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SOCIAL AND ENVIRONMENTAL IMPACT ASSESSMENT REPORT

SOCIAL AND ENVIRONMENTAL IMPACT ASSESSMENT PHASE 2b: PROPOSED EXPANSION OF RÖSSING URANIUM MINE

- Extension of current SJ open pit mining activity
- Increased waste rock disposal capacity
- Establishment of a new crushing plant
- Increased tailings disposal capacity
- Establishing of an acid heap leaching facility
- Establishing of a ripios disposal area
- Additional plant associated with the above

November 2011

Final

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ABBREVIATIONS

AIDS	Acquired Immune Deficiency Syndrome
AD	Anno Domini
ARD	Acid Rock Drainage
BID	Background Information Document
BC	Before Christ
Bq	Becquerel
Bq/cm^2	Becquerel per square centimetre
Bq/g	Becquerel per gram
CBWUF	Central Namib Bulk Water Users' Forum
CIX	Continuous Ion Exchange
cm	Centimetre
cm^2	Centimetre square
COP	Code of Practice
CPC	Central Processing Control
CSIR	South African Council for Scientific & Industrial Research
DAC	Daily Allowable Concentration
dB	Decibel
DEA	Directorate of Environmental Affairs (MET)
DMRP	Disaster Management & Recovery Plan
DRFN	Desert Research Foundation of Namibia
DWA	Department of Water Affairs
DWAF	South African Department of Water Affairs & Forestry
EHS	Environmental, Health and Safety
EIA	Environmental Impact Assessment
EMP	Environmental Management Programme
EMS	Environmental Management System
FeS_2	Pyrite
g/m^3	Grams per cubic metre
g/t	Grams per tonne
GBq	Gigabecquerel
GDP	Gross Domestic Product
GHG	Green House Gases
GIIP	Good International Industry Practice
H_2S	Hydrogen Sulfide
H_2SO_4	Sulphuric Acid
ha	Hectares
HDPE	High-Density Polyethylene
HDT	High Density Tailings
HIA	Heritage Impact Assessment
HIV	Human Immunodeficiency Virus
HIV/AIDS	Human Immunodeficiency Virus / Acquired Immune Deficiency Syndrome
HSE	Health, Safety & Environmental
HSE IPs	Health, Safety & Environmental Improvement Plans
HSE MS	Health, Safety & Environmental Management System
I&APs	Interested and Affected Parties
IAEA	International Atomic Energy Agency
ICMM	International Council on Mining and Metals
ICRP	International Commission on Radiation Protection
ISO	International Organisation for Standardisation
ISO 14001 EMS	International Organisation for Standardisation 14001 Environmental Management System

km	Kilometre
km/h	Kilometre per Hour
Lb	Pound
LOM	Life of Mine
m	Metre
m^3	Cubic Metre
m^3/day	Cubic Metres per Day
m^3/h	Cubic Metres per Hour
m^3/tonne	Cubic Metres per Tonne
mamsl	Metres Above Mean Sea Level
MAWRD	Ministry of Agriculture, Water & Rural Development
MBq/g	Megabecquerel per gram
MCDM	Multicriteria Decision Making
MET	Ministry of Environment & Tourism
MET:DEA	Ministry of Environment and Tourism's Directorate of Environmental Affairs
MFMR	Ministry of Fisheries & Marine Resources
mg	Milligram
mg/ℓ	Milligram per litre
mg/m^3	Milligram per cubic meter
MHSS	Ministry of Health & Social Services
MLA	Mine Licence Area
mm	Millimetre
mm/s	Millimetres per Second
Mm^3	Million Cubic Metres
Mm^3/a	Million Cubic Metres per Annum
MME	Ministry of Mines & Energy
MRLGH	Ministry of Regional & Local Government & Housing
MS	Management System
MSDS	Material Safety Data Sheet
mSv	Millisieverts
mSv/a	Millisieverts per Annum
mSv/h	Millisieverts per Hour
Mt	Megatonne (one million metric tonnes)
MTI	Ministry of Trade & Industry
MW	Megawatt
MWh	Megawatts per Hour
MWTC	Ministry of Works, Transport & Communications
N$	Namibian Dollar
Namport	Namibian Ports Authority
NamPower	Namibian Power Corporation (Pty) Ltd
NamWater	Namibian Water Corporation (Pty) Ltd
NFPA	National Fire Protection Association
NIMT	Namibian Industry for Mining Technology
NNP	Namib Naukluft Park
NOx	Nitrogen Oxides
NPV	Net Present Value
O_2	Oxygen
pH	Potential Hydrogen
PID	Public Information Document
PPE	Personal Protective Equipment
ppm	Parts per Million
PPP	Public Participation Process

Ripios	Spent, crushed "reject" ore, after being subjected to uranium leaching on heap leach facility
Rössing Uranium	Rio Tinto Rössing Uranium Limited
SABS	South African Bureau of Standards
SAIEA	Southern African Institute for Environmental Assessment
SEIA	Social and Environmental Impact Assessment
SEMP	Social and Environmental Management Plan
SO_2	Sulphur Dioxide
SO_3	Sulphur Trioxide
SOP	Standard Operating Procedure
SX	Solvent Extraction
t	Tonne
TDS	Total Dissolved Solids
ToR	Terms of Reference
tpd	Tonnes per day
TSF	Tailings Storage Facility
U	Uranium
U_3O_8	Uranium Oxide
US$	United States Dollar
v	Volt
VAC	Visual Absorption Capacity
WMP	Water Management Plan
µSv	Microsievert
µSv/a	Microsievert per Annum

1 EXECUTIVE SUMMARY

1.1 BACKGROUND

Rio Tinto Rössing Uranium Limited (Rössing Uranium) has operated an open pit uranium mine in the Erongo Region of Namibia since 1976. This region is strongly characterised by mining activity and mining for various minerals has been ongoing in the Central Namib since 1901 (SAIEA, 2010). As a result of the recent upward trend in uranium prices on the international market, and projected further increases in future, Rössing Uranium is able to consider possible expansion of its operations. Rössing Uranium is now looking at extending the Life of Mine plan to 2026 and consequently the associated potential social and environmental issues are being assessed in a multiphase Social and Environmental Impact Assessment (SEIA), focusing on specific expansion project components.

In terms of the Namibian Constitution (Government of Namibia, 1990) and relevant environmental legislation, in particular the Environmental Management Act (Act No 7 of 2007), the Environmental Assessment Policy (MET, 1994) and the Minerals Act (Act No 33 of 1992), the proposed expansion activity would require authorisation from the responsible authorities before it can be undertaken. Insofar as the social and environmental acceptability of Rössing Uranium's proposed expansion project is concerned, the Ministry of Environment and Tourism's Directorate of Environmental Affairs (MET:DEA) would need to issue a clearance for such expansion.

A SEIA has thus been commissioned by Rössing Uranium for their proposed expansion project, in accordance with these requirements, as well as the internal standards and guidelines prescribed by Rio Tinto, Rössing Uranium's parent company. MET:DEA's clearance will be based on the outcomes of the SEIA and this report serves to document such findings. Should MET:DEA issue a clearance for the project, the responsible sector ministry, i.e. the Ministry of Mines and Energy (MME), will be able to consider extending Rössing Uranium's current mining licence that is valid until 2019, to allow for the expansion of their current operations to 2026 and authorising the proposed new facilities and activities.

The purpose of this SEIA Report is to document the assessment stage of the process and in summary it comprises an outline of the legal and policy framework regarding the environment within which Rössing Uranium operates and this assessment is undertaken; a description of the proposed expansion project components, their alternatives and potential impacts; a description of the public participation process undertaken to date, and the way forward with this process; a description of the assessment methodology applied; and, most importantly, an assessment of the significance and possible mitigation of the potential impacts that were identified during the SEIA process.

A number of specialist studies have been undertaken to properly understand the most significant potential impacts of the proposed developments and to ensure an acceptable level of confidence in the assessment of such impacts. The outcomes of the SEIA stage of the process include confirmation of the social and environmental acceptability of the preferred or indicated sites for the proposed increased waste rock, crushing circuit, tailings and ripios disposal facilities and for the new acid heap leaching facility; confirmation of the social and environmental acceptability of the proposed expansion of the existing SJ open pit and additional plant infrastructure required; identification or confirmation of the environmentally preferred process and technology alternatives; identification of possible mitigation measures to reduce the significance of potential impacts; and documentation of the identified mitigation measures in a Social and Environmental Management Plan (SEMP).

1.2 PROJECT LOCATION

The Rössing Uranium Mine is located in the Erongo Region of Namibia. The Erongo Region comprises the central western part of Namibia. It is bordered by the Atlantic Ocean to the west, the Kunene Region to the north, Otjozondjupa Region to the north east, Khomas Region to the east and the Hardap Region to the south. The Erongo Region consists of seven constituencies covering approximately 64,000km² and was home to almost 108,000 people, representing approximately 6% of Namibia's populace in 2001. By 2007 the Erongo Region's population was estimated at 147,441 people, representing a massive influx. The majority of this population reside in the two urban centres, namely, the tourist town of Swakopmund (the closest large centre to the mine) and the fishing and major port town of Walvis Bay south of Swakopmund. Also located within the region are the smaller towns of Henties Bay, a coastal tourist town north of Swakopmund, and Arandis, a mining town historically associated with the Rössing Mine.

The Rössing Uranium mine site itself is found at 15º 27' 50" East and 22º 02' 30" South, approximately 65km east north east and inland from Swakopmund and the Atlantic Ocean, in the Arandis Constituency. The 18,411ha Mine Licence Area (MLA) and accessory works area is bordered by the town of Arandis, approximately 12km to the north west, and by the incised Khan River valley, approximately 4.5km to the south-east. The site is located on the generally south east-facing, rough and undulating slopes between the Khan River valley (at 350mamsl) and the gravel plains closer to Arandis (at 600mamsl), near the edge of the Central Namib Desert.

The proposed project will be located within the existing MLA of Rössing Uranium. The right to carry out exploration and mine for nuclear fuels is covered by a mining licence (ML28) by the Ministry of Mines and Energy on 11 November 2005. Together with this is an accessory works area in which facilities such as waste dumps, tailings dam, supporting infrastructure and water extraction infrastructure are allowed. The current mine licence is valid until 7 May 2019.

The Namib Desert is the oldest desert on earth and appears to be a barren and lifeless environment, however, on closer inspection, its climatic variations, varied landscapes and substrates in fact support a significant and largely endemic biological diversity. This is most notable in the reptiles and invertebrate groups, such as insects and spiders, which have over the eons developed remarkable adaptations to allow for their survival in the unforgiving Namib environment. The area is known as a hotspot of species diversity in these groups, particularly in geckos and sand lizards, beetles, scorpions and sun spiders. The habitat, its native species, including the larger fauna such as mammals and birds, are of conservation importance due to the high levels of adaptation, endemicity, and rarity. The south-eastern corner of the mine licence area overlaps with the Namib Naukluft National Park (NNP). Exploration by various companies within the park has identified significant uranium occurrences and led to one new mine (Langer Heinrich) and others may follow. Uranium mining in this region is therefore beholden to execute mining activities in a manner that maintains the overall habitat integrity and functioning and the recently completed SEA mentioned above provides specific development guidelines for the mining industry in this regard.

1.3 PROJECT DESCRIPTION

The Rössing Mine operated by Rio Tinto Rössing Uranium Limited (Rössing Uranium) was on record as being the third largest uranium mine in the world in 2009 and in 2010 supplied 5.3% of uranium oxide produced internationally. The mine's ownership comprises Rio Tinto with a majority 69% interest, and the balance of equity held by the Government of Iran at 15%, the Industrial Development Corporation of South Africa at 10%, the Government of Namibia at 3% and 3% made up by various private shareholders (Rio Tinto, 2011).

The rise in uranium price, availability of improved processing technologies and further exploration drilling resulting in an increase in the known ore reserves provided the impetus for the expansion project. This SEIA allows Rössing Uranium to consider the next step in the process, namely to determine whether the expansion project could be undertaken within acceptable socio-economic and biophysical parameters. As a basis for this SEIA Phase 2, the project team have identified a potential maximum expansion scenario, which goes beyond the current Life of Mine (LOM) plan ending in 2023.

The mine expansion foresees an increase in mining rate and volume to approximately 65Mt annually from the existing open pit, but potentially also includes the processing of stockpiled lower grade ores. Seven specific components of Rössing Uranium's expansion project are the subject of this SEIA Phase 2b

Report, namely the (1) expansion of the current SJ pit to enable mining operations to continue feasibly until at least 2026, (2) increased waste rock disposal capacity, (3) an additional crushing circuit to feed the proposed heap leach process, (4) increased tailings disposal capacity, (5) the establishment of a new acid heap leaching facility on the mine, (6) the establishment of a ripios disposal area associated with the new heap leaching facility and (7) additional plant associated with the above.

The Ministry of Environment and Tourism's Directorate of Environmental Affairs (MET:DEA) would need to issue a clearance for such expansion. The clearance would be based on the outcomes of the SEIA, as documented in the various reports that underpin the entire assessment process. A number of specialist investigations have been undertaken into the potential social and environmental impacts associated with the proposed expansion project components and ultimately inform the overall SEIA. The individual specialist studies each includes a baseline assessment, an assessment of the significance of the potential impacts and suggests measures that may be employed to mitigate such impacts by enhancing its positive aspects while minimising the negative aspects.

