Stephen Tysoe BEng	28 years in mechanical engineering and closure activities	ERA	Infrastructure design
Technical studies (consultants)			
Andrew Derrington BE (Mining)	27 years in mining engineering including 22 years working as a metalliferous mine ventilation consultant	OzVent Consulting Pty Ltd	Ventilation modelling
Ed Gleeson BEng	17+ years mine engineering, incl. 7 years underground hard-rock mining consultancy Information on AMC Consultants Pty Ltd can be found at: www.amcconsultants.com	AMC Consultants Pty Ltd	Mining description
Specialist studies, workshops			
Air quality study			
Peter D'Abreton	Information on Pacific Environment Ltd can be found at: www.pacific-environment.com	Pacific Environment Ltd	Air quality modelling
Li Fitzmaurice			Air quality modelling
Emir Kanalic			Air quality modelling
Mitch Kelly			Air quality modelling
Robin Ormerod			Air quality modelling

Person, Qualifications	Experience / Consultancy Website[1]	Company	Role / Responsibility
Health, safety and radiation study			
Jim Hondros BSc, GDipOHM, MAppSc	Information on JRHC Enterprises Pty Ltd can be found at: www.jrhc.com.au	JRHC Enterprises Pty Ltd	Health, safety and radiation
Phil Crouch PhD	35+ years in radiation protection in regulatory and operational roles, including radiological and environmental impact assessment	Papari Radiation Services	Radiation
Hydrogeology			
John Pickens	Information on INTERA Incorporated can be found at: www.intera.com	INTERA Incorporated	Groundwater modelling, project lead
John Sigda			Groundwater modelling lead
Cheng Cheng			Groundwater modelling
Bill Linderfelt			Groundwater modelling
Dennis Fryar			Groundwater modelling
John Ewing			Groundwater modelling
Randy Arthur			Geochemical modelling
Amber Whittaker			Geologic modelling
Frank Roecker			Geologic modelling
Richard Beauheim			Hydro testing
Dale Bowman	Information on HydroResolutions can be found at: www.hydroresolutions.com	HydroResolution	Hydraulic testing
David Chace			Hydraulic testing
Michael Fort			Hydraulic testing
Randall Roberts			Hydraulic testing
Noise and vibration			
Nathan Archer	Information on SLR Consulting Australia Pty Ltd can be found at: www.slrconsulting.com	SLR Consulting Australia Pty Ltd	Noise and vibration, project lead
John Cotterill			Technical acoustics
Paul Turyn			Noise monitoring
Social impact assessment			
Richard Boele	Information on Banarra can be found at: www.banarra.com	Banarra	Managing director
Bill Kruse			Project director
Catriona Peterson			Project manager
Christine Crispin			Analysis lead

Person, Qualifications	Experience / Consultancy Website[1]	Company	Role / Responsibility
Social impact assessment (continued)			
Claire Tucker	Information on Banarra can be found at: www.banarra.com	Banarra	Engagement and analysis
Špela Berlec			Desktop research
Frank Vanclay		University of Groningen	Peer review
Murray Garde		Australian National University	Anthropologist and linguist
Traffic study (and traffic risk workshop attendees)			
Nicole Conroy	Information on GHD Pty Ltd can be found at: www.ghd.com.	GHD Pty Ltd	Environment, study lead
Alex Holmes			Ecology
Chris Hall			Traffic and transport
Helen Flynn			Risk
Matthew Weir			Risk
Brad McDougall DMgt	20 years	Chemtrans	Operations
David Haynes	15 years	Kalari Pty Ltd	Quicklime supplier
David van Heerden	38 years	Shell Company of Australia	Transport, supply and distribution
Garry Fischer B.Env.Mgt	25 years	NT Department of Transport	Network operations
Geoff County PhD (Chem)	17 years	Orica Chemicals Pty Ltd	Supply chain
Neil Ketteringham Diploma Management	25 years in multi modal logistics and supply chain management	ERA	Supply coordinator
Shaun Stewart	10 years	Direct haul	Health, safety and environment
Steve Bartlett BComm	15 years logistics	ERA	Contractor management and commercial
Vittorio Bianco BSc (Agriculture)	14 years	Orica Chemicals Pty Ltd	Product specialist
Vegetation and fauna study			
Sarah Smith	Information on Eco Logical Australia Pty Ltd can be found at: www.ecoaus.com.au	Eco Logical Australia Pty Ltd	Project Manager
Maria Kraatz			Project Director
Andrew Buick			Environment
Anja Zimmermann			Vegetation
Ian Dixon			Vegetation
Ranid May			Fauna

Person, Qualifications	Experience / Consultancy Website[1]	Company	Role / Responsibility
Vegetation and fauna study (continued)			
Robert Browne-Cooper	Information on Eco Logical Australia Pty Ltd can be found at: www.ecoaus.com.au	Eco Logical Australia Pty Ltd	Fauna
Rob Mezzatesta			Web application
Sarah Dalgleish			Vegetation
Steve Dimitriadis			Web application
Vivian Hamilton			Spatial analysis
BPT and risk assessment – workshop			
Arthur Johnston, BSc(Hons), PhD	16 years in Nuclear Structure Physics research; 17 years research in environmental protection from the effects of uranium mining; 6 years regulation of environmental impact of uranium mining; 6 years development of BPT in mining operations	Environment & Radiation	Strategic advisor, review
William Danaher BSc(Hons), PhD, M.Litt.	8 years scientific research 22 years risk management	RMI Pty Ltd	Risk facilitator, analysis, reporting
Amy Lamb	As above	Rio Tinto	Test work and processing
Bruce Foster	As above	Rio Tinto	Environment
Catherine Turyn	As above	Rio Tinto	Environment
Claire Tucker BLibStud(Hon),GC-Eval.	6+ years in social research and analysis, including social impact assessment	Banarra	Social impact analysis
Daniel McIntyre	As above	ERA	Spatial science, environment
Ed Gleeson	As above	AMC Pty Ltd	Mining description
Glenn Woodrow	As above	ERA	Environment
Jim Hondros	As above	JRHC Pty Ltd	Health, safety and radiation
Jody Clark	As above	ERA	Tailings, water and closure
John Murphy	As above	ERA	Mine engineer, drawings
Lachlan Wilkinson	As above	JBS&G	EIS advisor
Larissa von Gerhardt	As above	ERA	Communications, design
Linda Pugh	As above	ERA	Environment
Luci David	As above	ERIAS Group	Environment
Mark Nott	As above	ERA	Prefeasibility study
Michelle Iles	As above	ERA	Water science
Michael Jones	As above	ERIAS Group	Water, technical editing

Person, Qualifications	Experience / Consultancy Website[1]	Company	Role / Responsibility
BPT and risk assessment – workshop (continued)			
Nicole Jacobsen	As above	ERA	Community relations and cultural heritage
Peter Anderson	As above	ERA	EIS Project management
Ryan Gordon BE (Mechanical)	5 years in mining industry	ERA	Operations engineer
Sarah Smith	As above	Eco Logical	Ecologist, project lead
Sharon Paulka	As above	ERA	Radiation and closure
Simon Kusabs	As above	ERA	Mine engineer
Stephen Booth	As above	ERA	Hydrology
Stephen Pevely	As above	ERA	Resource geologist