The entire extent of the envisaged expansion of the Rössing Uranium mine would comprise, in summary, the following components. These are being dealt with in two phases of the SEIA process, as follows:

- A sulphuric acid manufacturing plant;
- Associated sulphur storage on the mine;
- Transport of sulphur from the Port of Walvis Bay;
- A radiometric ore sorter plant;
- Mining of an ore body known as SK4;

Phase 1

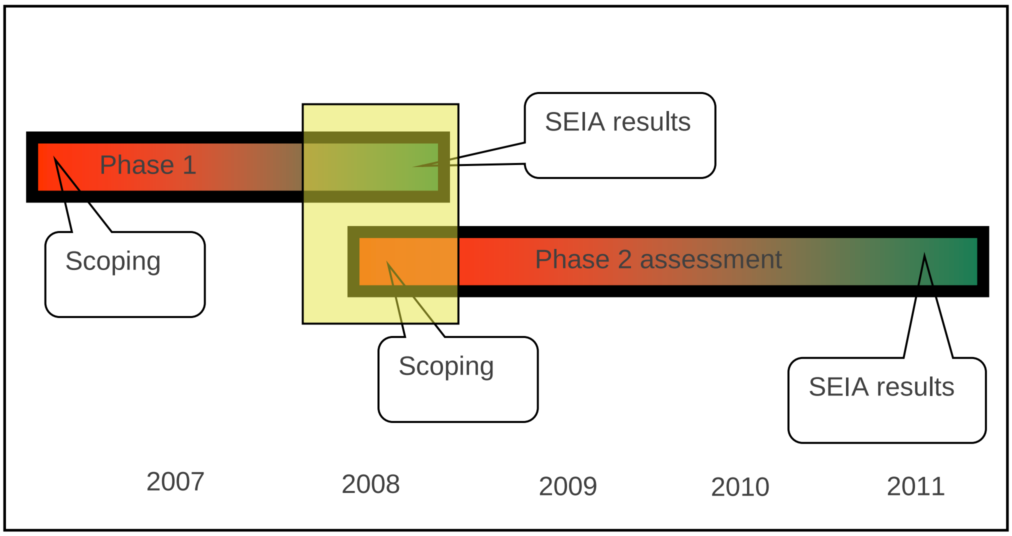
- Sulphur handling facility in the Port of Walvis Bay;

Phase 2a

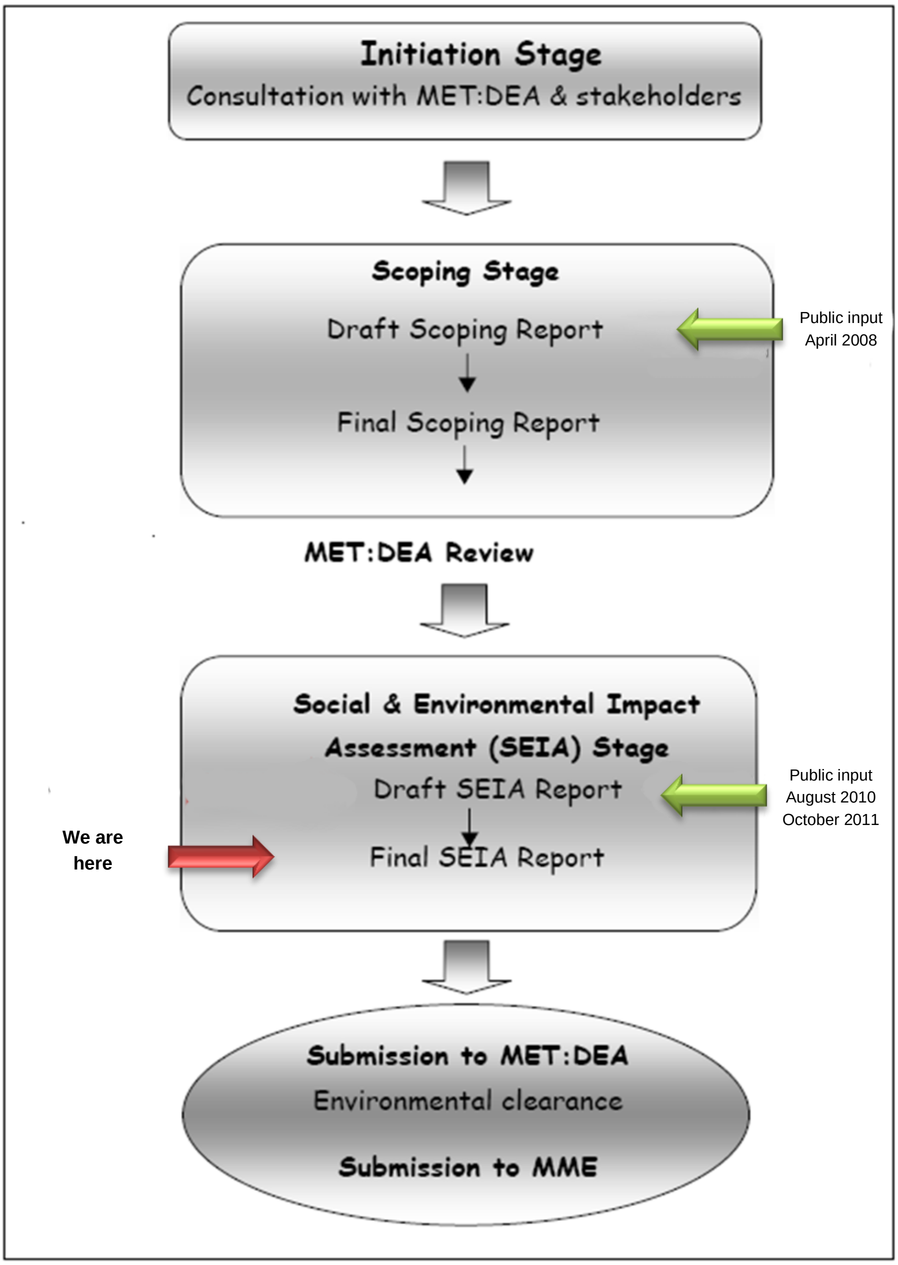
- Extension of the current mining activities in the existing SJ open pit;
- Increased waste rock disposal capacity;
- Establishment of a new crushing plant;
- Increased tailings disposal capacity;
- Establishing of an acid heap leaching facility;
- Establishing of a ripios disposal area; and
- Additional plant associated with the above.

Current Phase 2b

Both the SEIA Phase 1 and the SEIA Phase 2a have been approved by MET:DEA. A graphic representation of the timing of the assessment and implementation phases for the SEIA process of Rössing Uranium's expansion project is provided below.



The SEIA process and its sequence of supportive documentation are illustrated below. It should be noted that the Scoping stage of the process that precedes this assessment stage has been completed and submitted to MET:DEA in May 2008.



The series of documents that support the present SEIA Phase 2b process, and that culminate in this SEIA Report, comprise the following:

- A Public Information Document (PID) released in August 2007 to initiate the SEIA process;
- A Scoping Report released in April 2008;
- A Background Information Document (BID) released in October 2008;
- A summary of specialist study findings released in August 2010; and
- This SEIA Phase 2 Report.

The SEIA Phase 2 Report comprises three volumes:

- Volume 1 – Main Report;
- Volume 2a – Annexures, comprising Annexures A to N7; and
- Volume 2b – Annexures, comprising Annexures N8 to P.

A bibliography is included at the end of this report, which provides reference to other studies and that are of relevance to this SEIA process. A description of the socio-economic and biophysical context of the proposed developments was provided in the Scoping Report for the SEIA Phase 2 process (Ninham Shand, 2008) and should be referred to in conjunction with this SEIA Report.

The purpose of this SEIA Report is to document the assessment stage of the process and in summary it comprises the following:

- An outline of the legal and policy framework regarding the environment within which Rössing Uranium operates and this assessment is undertaken;
- A description of the proposed expansion project components, their alternatives and potential impacts;
- A description of the public participation process undertaken to date, and the way forward with this process;
- A description of the assessment methodology applied; and
- Most importantly, an assessment of the significance and possible mitigation of the potential impacts that were identified during the SEIA process.

The SEIA stage is the last stage in the assessment process. Accordingly, an SEIA Report aims to collate, interrogate, analyse and synthesize information from a range of sources, to provide sufficient and reliable information for MET:DEA to make an informed decision on whether or not the proposed components of Rössing Uranium's expansion project are acceptable from a social and environmental perspective.

1.4 PUBLIC PARTICIPATION PROCESS

Engagement with the public and stakeholders interested in, or affected by, development proposals forms an integral component of the assessment process. Interested and Affected Parties (I&APs) have had several opportunities at various stages throughout the SEIA process to gain more knowledge about the proposed project, to provide input and to voice any issues of concern.

1.4.1 IDENTIFICATION OF STAKEHOLDERS

The following stakeholder groups were identified as the key ones to be consulted throughout the SEIA process:

- Central Government ~ Ministries of:
  - Mines and Energy,
  - Health and Social Services,
  - Labour and Social Welfare,
  - Environment and Tourism,
  - Agriculture, Water and Forestry,
  - Regional and Local Government and Housing, and
  - Education;
- Regional and local government:
  - Erongo Regional Council,
  - Swakopmund Town Council,
  - Walvis Bay Town Council, and
  - Arandis Town Council;
- The !Oe#Gan Traditional Authority;
- Other uranium mines in the Erongo Region;
- Rössing Uranium;
- The Rössing Foundation;
- Organised labour;
- The media;

- NamPort;
- NamWater;
- NamPower;
- TransNamib;
- Roads Authority;
- The farming community, both small-scale and commercial;
- Economic sectors which may be affected by mineral exploitation, e.g. tourism;
- Community groups and social institutions in Swakopmund, Walvis Bay and Arandis; and
- Service providers.

1.4.2 PUBLIC PARTICIPATION DURING PHASE 1

The proposed expansion project was initially advertised between 14 and 20 August 2007 in national, regional and local newspapers and on Rössing Uranium's website, in order to make as many people as possible aware of the project and associated SEIA process. This was done to elicit comment and register I&APs from as broad a spectrum of the public as possible. Once an I&AP is registered, he or she is kept informed of progress throughout the SEIA process.

A Public Information Document (PID) was widely distributed during the initial public participation process and was also available on the Rössing Uranium and Aurecon (then Ninham Shand) websites. In addition to the advertising and PID, public and key stakeholder meetings were held with a wide array of interest groups and organisations during August 2007.

Public meetings were again held between 22 and 24 January 2008 in Arandis, Swakopmund and Walvis Bay and were advertised in national, regional and local newspapers between 16 and 22 January 2008. Copies of the report were lodged for public viewing at libraries in these same centres, as well as in Windhoek, and the report was also placed on the Rössing Uranium and Aurecon (then Ninham Shand) websites. The purpose of this series of meetings was the release of the Phase 1 Draft SEIA Report, as well as the introduction of the Phase 2 Scoping stage of the SEIA process.

1.4.3 PUBLIC PARTICIPATION DURING PHASE 2 – SCOPING

The following meetings were arranged (as mentioned above) to introduce the scoping stage of the SEIA Phase 2 process to the stakeholders and the general public:

- Alte Brücke, Swakopmund: 22 January 2008;
- Pelican Bay Hotel, Walvis Bay: 23 January 2008; and
- Arandis Town Hall, Arandis: 24 January 2008.

The table below reflects the placement of press notices for these meetings.

Newspaper	Placement Dates
Namib Times	18 & 22 January 2008
Republikein	16, 17 & 18 January 2008
Namibian	16, 17 & 18 January 2008

Notices of these meetings were also posted in public places in Swakopmund, Walvis Bay and Arandis.

The Draft Phase 2 Scoping Report was made available for I&APs and stakeholders to review at the same libraries that the Phase 1 SEIA Report was lodged, and was again uploaded to the Rössing Uranium website, as well as to the Aurecon (then Ninham Shand) website. Public input received during the comment period after release of the Draft Phase 2 Scoping Report was taken into account in the final report before submission to MET:DEA.

Issues relevant to the expansion project components covered in this SEIA Phase 2 that were raised during the meetings held from 22 to 24 January 2008 were captured and responses provided in the form of a stakeholder issues report.

During the public comment period for the draft Phase 2 Scoping Report, the Rössing Uranium website was visited 90 times to view the report, and 150 times to download specific sections of the report.

1.4.4 PUBLIC PARTICIPATION DURING THE PHASE 2a

An SEIA was completed in 2009 for the construction of a sulphur handling facility in the Port of Walvis Bay. Due to the sulphuric acid manufacturing plant on the mine receiving clearance from MET:DEA during the SEIA Phase 1, and its reliance on elemental sulphur as feedstock to operate, it was decided to separate the sulphur handling component in the port from the remainder of the SEIA Phase 2 process. It was thus subjected to an individual SEIA process (referred to as the Phase 2a process) in the interests of time and to allow for an earlier clearance than the remaining SEIA Phase 2b components addressed in this report.

A focus group meeting was held on 7 February 2008 in Walvis Bay. Attendees received Public Information Documents (PIDs) aimed at informing interested and affected parties (I&APs) and stakeholders about the proposed development by Rössing Uranium and to promote participation in the SEIA process. This focus group meeting was attended by eighteen stakeholders. The meeting was co-ordinated by Marie Hoadley, the public participation manager for the SEIA process, and three delegated representatives from Rössing Uranium were present to respond to queries and provide insight into the technical workings of the proposed sulphur handling facility.

The Final SEIA for the sulphur handling facility was submitted to MET:DEA for a decision in December 2009 and subsequently approved.

1.4.5 PUBLIC PARTICIPATION DURING THE PHASE 2b

The general low attendance of I&APs at public meetings and the lack of comments on the draft Phase 2 Scoping Report caused concern that the public was not accessing information about the expansion project, and that the concerns and recommendations of I&APs were not being articulated and recorded. It was hoped that a new approach would reach a broader audience than before and result in I&APs with a better and more detailed understanding of the project. This would, in turn, lead to more comprehensive input into the impact assessment. The difficulties in engaging with marginalised groups also needed to be addressed. A decision was accordingly taken to change the format of the public participation process for the launch of the SEIA Phase 2b, by moving away from large open house public meetings to specific focus groups based on stakeholder categories.

The final stakeholder mapping process was revisited in 2010 to address the concerns listed above, and stakeholders were categorised into interest groups. These were:

- Developmental agencies;
- Labour Unions – branch and regional;
- Local authorities;
- Parastatals and the Coastal Bulk Water Users' Forum;
- Environmentalists, tourism operators and the farming community in the vicinity of Rössing Uranium;
- The media;
- The Arandis community;
- The Swakopmund community; and
- The Mondesa and DRC communities.

During August 2010, focus group meetings were held with the first six interest groups. The meetings were preceded by a tour of the Rössing Mine and a visit to the site of the proposed expansion project components, for those who elected to partake. This contextualised the discussions at the meetings, and facilitated more informed and in-depth questions and comments. Meetings focused on issues which had been identified as of interest to each particular group and presentations and specialist attendance were arranged to match.

A public meeting was conducted in Arandis, and two road shows were held, one in the Swakopmund central business district, and one in Mondesa.

The table below reflects the placement of press notices of meetings that were held during August 2010.

Newspaper	Placement Dates
Namib Times	20 August 2010
Republikein	11 & 16 August 2010
Namibian	11 & 16 August 2010

The new format proved to be extremely productive. All the stakeholder groups were involved in the consultation process, and the inclusion of marginalised groups was particularly successful. I&APs freely voiced their concerns, questions and recommendations. These are captured in the stakeholder issues trail.

All I&APs and stakeholders were informed of the availability of the draft SEIA Phase 2b Report, the period for review and the venues and websites where the report was available. Comments received in the comment period are included in the updated Final Stakeholder Issues Trail. Where relevant, changes have been effected in this Final SEIA Phase 2 report.

1.4.6 ISSUES

The most noteworthy of the issues raised by I&APs to date, as derived from public consultation and stakeholder engagement are listed below:

- creation of employment opportunities;
- workplace health and safety concerns;
- housing implications;
- the nature and locality of construction camps;
- the sustainability of Arandis;
- negative social impacts due to newcomers seeking work;
- services such as schools, medical care and water availability;
- effects on the regional and local economy, including tourism;
- possible dust and noise threats to humans resulting from the expansion project;
- the effects of dust on flora and fauna;
- concerns about possible pollution of the Khan River from the heap leach pad and the ripios facility;
- biodiversity implications, particularly in the SK mining area and the Dome area;
- supply, storage, application, runoff and reuse of water resulting from the expansion project;
- regional implications of bulk water supply;
- visual impacts resulting from the expansion project;
- energy use; and
- the possible effects of blasting at Rössing Uranium on Arandis and on farm infrastructure in the vicinity of the mine.

Participants at meetings also showed great interest in the technical details of the proposed new acid heap leaching process.

The objectives of public participation were maintained throughout this SEIA process, which are to provide information to the public, identify key issues and concerns at an early stage, respond to the issues and concerns raised, provide a review opportunity and document the process accurately.

1.4.7 THE WAY FORWARD

This Final SEIA Phase 2b Report will be submitted to MET:DEA for review and a copy made available again to the public.

Should MET:DEA believe that the final submission contains information that is sufficiently comprehensive for sound decision-making, they will consider issuing a clearance for the project. Such clearance will probably include certain conditions, e.g. the implementation of mitigation as stipulated in the SEMP that accompanies the SEIA Phase 2b Report.

All registered I&APs and stakeholders will be informed of MET:DEA's decision once it is made available.

1.5 ALTERNATIVES AND IMPACTS IDENTIFIED

1.5.1 STRATEGIC ALTERNATIVES

The Chamber of Mines of Namibia has recently initiated a Strategic Environmental Assessment aimed specifically at the uranium mining interests in the Erongo Region (SAIEA, 2010). Rössing Uranium has indicated a commitment to sustainable development in their recognising the need for a holistic approach to planning future mining activities, by means of a Strategic Planning Process. Sustainability criteria will be included in this ongoing process and, as such, Life of Mine (LOM) planning will not only be based on financial considerations.

As a further move towards filling the gap between the strategic and project levels of assessment, the cumulative impacts of both Phase 1 and Phase 2 has been evaluated and assessed in this SEIA.

1.5.2 PROJECT LEVEL ALTERNATIVES

A key component of any thorough SEIA is the consideration of alternatives in the assessment process. Such alternatives may include strategic, as well as project level site (or arrangement of facilities / layout), or technology (process) alternatives. Rössing Uranium investigated, ranked and prioritised different facility layout alternatives, in a study concluded as a pre-runner to this SEIA process, with the purpose of feeding into the alternatives assessment. A two year process of refining the decision criteria and technical information used to inform the decision on the preferred layout was undertaken with the following main objectives:

- To minimise the physical footprint of the proposed expansion;
- To optimise the use of areas where the sustainable development impacts are minimised;
- To find the best practical site for each of the facilities;
- To make the best use of newly impacted sites; and
- To ensure that the expansion follows a strategic life of mine approach.

Key decisions had to be taken about facility locations and overall site layout during the 'order of magnitude' stage. Two workshops were held to identify the most appropriate areas for new processing and waste disposal facilities by using multicriteria decision making methodologies. The mine's land use database developed in 2008 was an essential tool in the subsequent process used to identify the most appropriate layouts for the project. The first workshop in August 2008 had to use limited information regarding engineering design and construction cost and made basic recommendations as to where the new facilities should be located. As more detailed project costing became available, the need for a review of the preferred alternative was identified and a number of new layout alternatives were added during a second workshop a year later in August 2009. However, the recommendation of the first exercise was confirmed and engineering studies continued accordingly.

Rössing Uranium determined a list of criteria comprising four main categories for use during the land use optimisation workshops. The objective was to ensure that the proposed extension is in line with its sustainable development approach. The three main pillars of sustainable development are economic viability, environmental sustainability, and social acceptability, which formed the basis from which these criteria categories were developed. Economic criteria were built into the technical (or engineering) category, since engineering solutions has budget implications. An additional criteria category, being Strategic Criteria, applied only to the evaluation of combined facility layouts. An overarching objective was to find the optimum arrangement (or layout) to limit the impacts on undisturbed ground. The four criteria categories for both the 2008 and 2009 workshops were very similar and the 2008 criteria are listed below:

Technical criteria and sub-criteria for consideration included

- Height and distance from plant, heap leach or pit:
  - Conveyor/haul routes and cycle times, and
  - Power consumption, diesel consumption and general equipment wear-and-tear;
- Topography and elevation:
  - Terrain preparation;
- Cut-off grade and pit size (will affect volumes/leach recovery):
  - Volume and area footprint, and
  - Material profile (final);
- Settlement;
- Sufficient buffer for fly rock;
- Deposition method (conveyors, pipelines, paddies, thickened, dry stacking, race track, on-off);
- Geohydrology:
  - Subsurface stability,
  - Lining requirements,
  - Leachate management, and
  - Storm water permeability; and
- Closure:
  - Cover requirements, and
  - Long term stability.

Environmental criteria and sub-criteria for consideration comprised

- Ecology:
  - Biodiversity,
  - Flora and fauna (including red listed species),
  - Ecological services, and
  - Impact on habitat;
- Land use, footprint extension;
- Dust emissions due to wind erosion;
- Resource use (water, energy):
  - Water losses due to wind, and
  - Power consumption;
- Seepage impact and control options;
- Geohydrology and seepage:
  - Water quality; and
- Closure:
  - Rehabilitation, and
  - Long term leachate.

THE SOCIO-ECONOMIC CRITERIA AND SUB-CRITERIA INCLUDED

- Dust impact and control options;
- Distance from Arandis (potential health impact on inhabitants);
- Surface area exposed (radon emissions);
- Visual impact, both with respect to colour and height;
- Archaeology;
- Geohydrology:
    - Resource use; and
- Closure:
    - Long term emissions (i.e. water, air).

STRATEGIC CRITERIA AND SUB-CRITERIA INCLUDED

- Sterilisation of ore reserves and future drilling areas;
- Co-disposal with waste rock;
- Potential reuse of material;
- Surrounding land uses;
- Sequencing;
- Phased use of separate sites for the same process options e.g. ripios placed in a number of sites;
- Reputation:
    - Bad and good practice,
- Extension of operational footprint into undisturbed areas, and
- Impact on habitat (possible loss of Red Data species);
- Closure:
    - Sequencing; and
- Water storage on site.

It was decided that the final outcome in terms of layout preference will feed into the SEIA Phase 2b process for the expansion project as the design freeze layout, unless further technical analysis raises questions as to its sustainability, as was the case.

Further expert input on heap leach and re-considering the location for a smaller pad enabled required tailings capacity to be planned on the current Tailings Storage Facility (TSF). Volumetric modeling showed that with this new layout, sufficient space would be available to accommodate the 200Mt tailings requirement for the tank leach operation over the life of mine. It was therefore decided to retain tailings facility in its current location and move ripios disposal to the Rössing Dome which represents the preferred layout assessed herein as the design freeze layout. The current conventional paddy disposal system will be retained.

1.5.3 IDENTIFIED IMPACTS

One of the main purposes of the SEIA process is to understand the significance of the potential impacts associated with the proposed mine expansion and its associated activities and infrastructure. A further objective of the SEIA is to determine if the potential impacts associated with the activity can be minimised or mitigated. This section of the SEIA Report identifies the range of potential impacts. It should be noted that the identification of the impacts described emerged as concerns from the stakeholders, as well as input from the project team and Rössing Uranium personnel. The following potential impacts were identified at the scoping stage:

- Construction phase impacts
    - The extent of employment opportunities created as a consequence of the proposed developments, both for permanent and contracted workers;
    - Impacts on water resources, namely groundwater and surface water resources;

    - Interference with current commercial activities in the port in the vicinity of the construction site;
    - Management of materials required for construction or establishment;
    - Increase in traffic volumes to the port and in the vicinity of the construction sites;
    - Windblown dust;
    - Noise pollution and vibration; and
    - Pollution from construction waste and other contaminants.
- Operational phase impacts
    - Permanent employment creation;
    - The potential increase in noise and vibration and the associated impact on the nearby residential areas;
    - The potential visual impact of extended waste disposal facility, ripios and tailings storage facilities and new heap leach facility;
    - Impacts on water resources, namely groundwater and surface water resources;
    - Interference with current commercial activities in the port in the vicinity of the construction site;
    - Increase in traffic volumes to the mine and between the mine and Swakopmund and Arandis;
    - Windblown dust;
    - Noise pollution and vibration; and
    - Pollution from construction waste and other contaminants.

1.6 ASSESSMENT OF POTENTIAL IMPACTS AND POSSIBLE MITIGATION MEASURES

The methodology applied during this SEIA uses a tabulated rating system, where each impact is described according to its extent (spatial scale), magnitude (size or degree scale, related to the relevant standard where applicable), and duration (time scale). These criteria are used to ascertain the significance of the impact, with and without mitigation. Once the significance of an impact has been determined, the probability of this impact occurring as well as the confidence in the assessment of the impact is determined. Lastly, the reversibility of the impact is estimated.

The following table provides a summary of the significance of the social and environmental impacts associated with this proposed project. In recognising the extent of the information available at this stage of the project planning cycle, the confidence in the assessment undertaken is regarded as acceptable for informed decision making.

MINE EXPANSION OPERATIONAL PHASE		WITHOUT Controls	WITH Recommendations
Socio-Economic			
	Sustainability of Arandis	High(-)	Medium(+)
	Employment creation	High(+)	High(+)
	Public health and safety	Medium(-)	Low(-)
	Housing on property markets	High(-)	Medium(-)
	Housing at Arandis and Swakopmund	High(-)	Medium(-)
	Local economies	Medium(+)	High(+)
	Inward migration	High(-)	High(-)
	Social services	High(-)	Medium(-)
Air quality			
	Human health due to PM10 emissions	High(-)	Medium(-)
Archaeology			
	Archaeological sites	Very Low(-)	Very Low(-)
Biodiversity			
	Possible species loss in the Dome area	High(-)	High(-)
	Reduction in the productivity of plants and in abundance of soil crust organisms and small invertebrates	High(-)	High(-)
Ground vibration and air blast			
	Ground vibration, air blast and fly rock	Low(-)	Low(-)
	Fumes	Medium(-)	Low(-)
Groundwater contamination			
	Waste rock dumps	Medium(-)	Medium(-)
	Heap leach and plant	Very Low(-)	Very Low(-)
	Ripios disposal facility	High(-)	Low(-)
	Tailings storage facility	High(-)	High(-)
Noise			
	Noise	Low(-)	Very Low(-)
Occupational health and safety			
	Occupational health and safety	High(-)	High(-)
Radiological public dose			
	Dust and radon inhalation	Low(-)	Low(-)
Traffic			
	Road network	High(-)	Medium(-)
	Emergency evacuation	Medium(-)	Low(-)
Visual			
	Visual	High(-)	Medium(-)
General waste			
	Pollution of ground and surface water	Very Low(-)	Very Low(-)
	Siltation of streams due to exposed surfaces	Very Low(-)	Very Low(-)
Hazardous waste			
	Pollution of groundwater	Low(-)	Very Low(-)
	Odours from landfill	High(-)	Low(-)
	Danger to health and safety of workers	High(-)	Low(-)
Water and energy resource use			
	Water supply	High(-)	Medium(-)
	Energy supply	High(-)	Medium(-)
	Greenhouse gas emissions	High(-)	High(-)

1.7 CONCLUSIONS

This chapter concludes the report, describes the recommendations that have emerged from the assessment of identified potential impacts and mitigation measures, and provides a synopsis of the preferred alternative actions that Rössing Uranium is applying for authorisation of.

1.7.1 LEVEL OF CONFIDENCE IN ASSESSMENT

With reference to the information available at this stage of the project planning cycle, the confidence in the environmental assessment undertaken is regarded as acceptable for decision making, due to the fact that the assessment is based on a maximum (worst case) expansion scenario and the potential impacts are well defined and understood as a result of this being an existing operational mine.

It is acknowledged that the project details may evolve during the detailed design and construction phases. However, these are unlikely to change the overall environmental acceptability of the proposed project. Furthermore, any significant deviation from that assessed in this SEIA should be subject to further assessment and may require an amendment to the conditions of the MET:DEA clearance, after due process has been met.

1.7.2 SOCIAL AND ENVIRONMENTAL MANAGEMENT PLAN

A SEMP has been developed to guide the design, construction, operational and closure phases of the proposed project. The implementation of the SEMP would minimise possible negative impacts on construction and operation and assign responsibility for environmental controls, i.e. ensure that the recommended mitigation measures are applied and the impact significance ratings are consequently reduced to acceptable levels. More detailed project specifications, for inclusion in the various construction contracts, would be required should the project be approved and the engineering designs of the various components have been finalised. The detailed project specification would also take cognisance of any conditions of the MET:DEA clearance.

The Draft SEMP is designed to serve as a clear and detailed indication of Rössing Uranium's intention to address social and environmental controls during the design, construction, operational and closure stages of the expansion project. Its finalisation and ultimate approval is expected to be a condition of the environmental clearance presently being sought from MET:DEA.

1.8 RECOMMENDATIONS

1.8.1 ALTERNATIVES

With reference to the project alternatives examined in the SEIA Phase 2 process and described in this report, we recommend that the preferred alternative as presented herein be approved based on the conclusions reached and the extensive process followed to determine the preferred layout for the proposed project components and facilities.

1.8.2 THE WAY FORWARD

This final SEIA Report will be submitted to MET:DEA for their consideration.

In considering this final SEIA Report, MET:DEA will ascertain whether the process undertaken is acceptable and whether there is adequate information to allow for an informed decision. Should the above be acceptable, they will need to decide on the social and environmental acceptability of the proposed project. MET:DEA's decision will be documented by a clearance of the project that will detail the decision and describe any conditions they might impose. Following the issuing of the MET:DEA clearance, their decision will be communicated by means of a letter to all registered I&APs and stakeholders.

If a clearance is issued for the SEIA Phase 2 process, Rössing Uranium will be able to move from the planning stage of the project into the design and construction stages.

As the environmental practitioners responsible for leading this SEIA process, Aurecon are of the opinion that the project components assessed and being applied for should be positively received by MET:DEA and that an environmental clearance should be issued. This opinion is based on our comprehensive understanding of the environmental impacts likely to result from these activities and facilities, as detailed in this and preceding documentation, and that the alternatives and mitigation measures as described and recommended will reduce the identified environmental impacts to an acceptable level.

2 INTRODUCTION AND BACKGROUND

The purpose of this chapter is to provide the context of the facilities and activities of the mine expansion project as proposed by Rio Tinto Rössing Uranium Limited and to introduce the Social and Environmental Impact Assessment Phase 2b Report. After providing the background, it describes the policy and legal framework within which the assessment has been undertaken. Thereafter, the chapter outlines the assessment process to date, its assumptions, and limitations, and the approach to the present stage in the assessment process. This chapter ends with a brief section on the context and structure of the remaining chapters of the report.

2.1 INTRODUCTION

Rio Tinto Rössing Uranium Limited (Rössing Uranium) has operated an open pit uranium mine in the Erongo Region of Namibia since 1976. This region is strongly characterised by mining activity and mining for various minerals has been ongoing in the Central Namib since 1901 (SAIEA, 2010). Figure 1 provides a locality map for the mine. Although of considerable extent, the Rössing ore body is of a low uranium grade and consequently large volumes of rock have to be mined to extract the uranium ore and to produce the processed (powdered) uranium oxide (U_3O_8) concentrate that is the final product.

As a result of the recent upward trend in uranium prices on the international market, and projected further increases in future, Rössing Uranium is able to consider possible expansion of its operations. The increased demand for uranium is primarily driven by rapidly growing international energy demands and associated increased future reliance on nuclear energy. According to the World Nuclear Association, there are 439 reactors operating globally, with 36 under construction. There are also 93 new reactors on the drawing board, with another 219 proposed. Should all of the planned and proposed reactors be built, the world total will be more than 787, or an almost 79% increase over the current level (Mining Weekly, August 8, 2008). Nuclear energy, a clean, competitive energy source that produces no greenhouse gas (GHG) emissions, is now seen as a key component of the long term energy solution in much of the world (Rössing Uranium Limited, 2009).

Rössing Uranium is thus considering extending its mine plan. The previous mine plan predicted an operational period ending in the year 2016. According to this plan, a sustainability assessment was undertaken and approved in 2005. Rössing Uranium is now looking at a 2026 mine plan (projected extended Life of Mine (LOM)) and consequently the associated potential social and environmental issues are being assessed in a multiphase Social and Environmental Impact Assessment (SEIA[1]), focusing on specific expansion project components.

The maximum extent of the envisaged expansion would entail, in summary, an increase in size of the current mining open pit known as SJ pit, with concomitant new disposal areas for waste rock, an additional crushing circuit, a new open acid heap leach process and ripios (spent ore from acid heap leaching) disposal, new or expanded processing plants, additional tailings dam capacity, and an increase in staff numbers and facilities.

[1] It is recognised that the term "environment" when applied in the context of an environmental impact assessment refers to the total environment, encompassing both the socio-economic and biophysical environments. However, Rössing Uranium prefers to retain the term "social" in the title of the present environmental impact assessment, as a clear indication of their commitment to the human element in the affected environment and in keeping with their Sustainable Development Framework.

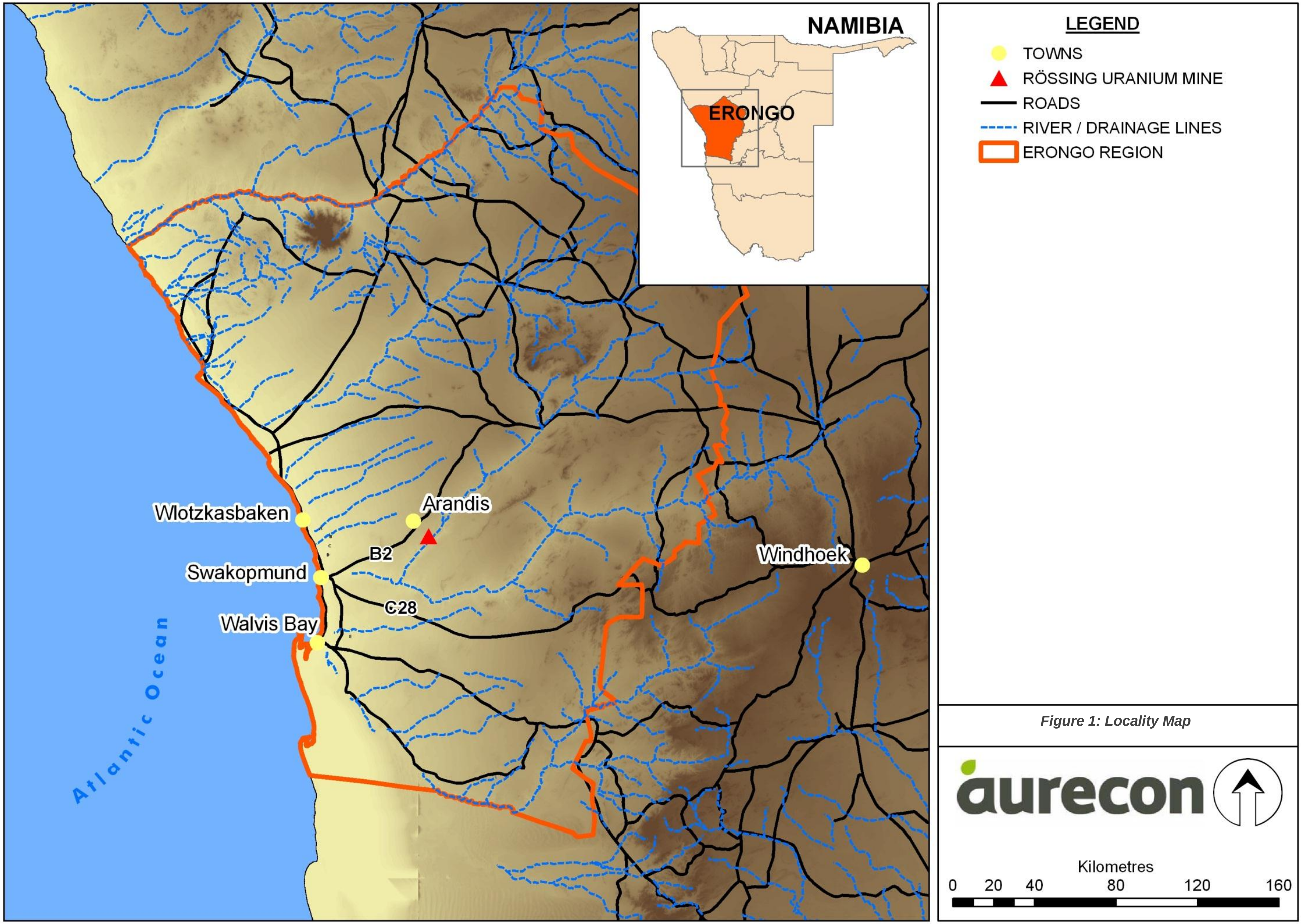


Figure 1: Locality Map

In terms of the Namibian Constitution (Government of Namibia, 1990) and relevant environmental legislation, in particular the Environmental Management Act (Act No 7 of 2007), the Environmental Assessment Policy (MET, 1994) and the Minerals Act (Act No 33 of 1992), the proposed expansion activity would require authorisation from the responsible authorities before it can be undertaken. Insofar as the social and environmental acceptability of Rössing Uranium's proposed expansion project is concerned, the Ministry of Environment and Tourism's Directorate of Environmental Affairs (MET:DEA) would need to issue a clearance for such expansion.

A SEIA has thus been commissioned by Rössing Uranium for their proposed expansion project, in accordance with these requirements, as well as the internal standards and guidelines prescribed by Rio Tinto, Rössing Uranium's parent company.

MET:DEA's clearance will be based on the outcomes of the SEIA and this report serves to document such findings. Should MET:DEA issue a clearance for the project, the responsible sector ministry, i.e. the Ministry of Mines and Energy (MME), will be able to consider extending Rössing Uranium's current mining licence that is valid until 2019, to allow for the expansion of their current operations to 2026 and authorising the proposed new facilities and activities.

It is important to note that seven specific components of Rössing Uranium's expansion project are the subject of this SEIA Phase 2b Report, namely the (1) **expansion of the current SJ pit** to enable mining operations to continue feasibly until at least 2026, (2) **increased waste rock disposal** capacity, (3) an **additional crushing circuit** to feed the proposed heap leach process, (4) **increased tailings disposal** capacity, (5) the **establishment of a new acid heap leaching facility** on the mine, (6) the **establishment of a ripios disposal area** associated with the new heap leaching facility and (7) **additional plant** associated with the above. These components form an integral part of the overall Rössing Uranium expansion project. The Phase 1 assessment components, as described in below, have been dealt with in another assessment process that was launched during 2007. Interested and affected parties (I&APs) registered for Phase 1 of the SEIA have, and will continue to be, kept informed as this Phase 2b process continues.

The entire extent of the envisaged expansion of the Rössing Uranium mine would comprise, in summary, the following components. These are being dealt with in two phases of the SEIA process, as follows:

- A sulphuric acid manufacturing plant[2];
- Associated sulphur storage on the mine;
- Transport of sulphur from the Port of Walvis Bay;
- A radiometric ore sorter plant;
- Mining of an ore body known as SK4[2];

Phase 1

- Sulphur handling facility in the Port of Walvis Bay;

Phase 2a

- Extension of the current mining activities in the existing SJ open pit;
- Increased waste rock disposal capacity;
- Establishment of a new crushing plant;
- Increased tailings disposal capacity;
- Establishing of an acid heap leaching facility;
- Establishing of a ripios disposal area; and
- Additional plant associated with the above.

Current Phase 2b

[2] The Phase 1 components implemented to date.

It should be noted that due to technical reasons, the list of SEIA Phase 2b project components has changed since the submission of the Phase 2 final scoping report. Changes are the exclusion of the "New mining activity in the larger SK area" which is no longer being pursued, and the addition of "Establishment of a ripios disposal area" to highlight the need to assess this significant component separately, even though it was always deemed to have been included in the "Establishing an acid heap leaching facility" component.

The reason for separating these components into the two main SEIA phases is that the engineering design and detailed feasibility studies for each of the nine components are not occurring simultaneously. This is due to the complex and highly technical nature of the various expansion project components necessitating a sequential approach to the execution of the proposed developments. It is understandable that economic and engineering criteria may influence the feasibility of Rössing Uranium's entire expansion project during the formulation and approval stages of the project cycle.

Originally, the sulphur handling in the Port of Walvis Bay was excluded from the SEIA Phase 1 due to the fact that the lessee and operator of the Bulk Handling Terminal in the Port of Walvis Bay had embarked on an environmental assessment for a sulphur handling facility themselves. However, since that time, Rössing Uranium identified additional potential locations for such a facility, that required assessment as to the suitability of these locations and the facility was therefore included in the SEIA Phase 2 process (referred to as Phase 2a). Due to the sulphuric acid manufacturing plant on the mine receiving clearance from MET:DEA during the Phase 1 SEIA, and its reliance on elemental sulphur as feedstock to operate, it was decided to separate the sulphur handling component in the port from the remainder of the SEIA Phase 2 components. It was thus subjected to an individual SEIA process in the interests of time and to allow for an earlier clearance than the remaining SEIA Phase 2b components addressed in the current report. The Final SEIA for the sulphur handling facility was submitted to MET:DEA for a decision in December 2009 and subsequently approved.

A graphic representation of the timing of the assessment and implementation phases for the SEIA process of Rössing Uranium's expansion project is provided in Figure 2.

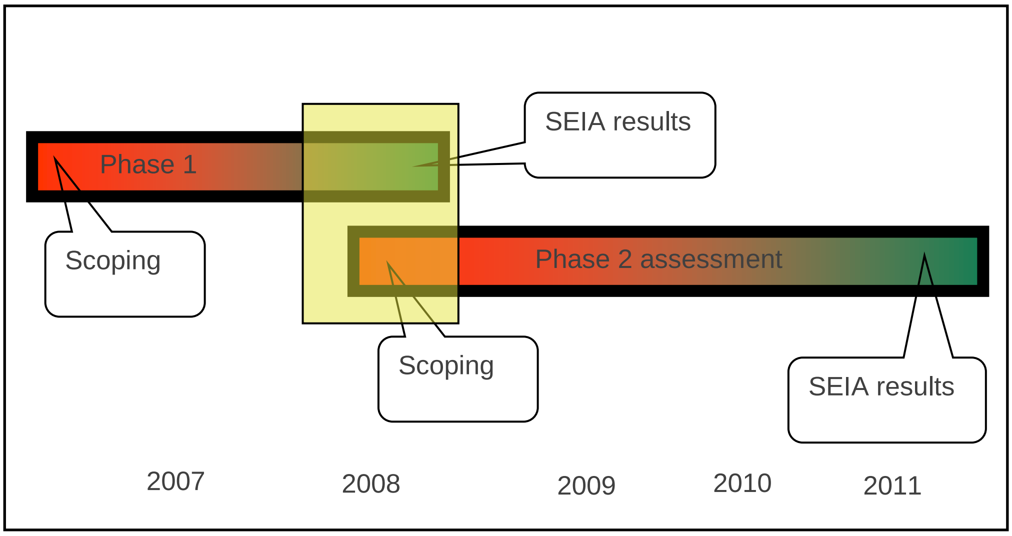


Figure 2: SEIA assessment and implementation phases[3]

The SEIA process and its sequence of supportive documentation are illustrated in Figure 3. It should be noted that the Scoping stage of the process that precedes this assessment stage has been completed and submitted to MET:DEA in May 2008.

[3] Source: Adapted from Rössing Uranium public participation information.

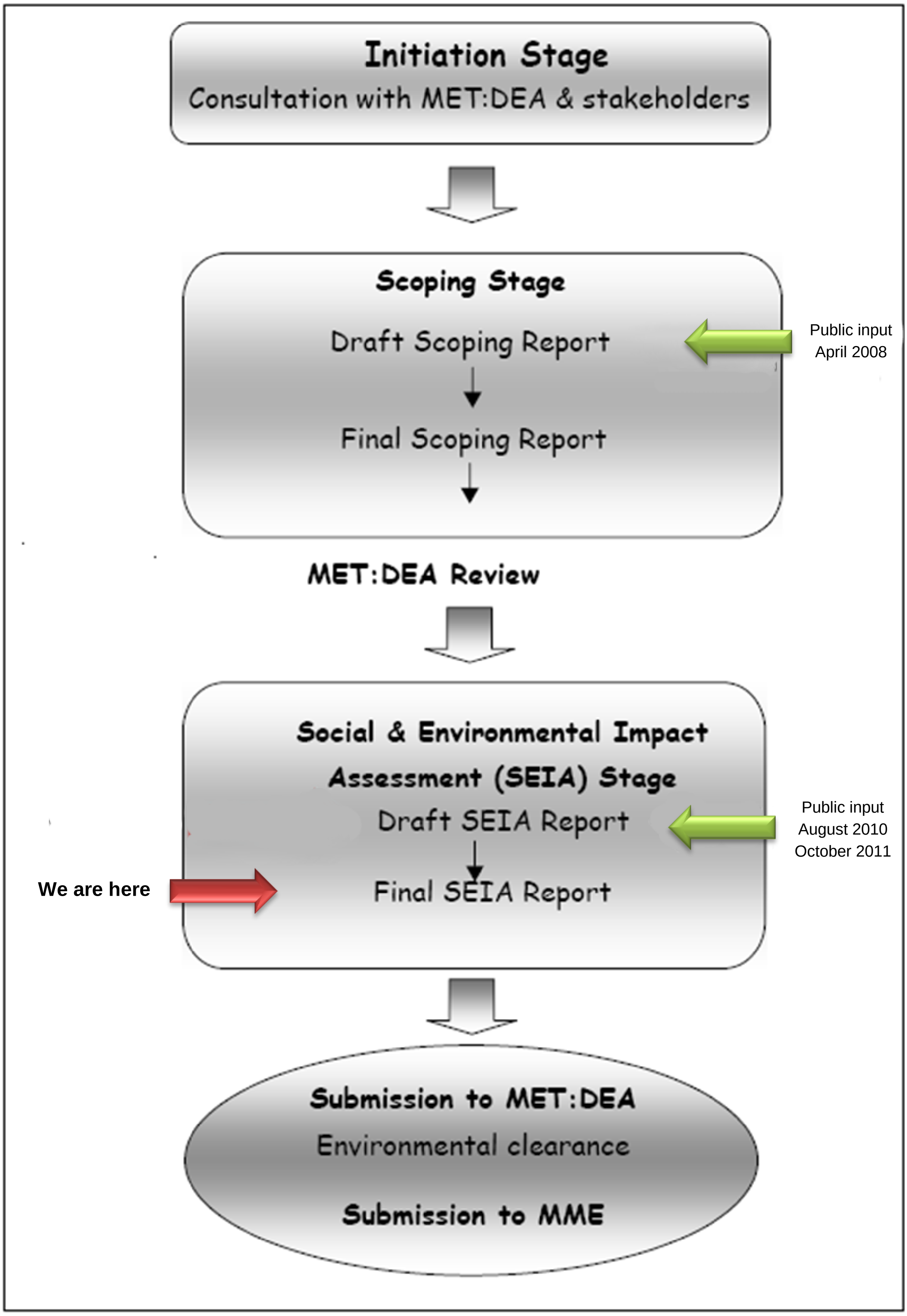


Figure 3: The SEIA process

The series of documents that support the present SEIA Phase 2b process, and that culminate in this draft SEIA Report, comprise the following:

- A Public Information Document (PID) released in August 2007 to initiate the SEIA process;
- A Scoping Report released in April 2008;
- A Background Information Document (BID) released in October 2008;
- A summary of specialist study findings released in August 2010; and
- This draft SEIA Phase 2 Report.

The Draft SEIA Phase 2 Report comprises three volumes:

- Volume 1 – Main Report;
- Volume 2a – Annexures, comprising Annexures A to N7; and
- Volume 2b – Annexures, comprising Annexures N8 to P.

A bibliography is included at the end of this report, which provides reference to other studies and that are of relevance to this SEIA process.

The purpose of this SEIA Report is to document the assessment stage of the process and in summary it comprises the following:

- An outline of the legal and policy framework regarding the environment within which Rössing Uranium operates and this assessment is undertaken;
- A description of the proposed expansion project components, their alternatives and potential impacts;
- A description of the public participation process undertaken to date, and the way forward with this process;
- A description of the assessment methodology applied; and
- Most importantly, an assessment of the significance and possible mitigation of the potential impacts that were identified during the SEIA process.

A description of the socio-economic and biophysical context of the proposed developments was provided in the Scoping Report for the SEIA Phase 2 process (Ninham Shand, 2008) and should be referred to in conjunction with this draft SEIA Report.

A number of specialist studies have been undertaken to properly understand the most significant potential impacts of the proposed developments and to ensure an acceptable level of confidence in the assessment of such impacts. The outcomes of the SEIA stage of the process include:

- Confirmation of the social and environmental acceptability of the preferred or indicated sites for the proposed increased waste rock, crushing circuit, tailings and ripios disposal facilities and for the new acid heap leaching facility;
- Confirmation of the social and environmental acceptability of the proposed expansion of the existing SJ open pit and additional plant infrastructure required;
- Identification or confirmation of the environmentally preferred process and technology alternatives;
- Identification of possible mitigation measures to reduce the significance of potential impacts; and
- Documentation of the identified mitigation measures in a Social and Environmental Management Plan (SEMP).

As indicated in Figure 3, the SEIA stage is the last stage in the SEIA process. Accordingly, an SEIA Report aims to collate, interrogate, analyse and synthesize information from a range of sources, to provide sufficient and reliable information for MET:DEA to make an informed decision on whether or not the proposed components of Rössing Uranium's expansion project are acceptable from a social and environmental perspective.

2.1.1 POLICY FRAMEWORK

As a significant contributor to the Namibian economy[4], Rössing Uranium's role in local and regional economic development requires that they demonstrate adherence to sound environmental practices. The decision to pursue possible expansion of their operations thus needed to be underpinned by informed strategic planning. To this end, the hierarchy of policy, planning and procedural documentation seen in Figure 4 reflects the point of departure for the proposed expansion project.

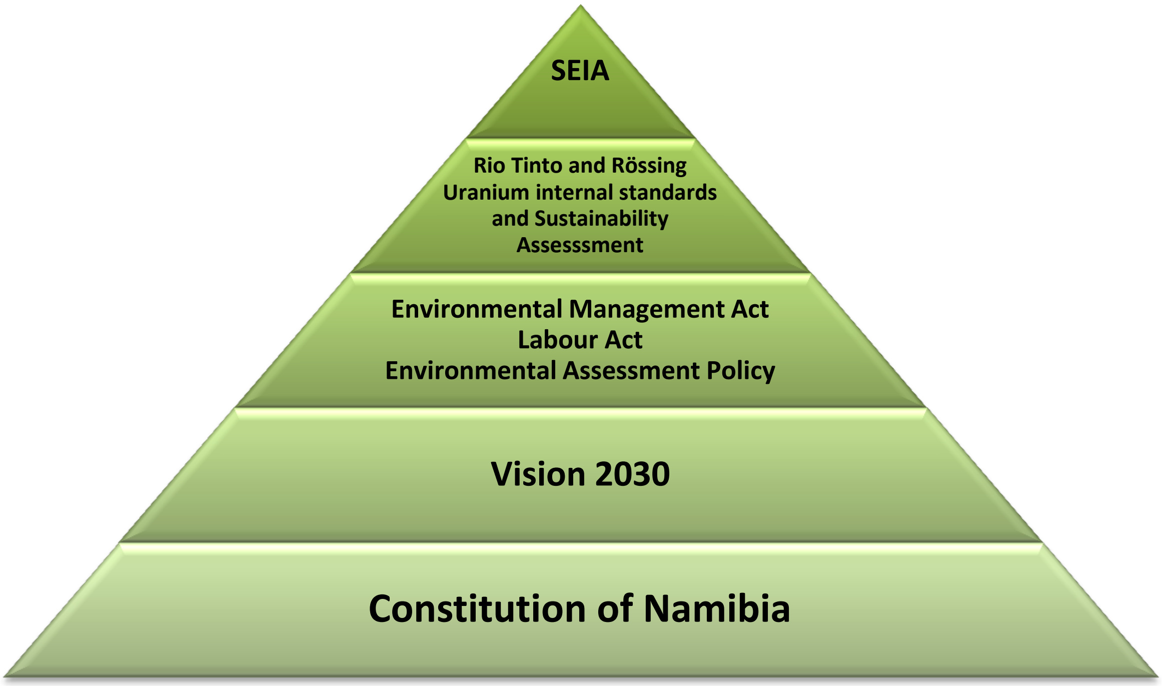


Figure 4: Hierarchy of policy and planning documents

The strategic policy and planning documents reflected in Figure 4 above are now briefly described. Regulated procedural requirements are dealt with in more detail in Section 2.1.7 below, together with other standards, conventions, and relevant pending legislation.

2.1.2 THE CONSTITUTION OF THE REPUBLIC OF NAMIBIA

There are two clauses contained in the Namibian Constitution that are of particular relevance to sound environmental management practice, viz. articles 91(c) and 95(l). In summary, these refer to:

- guarding against over-utilisation of biological natural resources;
- limiting over-exploitation of non-renewable resources;
- ensuring ecosystem functionality;
- protecting Namibia's sense of place and character;
- maintaining biological diversity; and
- pursuing sustainable natural resource use.

[4] In 2001 Rössing Uranium contributed 2.5% of Namibia's Gross Domestic Product (GDP) and 10% of the country's export earnings (Rössing Uranium, 2004).

The State is thus committed to actively promote and maintaining the environmental welfare of Namibians by formulating and institutionalising policies that can realise the abovementioned sustainable development objectives. As an important role-player in the beneficiation of Namibia's non-renewable mineral resources, Rössing Uranium has demonstrated its alignment with these constitutional principles.

2.1.3 VISION 2030

The principles that underpin Vision 2030[5], a policy framework for Namibia's long term national development, comprise the following:

- good governance;
- partnership;
- capacity enhancement;
- comparative advantage;
- sustainable development;
- economic growth;
- national sovereignty and human integrity;
- maintaining stable, productive and diverse ecosystems managed for long term sustainability; and
- peace and security.

In pursuing the further development of the uranium resources available to it, Rössing Uranium is in a position to contribute significantly to the realisation of most of the Vision 2030 principles.

Other forward-planning initiatives related to the Vision 2030 policy towards Namibia's national development, the tourism sector and to natural resource management are the Erongo Region Development Plan (2000), MET's North West Tourism Master Plan, the Namib Coast Conservation and Management Project and the Strategic Environmental Assessment for the Central Namib Uranium Rush (SAIEA, 2010).

2.1.4 ENVIRONMENTAL MANAGEMENT ACT 7 OF 2007

In giving effect to Articles 91(c) and 95(l) of the Constitution of Namibia, general principles for sound management of the environment and natural resources in an integrated manner have been formulated. This has resulted in an Environmental Assessment and Management Act being approved by the Namibian Parliament in October 2007. It was gazetted on 27 December 2007 as the Environmental Management Act (No 7 of 2007), Government Gazette No. 3966[6]. Part 1 of the Environmental Management Act describes the various rights and obligations that pertain to citizens and the Government alike, including an environment that does not pose threats to human health, proper protection of the environment, broadened *locus standi*[7] on the part of individuals and communities, and reasonable access to information regarding the state of the environment.

Part 2 of the Act sets out 13 principles of environmental management, as follows:

- Renewable resources shall be utilised on a sustainable basis for the benefit of current and future generations of Namibians.
- Community involvement in natural resource management and sharing in the benefits arising there from shall be promoted and facilitated.

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[5] Derived from Namibia's Green Plan drafted by MET in 1992 and followed by the sequence of National Development Plans.
[6] Regulations that will provide the enabling legislation for this Act are presently being formulated.
[7] Definition: Latin for 'place to stand', in law, the right to bring an action.

- Public participation in decision-making affecting the environment shall be promoted.
- Fair and equitable access to natural resources shall be promoted.
- Equitable access to sufficient water of acceptable quality and adequate sanitation shall be promoted and the water needs of ecological systems shall be fulfilled to ensure the sustainability of such systems.
- The precautionary principle and the principle of preventative action shall be applied.
- There shall be prior environmental assessment of projects and proposals which may significantly affect the environment or use of natural resources.
- Sustainable development shall be promoted in land-use planning.
- Namibia's movable and immovable cultural and natural heritage, including its biodiversity, shall be protected and respected for the benefit of current and future generations.
- Generators of waste and polluting substances shall adopt the best practicable environmental option to reduce such generation at source.
- The polluter pays principle shall be applied.
- Reduction, reuse, and recycling of waste shall be promoted.
- There shall be no importation of waste into Namibia.

There is a clear commitment to pursuing these principles of environmental management on the part of Rössing Uranium as the proponent of the expansion project. Further, cognisance has also been taken of the draft Regulations for Strategic Environmental Assessment and Environmental Impact Assessment (2008) as well as the draft Procedures and Guidelines for Environmental Impact Assessment and Environmental Management Plans (2008).

2.1.5 MINERALS ACT

A provision of the Minerals Act (Act No 33 of 1992), specifically Section 48(2)(b)(i) of the Act, is that "environmental impact studies" may be called for by the Minister of Mines and Energy (MME) when mineral licences – or their renewal or transfer – are applied for.

Rössing Uranium is presently operating under a mining licence issued by MME and this will remain unaffected for the current mining operation until it expires in 2019. However, as the responsible sector ministry, MME will consider extending the current mining licence until 2026, as well as to consider awarding the necessary mining licence for Rössing Uranium's expanded mining activities, once MET:DEA has issued environmental clearances. Copies of the Scoping Report, as well as this SEIA Report, will thus be submitted to the Ministry for their decision-making regarding mining licences for the extended and expanded mining operation.

2.1.6 RÖSSING URANIUM SUSTAINABILITY ASSESSMENT

In determining the viability of extending the life of the Rössing Uranium mine, a detailed sustainability assessment (Rössing Uranium, 2004) was undertaken. This sustainability assessment is in support of the engineering and financial feasibility studies that were the primary informants in considering such an extension of the life of the mine.

It is important to note that a sustainability assessment considers impacts that may result from a proposed development at a broader level than the site-specific impacts. The aims of the 2004 sustainability assessment were thus to:

- Identify any aspects of the proposed expansion project that could present fatal flaws that could be contrary to any development at all;
- Identify the opinions of all stakeholders and interested and affected parties, insofar as any real concerns that emerged could influence the future of the mine;
- Evaluate the risks and benefits of extending the life of the mine to either 2016 or 2026, compared to early closure in 2007; and

- Suggest possible mitigatory measures to minimise potentially negative impacts, as well as means of enhancing the positive impacts that may result from extending the life of the mine.

Developing a measure of sustainability, by quantifying the net environmental[8] benefit or detriment of the proposed expansion project, positioned Rössing Uranium to consider the next step in the development process, namely whether or not the project could be implemented within acceptable social and environmental parameters. The sustainability assessment is consequently a vital strategic informant in undertaking all phases of the SEIA for the proposed expansion project.

2.1.7 LEGAL REQUIREMENTS, STANDARDS AND CONVENTIONS

In order to protect the environment and ensure that Rössing Uranium's proposed expansion project is undertaken in an environmentally responsible manner, there are two significant pieces of environmental legislation that focus this assessment, *viz*. the Environmental Assessment Policy and the Minerals Act. These are reflected below, followed by reference to other legislation, standards, and conventions that are relevant. Note that although the Environmental Management Act has been promulgated, the enabling regulations have yet to follow. Consequently, the requirements of the Environmental Assessment Policy are deemed to remain in force. The Environmental Management Act, 7 of 2007 will give legislative effect to the EIA Policy. Draft Procedures and Guidelines for Environmental Impact Assessment and Environmental Management Plans were published in April 2008 (Government Notice 1, April 2008).

2.1.7.1 Environmental Assessment Policy of 1994

An appendix of the Environmental Assessment Policy contains a schedule of activities that may have significant detrimental effects on the environment and which require authorisation from MET:DEA. The nature of Rössing Uranium's proposed expansion project includes activities listed in this schedule. The primary triggers[9] are, *inter alia*:

"10~ Transportation of hazardous substances and radioactive waste;

11~ Mining, mineral extraction and mineral beneficiation;

12~ Power generation facilities with an output of 1MW or more;

14~ Storage facilities for chemical products;

15 ~ Industrial installations for bulk storage of fuels;

36~ Water intensive industries;

39~ Effluent plants;

46~ Chemical production industries; and

50~ Waste disposal sites".

Accordingly, the proposed expansion project requires authorisation from MET:DEA and will be based on the findings of the present SEIA process. The SEIA process accords with the requirements of such processes as described in an appendix of the Environmental Assessment Policy.

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[8] Note that the term "environment" in this sense is understood to refer to the total environment, i.e. to encompass both biophysical as well as socio-economic aspects.

[9] Given the complex nature of the proposed expansion project, other activities may also serve as triggers. However, the comprehensive SEIA undertaken has addressed all of the identified impacts.

2.1.7.2 Rio Tinto and Rössing Uranium Internal Standards

Rio Tinto, Rössing Uranium's parent company, operates within a comprehensive Health, Safety, and Environmental (HSE) management system that accords with international standards of best practice. An array of environmental standards are thus in place and all Rio Tinto subsidiaries, such as Rössing Uranium, are committed to achieving and maintaining such international standards. Rio Tinto's business policy statement titled *The Way We Work* provides the overarching environmental touchstone for all Rio Tinto employees, designed to ensure that standards and values are upheld, particularly accountability, fairness, integrity and openness. The policies and principles are then put into practice through local codes of conduct for each subsidiary, the implementation of which is reported on. Rio Tinto expects business partners, including suppliers, contractors, and consultants, to work to similar standards.

Rio Tinto strives to find, develop, operate, and eventually close world class ore deposits in a safe manner by taking a disciplined and integrated approach to all social, environmental, and economic activities. Business is conducted in an accountable and transparent manner, which relates not only to shareholders and employees, but also to host communities and customers and any other parties affected by their activities. The corporate policies presented in *The Way We Work* seek to respect the different laws, cultures, traditions, customs, and employment practices applicable to each business unit such as Rössing Uranium. The health, safety, social and environmental responsibilities that come with business operating activities, are managed to the highest standards and sound working relations, internal and external, are nurtured in a constructive and respectful manner (refer to Annexure A for Rössing Uranium's Health, Safety and Environmental Policy, June 2011). Extracts from Rio Tinto's policies on the environment and sustainable development follow:

- Environment: "Wherever possible we prevent, or otherwise minimise, mitigate and remediate, harmful effects of the Group's operations on the environment."
- Sustainable development: "Rio Tinto business, projects, operations, and products should contribute constructively to the global transition to sustainable development."

Furthermore, a recent Rössing Uranium report to stakeholders stated that sustainable development is the distinctive, significant, and characteristic centre of their overall approach to business. This suggests that meeting the needs of future generations depends on how well Rössing Uranium balances social, economic and environmental needs when making development and is, therefore, to seek out win-win situations that can achieve environmental quality and increase economic wealth and social well-being presently and in future (Rössing Uranium, 2009). Rössing Uranium aims to be the leader in environmental stewardship and maintains their reputation as a responsible corporate citizen. This can be realised when Rössing Uranium correctly understand and appreciate their natural resources, both biotic and abiotic, utilise them in a sustainable manner, and create a net positive impact.

Matters of planning, implementation and operation, checking and corrective action, and management review, are embodied in the Rio Tinto Health, Safety and Environment Management System (HSE MS) that each business unit, like Rössing Uranium, is obliged to maintain. The HSE MS is based on the principles of internationally applied management systems for health, safety, environment, and quality, including the relevant ISO standards. Rössing Uranium was certified as being compliant with the ISO 14001 EMS in February 2001 and recertified in 2004, 2007, and 2010. Certification services and independent third party auditing will continue through a Rio Tinto nominated international auditing organisation to ensure continued compliance to the standard throughout the group.

Specifically as it relates to the expansion project, the planning component of Rössing Uranium's EMS requires that the project be treated as a new activity and is thus subjected to "…*previous identification of (its) environmental aspects and impact assessment*…" and that the assessment of the project is measured against related environmental performance indicators. This may be interpreted as an explicit intention to undertake the present SEIA in accordance with local statutory requirements and international best practice.

In order to present the complex HSE MS in a publicly accessible format, a summary was compiled to explain the key components of existing mitigations and management practices. This summary is included as Appendix B to this report and includes a graphic representation of some of the key system components. The existing HSE MS, and mitigations it includes, also form a solid basis from which we have assessed impact significance and prescribed necessary further mitigations, without unnecessarily elaborating on the existing system.

2.1.8 OTHER LEGISLATION AND CONVENTIONS

In addition to the Environmental Assessment Policy, the Minerals Act and Rössing Uranium's internal standards described above, the following additional pieces of existing or pending legislation and conventions may have some bearing on the proposed expansion project:

2.1.8.1 The socio-economic environment

- Atomic Energy and Radiation Protection Act (2005);
- Communal Land Act (2002);
- Decentralisation Policy (1998);
- Hazardous Substances Ordinance (1956);
- International Atomic Energy Agency Non-proliferation Treaty (1970);
- Labour Act (1992);
- Marriage Equality Act (2002);
- National Code on HIV/AIDS and Employment (1996);
- National Employment Policy (1997);
- National Heritage Act (2004);
- Pending Minerals Safety Bill;
- Primary Health Care Policy (1990);
- Public Health Act (1919);
- Regional Councils Act (1992) as amended;
- Road Traffic and Transport Act (1999);
- Traditional Authorities Act (1995); and
- War Graves and National Monuments Amendment Act (1986).

2.1.8.2 The biophysical environment

- Air Quality Act (2004);
- Atmospheric Pollution Prevention Act (1965);
- Atmospheric Pollution Prevention Ordinance (1976);
- Convention on Biological Diversity (2000);
- Convention to Combat Desertification (1997);
- Forestry Act (2001);
- Minerals Policy of Namibia (2003);
- Namibian Water Corporation Act (1997);
- Nature Conservation Ordinance (1975) and Nature Conservation Amendment Act (1996);
- Pollution and Waste Management Bill (draft);
- Ramsar Convention (1975);
- Soil Conservation Act (1969);
- United Nations Framework Convention on Climate Change (1992);
- Water Act (1956); and
- Water Resources Management Act (2004) (to be enabled).

Rio Tinto subscribes to the International Council on Mining and Metals (ICMM) and as such adheres to their suite of policies on best practice and improved performance standards, which are:

- Principle 1: Implement and maintain ethical business practices and sound systems of corporate governance.
- Principle 2: Integrate sustainable development considerations within the corporate decision-making process.
- Principle 3: Uphold fundamental human rights and respect cultures, customs and values in dealings with employees and others who are affected by our activities.
- Principle 4: Implement risk management strategies based on valid data and sound science.
- Principle 5: Seek continual improvement of our health and safety performance.
- Principle 6: Seek continual improvement of our environmental performance.
- Principle 7: Contribute to conservation of biodiversity and integrated approaches to land use planning.
- Principle 8: Facilitate and encourage responsible product design, use, re-use, recycling, and disposal of our products.
- Principle 9: Contribute to the social, economic, and institutional development of the communities in which we operate.
- Principle 10: Implement effective and transparent engagement, communication and independently verified reporting arrangements with our stakeholders.

Some other international conventions supported by Rio Tinto include the Australian Minerals Industry Code for Environmental Management, Global Sullivan Principles of Social Responsibility, International Chamber of Commerce Business Charter for Sustainable Development, International Labour Organisation Convention 169: Indigenous and Tribal Peoples in Independent Countries, International Labour Organisation Declaration on Fundamental Principles and Rights at Work, Organisation for Economic Cooperation and Development Guidelines for Multinational Enterprises, Organisation for Economic Cooperation and Development Convention on Bribery and Corruption, United Nations Universal Declaration of Human Rights, United Nations Global Compact, US/UK Voluntary Principles on Security and Human Rights, and World Economic Forum Global Corporate Citizenship Statement (Rio Tinto, 2008).

The extent to which these pieces of legislation, conventions and management principles may be relevant to the undertaking of the expansion project SEIA were evaluated throughout the process. To date, no specific concerns have been raised regarding other legislation or conventions. Other government departments and statutory institutions that may have an interest in or responsibility for the SEIA process, such as the Ministry of Agriculture, Water and Forestry, Mines and Energy, NamPower, NamPort and TransNamib were provided with copies of the Scoping Report as well as the draft SEIA Report, for their comment. This final SEIA Report will also be made available to them.

2.2 BACKGROUND TO THE SEIA PHASE 2 PROCESS TO DATE

The SEIA process being undertaken is illustrated in Figure 3 above. As can be seen, the Initiation Stage and Scoping Report Stage have been completed and the SEIA Report Stage is currently in progress. To date, the SEIA process has comprised the following tasks:

- Consultation with the Head of the Environmental Impact Assessment Unit at MET:DEA during August 2007 (the commencement of Phase 1 of the SEIA), which resulted in a letter confirming their acceptance of the registration and screening of the SEIA process. A copy of this letter was provided in the Phase 1 Scoping Report. This represents the formal initiation of the SEIA process.
- In January 2008 a letter was submitted to MET:DEA to confirm the launch of the SEIA Phase 2 process, summarise the Phase 1 process and explain the Phase 2 process going forward. This letter was included in the Phase 2 Scoping Report and is again attached to this Report as Annexure C.
- Undertaking a comprehensive public participation process. This vital component of the SEIA process is the responsibility of Marie Hoadley, an independent public facilitation and social assessment practitioner. The public participation tasks completed to date are reported in detail in Section 5 and the process is on-going.

- Consultation with key stakeholders (national, regional, and local government authorities, and other statutory institutions).
- Compilation, review, finalisation and subsequent release during May 2008 of the Phase 2 Scoping Report to MET:DEA, and key stakeholders.
- Commissioning of specialist studies, after a scoping site visit and workshop, and finalisation of the scope of the specialists' studies. The Scoping Report provides details of the specialists in question and the scope of their work.
- Compilation of a Draft SEIA Report, after receiving the various specialist reports and further consultation with key stakeholders and project team members, and release thereof to I&APs and other stakeholders.
- Submission of the Final SEIA Report to MET:DEA as the primary environmental authority.

This Final SEIA Report is a revision of the Draft SEIA Report in response to inputs received from I&APs, stakeholders, independent review consultants and the project team. It will be submitted to MET:DEA to consider for decision-making and will be released to the public.

The SEIA Phase 2 Scoping Report of May 2008 for Rössing Uranium's expansion project outlined a range of potential social and environmental impacts and feasible project alternatives and how these were derived. It also described the proposed approach to the assessment and the methodology to be applied. It is thus important that this Report is read in conjunction with the Scoping Report of May 2008.

The SEIA Phase 2 Report has collated, interrogated, analysed and synthesized information from a range of sources and it is believed that it provides sufficient and reliable information for informed decision-making regarding the proposed components of Rössing Uranium's expansion project.

2.2.1 ASSUMPTIONS AND LIMITATIONS

The process that this SEIA Phase 2 Report is part of is limited to the specific components of the expansion project detailed in Section 3 and is being undertaken in terms of the Environmental Management Act, the Environmental Assessment Policy and internationally recognised best practice in environmental assessment. In developing the approach to this project, Aurecon took cognisance of Rössing Uranium's deliberations regarding their sustainability assessment (Rössing Uranium et al, 2004), as well as the most recent update of the Rössing Uranium Closure Management Plan (Rio Tinto, 2005).

Specific assumptions that have been made are:

- Regarding the assessment of relevant project-level alternatives, it emerged from the Scoping stage of the assessment that the number of such alternatives is limited. This is not a shortcoming in the process, however, since the principle of applying best practice and the adoption of the most environmentally appropriate technology has informed the engineering design of the expansion project components. The SEIA nevertheless determines the acceptability of such best practice and appropriate technology.
- As for site layout alternatives, a thorough multicriteria decision making (MCDM) model was used to cater for the complex process of assessing the numerous alternatives and rank them in order of preference (Ninham Shand, 2008, and Aurecon, 2009). This process has several advantages (Schneeweiss and Van der Merwe, 2009) and provides a defendable methodology to address site selection challenges, especially where through the evaluation against different criteria results in different alternatives being preferred.

- Due to the complexity of the present SEIA, in terms of the variety of different components being addressed and the sequencing of related engineering design, there are cases where the available information is incomplete or not available timeously. As indicated in the Scoping Report, where such information gaps are a shortcoming in the assessment, these would be clearly identified. However, where the subject matter is well understood and not critical to the assessment, provision has been made for their inclusion in the decision-making process in the Social and Environmental Management Plan (SEMP) that accompanies the SEIA Report. It should be noted that such gaps in information are limited in this case, as the completion of the SEIA was delayed due to changes in finalising the engineering designs.
- While external review has been carried out by the Southern African Institute for Environmental Assessment, Aurecon also undertook internal reviews throughout the process. The latter was carried out by a recognised expert with particular knowledge of the Rössing site and operations, as described in the Scoping Report.

2.2.2 APPROACH TO THE SEIA STAGE

2.2.2.1 The SEIA Report Stage

As outlined in the Phase 2 Scoping Report, there are three distinct phases or stages in the SEIA process, as described generically in the Environmental Management Act, Act 7 of 2007, namely the Initiation Stage, the Scoping Report Stage and the SEIA Report Stage. Figure 3 in Section 2.1 summarises the process followed. This document addresses the final phase, namely the SEIA Report Stage.

The purpose of the SEIA Report is to describe and assess the range of project actions and, where possible, the feasible alternatives formulated during the Scoping Stage, in terms of the potential environmental impacts identified. The ultimate purpose of the SEIA Report is to provide a basis for informed decision, firstly by Rössing Uranium as the proponent, with respect to the development options they wish to pursue, and secondly by the authorities regarding the acceptability of the proponent's preferred development options.

The approach to the SEIA Report Stage has entailed the following:

- Undertaking further review of relevant information.
- Appointing various specialists to undertake the specialist studies identified during the Scoping Report Stage, namely:
  - Air quality study, undertaken by Airshed Planning Professionals;
  - Occupational health and safety risk assessment, undertaken by Rössing Uranium in conjunction with AkerSolutions;
  - Visual impact assessment, undertaken by Visual Resources Management Africa cc;
  - Socio-economic impact assessment, undertaken by Marie Hoadley, an Independent Consultant;
  - Biodiversity, undertaken by Environmental Evaluation Associates of Namibia and later Biodata cc;
  - Groundwater and water balance study, undertaken by SRK Consulting;
  - Ground vibration study, undertaken by Blast Management & Consulting;
  - Archaeology (heritage) impact assessment, undertaken by Quaternary Research Services;
  - Noise impact assessment, undertaken by DDA Environmental Engineers;
  - Radiological public dose assessment, undertaken by the South African Nuclear Energy Corporation (NECSA);
  - General solid waste assessment, undertaken by PASCO Waste & Environmental Consulting cc;
  - Hazardous solid waste assessment, undertaken by PASCO Waste & Environmental Consulting cc;
  - Assistance with HSE MS summary description provided by Achmet Abrahams;
  - Traffic impact assessment, undertaken by Burmeister and Partners; and
  - Water and energy resource use, undertaken by Rössing Uranium.
- Review of available information in the SEA.

- Compiling this SEIA Phase 2 Report, based on the collation, interrogation, analysis, and synthesis of all relevant information. This allows for the description and assessment of the significance of identified potential impacts associated with the proposed development, with the objective of providing a balanced view of the proposed activities and their implications for the environment. The relevant information referred to includes the specialist reports, the comments, and concerns from the public and stakeholders, and input from the project team.

2.2.2.2 Decision-making and authority involvement

As indicated earlier, MET:DEA is the competent environmental authority and will make a decision in light of the information presented in the SEIA Report. If the decision is positive, MET:DEA will issue a clearance for the proposed mine expansion development.

There are other authorities and institutions that have a commenting role to play in the SEIA process. Their comments on the SEIA Report will help to inform MET:DEA's decision making. These authorities and parastatals include *inter alia*:

- Ministry of Agriculture, Water and Forestry;
- NamPower;
- NamPort; and
- TransNamib.

These and several other authorities and statutory institutions, in particular the regional and local councils and municipalities, were approached as stakeholders in the public participation process. See Section 5 in this regard.

2.2.2.3 Context and structure of this report

As outlined above, the assessment process undertaken to date included the production of a comprehensive Scoping Report which provided detailed information relevant to the project. However, for the sake of being succinct, information contained within the Phase 2 Scoping Report is not repeated within this SEIA Phase 2b Report unless it has a direct bearing on the issues under discussion.

Accordingly, to ensure a holistic understanding of the project, the nature of the activities and the substance of the assessment process, it is necessary that this SEIA Phase 2b Report is read in conjunction with the Phase 2 Scoping Report (Ninham Shand, November 2007), although substantial scope changes have been introduced as the project evolved.

The structure of this SEIA Report has been guided by the Environmental Management Act and the Environmental Assessment Policy. Further, cognisance has also been taken of the draft Regulations for Strategic Environmental Assessment and Environmental Impact Assessment (2008) as well as the draft Procedures and Guidelines for Environmental Impact Assessment and Environmental Management Plans (2008).

It has also been informed by the South African Department of Environmental Affairs and Tourism's *Environmental Impact Reporting Guideline* (Gov of SA, 2004), as well as by the review approach formulated by the Southern African Institute for Environmental Assessment that appears as an appendix of the DEAT *Review in EIA Guideline* (Gov of SA, 2004). In this way, informed decision-making by the proponent and the competent environmental authority should be facilitated. The SEIA Phase 2b Report and preceding Phase 2 Scoping Report contain the following information:

- A description of the approach adopted and methodology used in compiling the documentation;
- A description of the proposed project;
- An assessment of the alternatives relevant to the proposed project;
- A description of the affected environment;
- A description of the potential impacts of the proposed project, including cumulative impacts;

- A consideration of measures to mitigate the potential impacts;
- A conclusion and various recommendations with regard to the way forward;
- A series of annexures containing relevant information, including the various specialist studies and details of the public participation process; and
- An executive summary.

This Draft SEIA Report is structured as follows:

Chapter Two	Provides the introduction, policy, and legislative framework, details of the SEIA process and approach to the assessment;
Chapter Three	Describes the project proposal, including identification of alternatives and potential impacts;
Chapter Four	Describes the baseline of the receiving environment;
Chapter Five	Describes the public participation process;
Chapter Six	Describes the assessment methodology;
Chapter Seven	Discusses and assesses the identified potential impacts and mitigation measures including cumulative impacts; and
Chapter Eight	Concludes the report, describes the recommendations being made, and indicates the way forward.

3 PROJECT DESCRIPTION AND IDENTIFICATION OF ALTERNATIVES AND POTENTIAL IMPACTS

The purpose of this chapter is to provide project background and a technical description of the proposed activities associated with the mine expansion project currently being assessed, as well as the identification of feasible project alternatives. The identification of potential impacts associated with the project, as described here, are considered for further evaluation during the assessment stage of the present SEIA process.

3.1 INTRODUCTION

3.1.1 NEED FOR THE PROJECT

The Rössing Mine operated by Rio Tinto Rössing Uranium Limited (Rössing Uranium) was on record as being the third largest uranium mine in the world in 2009 and in 2010 supplied 5.3% of uranium oxide produced internationally. During 2010 a total of 52 million tonnes (Mt) of rock was mined from the open pit producing 3,628t of uranium oxide (Rio Tinto, 2011). The mine's ownership comprises Rio Tinto with a majority 69% interest, and the balance of equity held by the Government of Iran at 15%, the Industrial Development Corporation of South Africa at 10%, the Government of Namibia at 3% and 3% made up by various private shareholders (Rio Tinto, 2011).

Rössing Uranium undertook a detailed sustainability assessment in 2004 to determine the viability of extending the life of the Rössing Uranium mine. The outcome was in support of the engineering feasibility studies which were in favour of extending mining operations to beyond the current expected life of mine plan. The rise in uranium price, availability of improved processing technologies and further exploration drilling resulting in an increase in the known ore reserves provided the impetus for the expansion project. This SEIA allows Rössing Uranium to consider the next step in the process, namely to determine whether the expansion project could be undertaken within acceptable socio-economic and biophysical parameters. As a basis for this SEIA Phase 2, the project team have identified a potential maximum expansion scenario, which goes beyond the currently proposed Life of Mine (LOM) plan ending in 2023.

The mine expansion foresees an increase in mining rate and volume to approximately 65Mt annually from the existing open pit, but potentially includes the processing of stockpiled lower grade ores and other new sources. In order to process the ore economically, Rössing Uranium needs to upgrade and modernise its processing facilities by introduction of new technologies.

The Rössing Uranium ore body is considered to be of a low grade and the feasibility of Rössing Uranium's operations are significantly influenced by global commodity prices. Since 1989, falling uranium oxide market prices saw a steady decline in the mining activity, and planning for the early closure of the mine. Rössing Uranium developed its first mine closure plan in 1993 and the last major update of the closure strategy, plan and costing was done and externally reviewed in 2005. However, since 2005, market prices for uranium oxide have recovered and the feasibility of mining the low grade deposits improved. This resulted in a rapid increase in uranium exploration and development in the region and whilst the spot price for uranium oxide has remained volatile due to the effects of the global financial crisis, the long term outlook for this industry remains positive. As a result, Rössing Uranium has elected to extend the LOM and expand and modernise its mining operations. The Social and Environmental Impact Assessment (SEIA) process was divided into two phases dealing with different expansion project components of which this is the second phase.

This SEIA has thus been commissioned by Rössing Uranium for the proposed expansion project and the Ministry of Environment and Tourism's Directorate of Environmental Affairs (MET:DEA) would need to issue a clearance for such expansion. The clearance would be based on the outcomes of the SEIA, as documented in the various reports that underpin the entire assessment process. A number of specialist investigations have been undertaken into the potential social and environmental impacts associated with the proposed expansion project components and ultimately inform the overall SEIA. The individual specialist studies each includes a baseline assessment, an assessment of the significance of the potential impacts and suggests measures that may be employed to mitigate such impacts by enhancing its positive aspects while minimising the negative aspects.

This expansion and extension of life of mine project is taking place against the background of a general "uranium rush" to the Erongo Region of Namibia. A number of mineral exploration companies are active in the area and two new mines (Langer Heinrich and Trekkopje) are already in operation, whereas in the past, Rössing Uranium was the only uranium producer in the country. The diversification of uranium exploration and mining activity has resulted in a tightening of the legislative environment in a number of jurisdictions. However, the cumulative pressure on social infrastructure, such as housing and schools amongst others, is increasing. Critical to the sustainable development of the region is the recognition that alternate water supplies to sparse groundwater resources need to be established in order to accommodate further mining and industrial development and ensure that future economic opportunities (such as tourism) are not compromised by medium term mining projects. From the sustainable development perspective it is therefore essential that the Rössing Uranium expansion is assessed in a broader framework than at project level alone and for this reason the recently completed Strategic Environmental Assessment (SEA) for the Central Namib Uranium Rush (SAIEA, 2010) has been extensively consulted in completion of this SEIA.

3.1.2 PROJECT LOCATION AND GEOGRAPHICAL CONTEXT

The Rössing Uranium Mine is located in the Erongo Region of Namibia. The Erongo Region comprises the central western part of Namibia. It is bordered by the Atlantic Ocean to the west, the Kunene Region to the north, Otjozondjupa Region to the north east, Khomas Region to the east and the Hardap Region to the south. The Erongo Region consists of seven constituencies covering approximately 64,000km² and was home to almost 108,000 people, representing approximately 6% of Namibia's populace in 2001. By 2007 the Erongo Region's population was estimated at 147,441 people, representing a massive influx. The majority of this population reside in the two urban centres, namely, the tourist town of Swakopmund (the closest large centre to the mine) and the fishing and major port town of Walvis Bay south of Swakopmund. Also located within the region are the smaller towns of Henties Bay, a coastal tourist town north of Swakopmund, and Arandis, a mining town historically associated with the Rössing Mine. Refer to Figure 5 for a regional map indicating the mine's location in context with the Erongo region, as well as the main other mining or exploration licence areas.

The Rössing Uranium mine site itself is found at 15º 27' 50" East and 22º 02' 30" South, approximately 65km east north east and inland from Swakopmund and the Atlantic Ocean, in the Arandis Constituency. The 18,411ha Mine Licence Area (MLA) and accessory works area is bordered by the town of Arandis, approximately 12km to the north west, and by the incised Khan River valley, approximately 4.5km to the south-east. The site is located on the generally south east-facing, rough and undulating slopes between the Khan River valley (at 350mamsl) and the gravel plains closer to Arandis (at 600mamsl), near the edge of the Central Namib Desert.

The proposed project will be located within the existing MLA of Rössing Uranium. The right to carry out exploration and mine for nuclear fuels is covered by a mining licence (ML28) by the Ministry of Mines and Energy on 11 November 2005. Together with this is an accessory works area in which facilities such as waste dumps, tailings dam, supporting infrastructure and water extraction infrastructure are allowed. The current mine licence is valid until 7 May 2019.

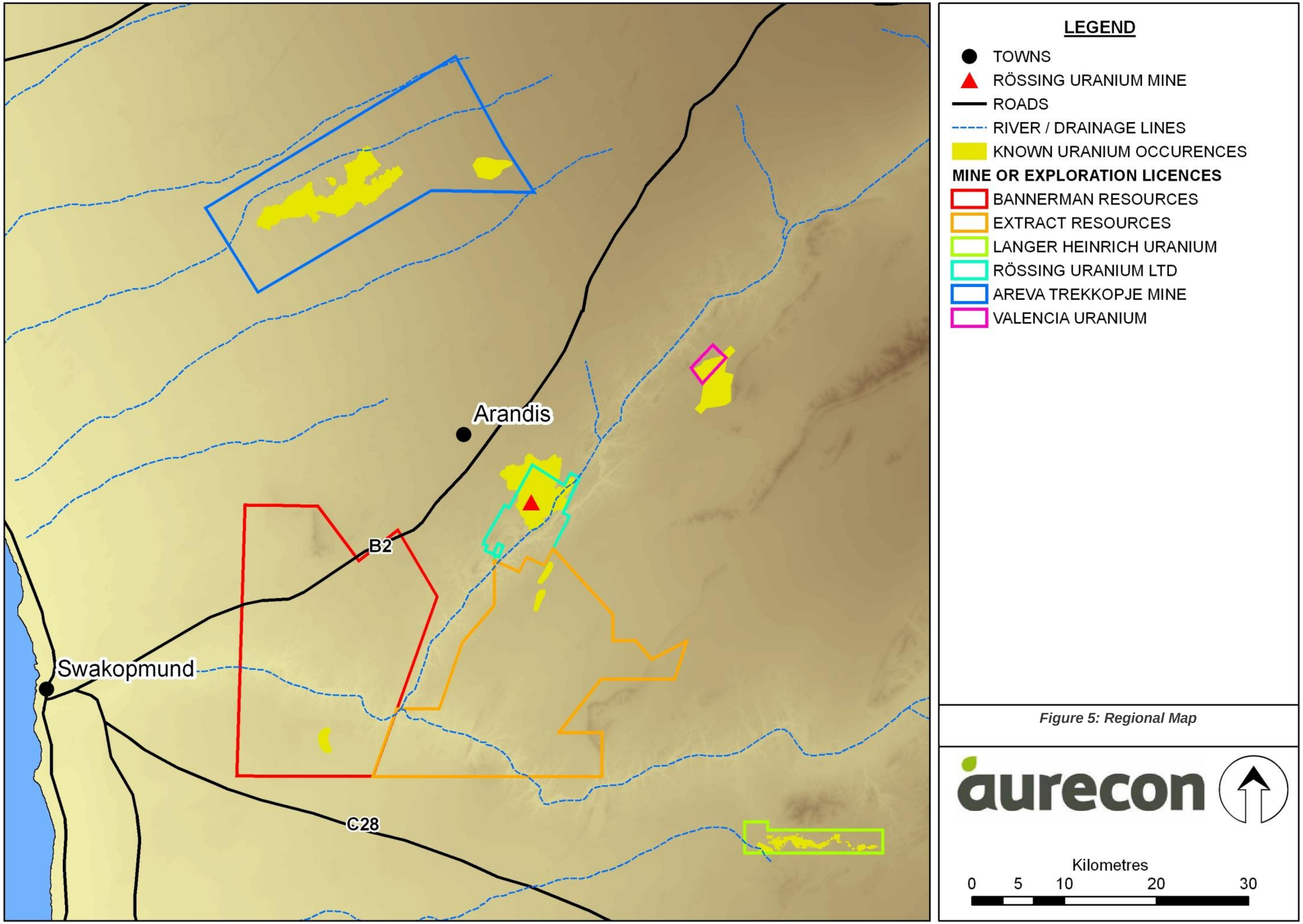

Figure 5: Regional Map

The Namib Desert is the oldest desert on earth and appears to be a barren and lifeless environment, however, on closer inspection, its climatic variations, varied landscapes and substrates in fact support a significant and largely endemic biological diversity. This is most notable in the reptiles and invertebrate groups, such as insects and spiders, which have over the eons developed remarkable adaptations to allow for their survival in the unforgiving Namib environment. The area is known as a hotspot of species diversity in these groups, particularly in geckos and sand lizards, beetles, scorpions and sun spiders. The habitat, its native species, including the larger fauna such as mammals and birds, are of conservation importance due to the high levels of adaptation, endemicity, and rarity. The south-eastern corner of the mine licence area overlaps with the Namib Naukluft National Park (NNP). Exploration by various companies within the park has identified significant uranium occurrences and led to one new mine (Langer Heinrich) and others may follow. Uranium mining in this region is therefore beholden to execute mining activities in a manner that maintains the overall habitat integrity and functioning and the recently completed SEA mentioned above provides specific development guidelines for the mining industry in this regard.

Apart from the urban centres, the smallholdings located on the lower Swakop River and a number of privately owned farms in the area, much of the land remain uninhabited and unproclaimed, excluding designated National Parks, such as the NNP and the recently proclaimed Dorob National Park[10], which incorporates the former National West Coast Recreation Area stretching from the Ugab River southwards to just north of Swakopmund. This sparse inhabitancy and land use pattern in the surrounding areas arises from the scarcity of surface and groundwater and associated low agricultural and developmental potential that characterises the area.

The topography of the area is typically characterised by a series of steeply incised valleys of the tributaries of the Khan River, intersecting the site and running in a northwest to southeast alignment. Of the MLA and accessory works area, approximately 2,165ha (11.4%) has been disturbed by mining activity, mining waste disposal and mine infrastructure to date. The Rössing Mine is situated amongst a number of other existing uranium mining operations in the Erongo Region, of which the main ones are indicated on Figure 5.

The immediate neighbours to the Rössing MLA are:

- Exclusive Exploration Licence (EPL) 3138 which is situated to the south of the mine and has been granted to Swakop Uranium who is a subsidiary of Australian listed Extract Resources. The EPL covers the newly discovered world class granite hosted uranium deposit Rössing South which is being studied to be developed into the Husab Mine in the near future.
- EPL 3602 is situated to the east of Rössing Mine and is granted to Zhonghe Resources (Namibia) Development (Pty) Ltd., a Chinese exploration company exploring for uranium occurrences which have been investigated by Rio Tinto Zinc in the 1970s but had not been developed further. A mining licence is currently being applied for.
- Another licence, EPL 3624 overlaps with Rössing's accessory works area to the north west of the mine and has been taken out by the Namibian company Creative Enterprises to explore for base and rare metals, industrial minerals, precious metals and dimension stone. Stone Africa operates two dimension stone quarries to the west of the mine.
- Arandis townlands to the north west.
- The NNP to the south.

[10] Dorob National Park was declared as a game park in terms of Section 14(2) of the Nature Conservation Ordinance (No 4 of 1975). Information accessed from www.nacoma.org.na

3.1.3 CURRENT OPERATIONS

The Rössing Mine has been mining and processing uranium since 1976. The mine produces a single product (uranium oxide or U_3O_8) and the product is sold forward on long term contracts. Mining is undertaken in a conventional open pit blast, load, and haul operation. The open pit currently measures approximately 3,000m long, 1,500m wide, and 390m deep and is excavated in 15m lifts. With the deepening and expanding pit, an overhead electrical trolley assist system was installed in 1986 to improve the efficiency (reduces fuel consumption and increases speed) and longevity of the haul trucks carrying ore from the pit. Ore grade control is undertaken by various means including a radiometric truck scanning system.

The main zones of economic mineralisation at Rössing Uranium are situated on the south-eastern flank of a major dome structure and are hosted by alkaline leucogranites (locally termed alaskites) appearing as sheeted dykes and sills intruded into metamorphosed country rock. There are a number of discrete zones of mineralisation, which are depicted in Figure 6. At present, Rössing Uranium is only mining the SJ mineral deposit, as well as a small area within the SK deposit referred to as SK4, and this is processed through the current acid tank leaching process.

The SH deposit was found to contain only refractory mineralisation. Drilling results from Z21, Z25 and RB anomalies indicate very limited, low grade mineralisation. The Z19 and Z20 deposits are currently being explored as potential uranium sources. Additional lower grade ore sources may lie in waste dumps and stockpiles, especially if alternative processing technologies are implemented.

Currently, the ore is processed by tank leaching which is preceded by four stages of crushing, rod-milling, and acid leaching followed by solid/liquids separation and tailings disposal. Uranium is recovered from the leach liquor in a continuous ion exchange (CIX) plant after which the solution is concentrated by solvent extraction (SX) and precipitated to recover yellowcake which is roasted to produce uranium oxide (U_3O_8). The plant has a nameplate design capacity to treat 14Mt per year of feed and produces up to 4,500t per year U_3O_8 product (was 3,628t in 2010). The processing facilities described above and the various facilities making up the Rössing Mine industrial complex are shown in Figure 7. Further descriptions of the current mining and product extraction processes are contained in the HSE MS summary description in Annexure B.

The basic infrastructure servicing the mine and its surrounds consists of the following:

Road: Vehicle access to site is gained via a government national road (D1991) off the B2 highway which serves to connect the mine to Arandis, Swakopmund, Walvis Bay, and Windhoek. The roads between the mine and these centres are tarred and single lane in each direction. The main road through the mine complex is also tarred but there are numerous un-tarred roads linking the lower portions of Dome, Pinnacle, and Panner Gorges to the central mine operations.

Rail: A full gauge railway line links the mine's services areas with the main line between Walvis Bay and Windhoek via Swakopmund. Main supplies brought in by rail include sulphuric acid, diesel, ammonia, manganese, and ammonium nitrate with drums of U_3O_8 product loaded into containers and railed to Walvis Bay for export.

Port: The Port of Walvis Bay is predominantly utilised by Rössing Uranium for the importation of sulphuric acid. Rössing Uranium controls a leased facility in the port which comprises four 30kt acid storage tanks.

Water: Water is supplied by NamWater (Namibian's bulk water supplier) via pipeline from Swakopmund to storage reservoirs located at the mine. The current source of water is predominantly the Omdel aquifer north of Henties Bay. Desalinated seawater will supplement existing water supplies due to the escalation of mining activities in the region and the associated demand for water in mining operations. Water for drilling and dust suppression purposes were mostly abstracted from the Khan River (limited to $600m^3$/day), although this was discontinued in 2010.

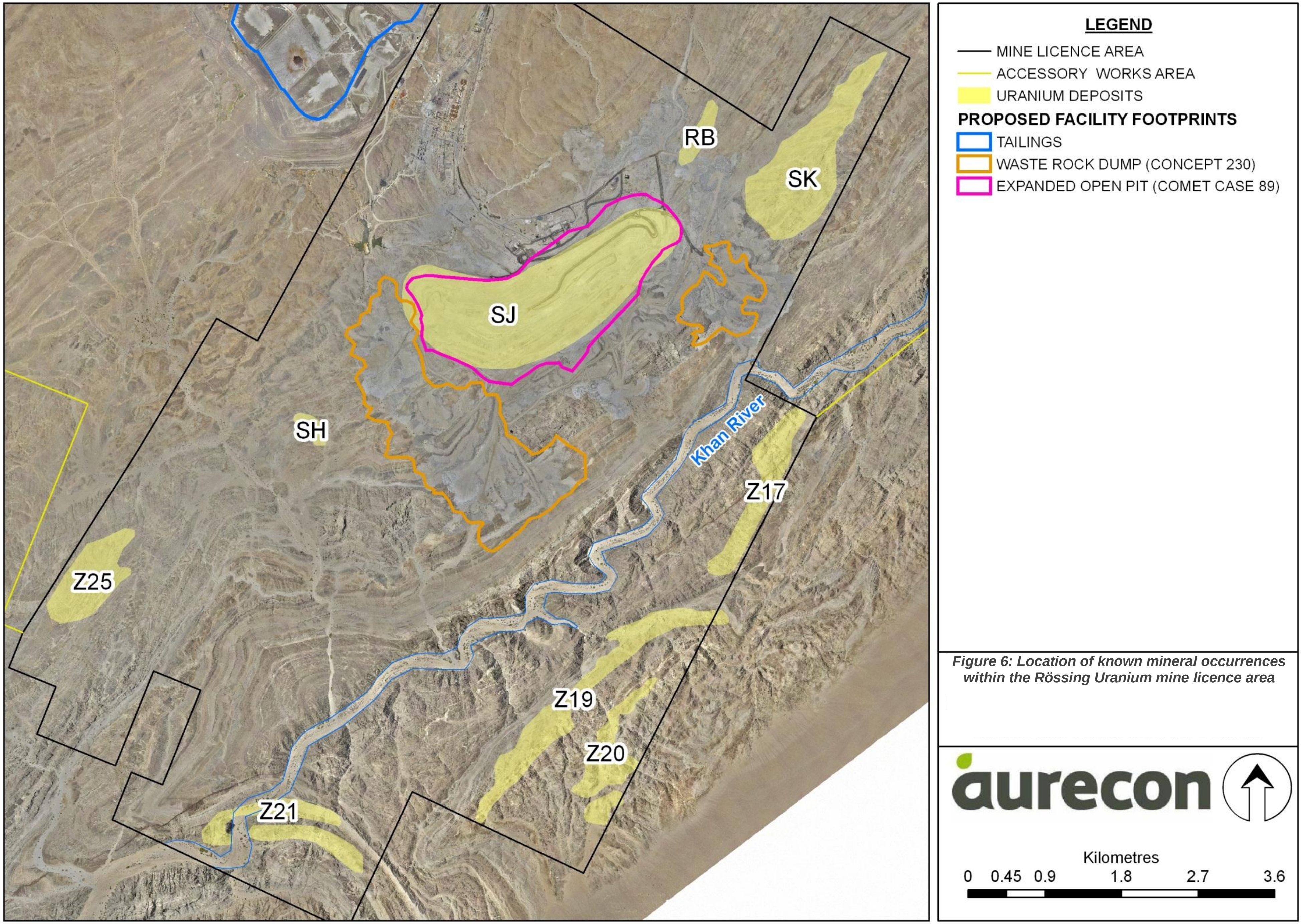

Figure 6: Location of known mineral occurrences within the Rössing Uranium mine licence area

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LEGEND

1	OFFICES
2	CONTRACTORS YARD
3	RAILWAY LINE
4	SALVAGE YARD
5	ACID TANKS
6	THICKENER CIRCUIT
7	MANGANESE PLANT
8	FINE ORE STOCKPILE
9	ROD MILLS
10	LEACH TANK
11	LAB OFFICES
12	SOLVENT EXTRACTION
13	CONT. ION EXCHANGE
14	FINAL RECOVERY PLANT
15	OFFICES
16	PLANT SPILLAGE SUMP
17	WORKSHOPS
18	MAIN SUBSTATION
19	FINE CRUSHING PLANT
20	CONVEYOR
21	COARSE ORE STOCKPILE

Figure 7: Existing plant facilities

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Kilometres
0 0.2 0.4 0.8

Electricity: Electricity is supplied by NamPower off the Omburu (close to Omaruru) to Walmund (close to Walvis Bay) 220kV line which forms part of the national grid. This power line also supplies power to Arandis, Swakopmund, and Walvis Bay.

3.1.4 THE EXPANSION PROJECT ASSESSED

The proposed mine expansion activities include the following:

- Extension of the current mining activities in the existing SJ open pit;
- Expanding the waste rock disposal capacity;
- Establishment of a new crushing plant;
- Expanding the tailings disposal capacity;
- Establishment of an acid heap leaching facility;
- Establishment of a ripios (spent ore from heap leaching) disposal area; and
- Additional plant infrastructure associated with the above.

Various arrangement alternatives (layouts) regarding the location of waste rock dumps, tailings storage facility, acid heap leach facility and ripios disposal area were considered, as these have the most significant footprint impacts. Sustainable development criteria carried the most weight in the final steps of this process, as described in more detail in Section 3.3. This preferred layout represents the final design freeze for the SEIA process.

The layout of the various proposed project component locations is shown in Figure 8 and described under separate headings to follow. The figure indicates the proposed preferred layout of the facilities. This layout was selected following the assessment of the social and environmental, technical and financial feasibility of various layout options, hence referring to it as the design freeze layout.

Several delays in this SEIA process related to the optimisation and refinement of the proposed expansion project components, specifically the financial feasibility thereof against a global financial crisis and technical design changes, hence the extensive process to determine the design freeze layout for assessment.

Many of the specialist studies[11] were relying on this design freeze for the expansion project. For example, the visual impact study needs to base the assessment of the final footprint area and height of the waste rock dumps. The noise impact study needs to consider the final choice of equipment to be used and the specifically the air quality study requires a good understanding of dust emissions caused by load and haul activity of a defined production schedule.

An expansion case based on the maximum expansion, worst impact case and was chosen and taken forward in the assessment as the design freeze layout. Minor refinements continued to be evaluated up until the end of the pre-feasibility stage but do not influence the scale of the heap leach, mining rates, waste volumes, equipment choice, and production schedules substantially.

3.1.5 SPECIFIC PROJECT COMPONENTS

Figure 8 shows the current preferred location of the heap leach facility, ripios, tailings, and waste rock dumps that have been taken forward as the design freeze layout. Each of these facilities are discussed in greater detail in the subsections to follow.

[11] Some specialist studies concluded prior to this final design freeze, but layouts assessed represent worst case scenarios, i.e. impact rating as assessed would be more conservative. Where required, updates to the relevant reports are included as appendices to the originals.

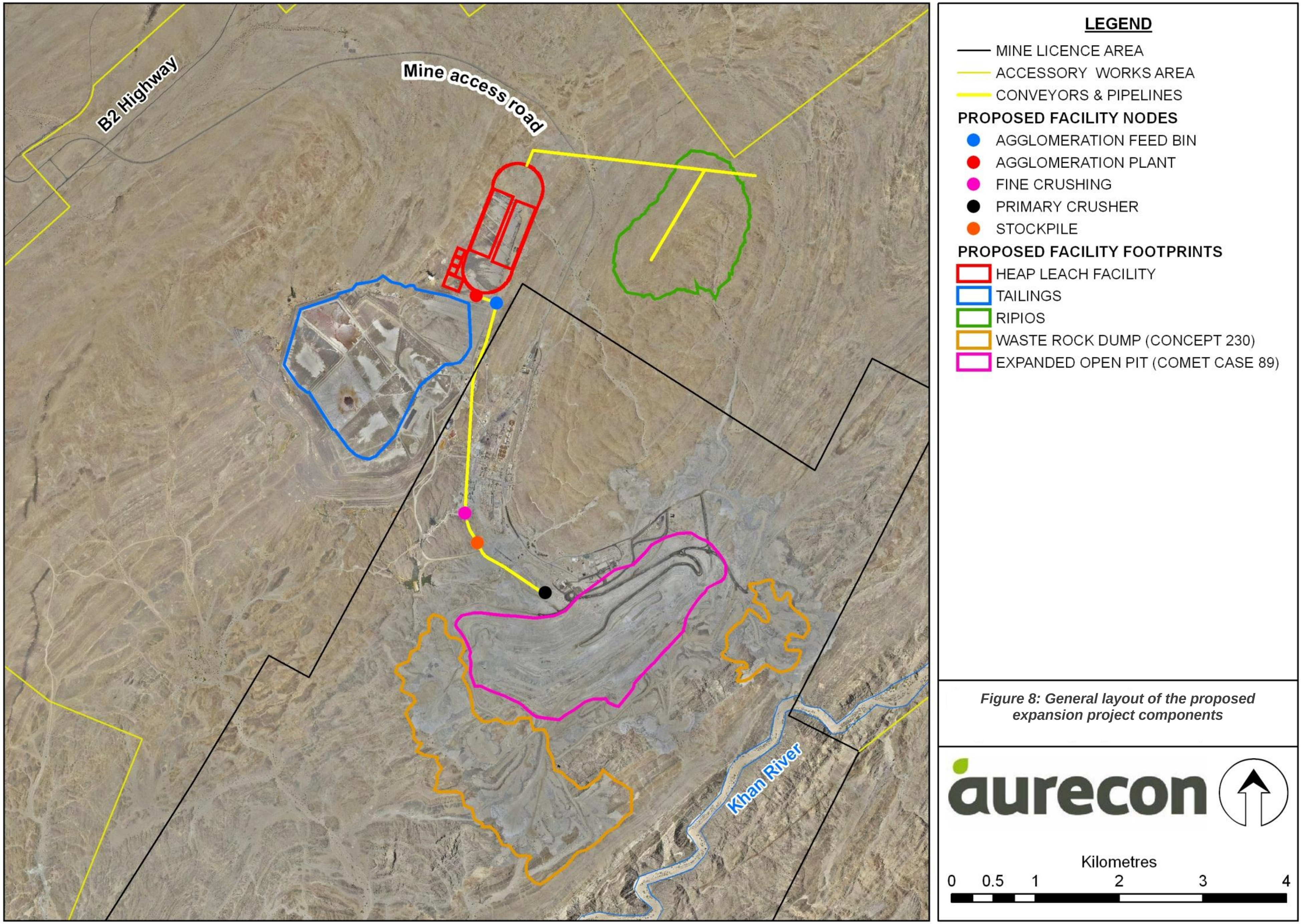


Figure 8: General layout of the proposed expansion project components

3.1.5.1 Expansion of the SJ Open Pit

The SJ mineral deposit has been the only source of ore production at the Rössing Mine until the recent opening of the small SK4 satellite pit. The current SJ pit measures approximately 3,000m in length by 1,500m at its widest point and 390m in depth. The type of mining activity is an open pit blast, load and haul operation with haul trucks running on a trolley-assist system installed in the pit in 1986. The envisaged enlarged (footprint wise) SJ pit will continue to be mined using the same method although additional equipment will be required to achieve the envisaged tonnages.

Approximately 19 new 180t haul trucks will need to be acquired over the remaining LOM, together with five rope shovels and one hydraulic shovel. One additional blast hole diesel drill and three blast hole drilling rigs are foreseen to be required.

Alaskites have been intruded into a synclinal structure formed in the Khan and Rössing Formations. The stratigraphy of the lower Khan Formation consists of gneisses and amphibole schist and is found in the north of the SJ pit. The overlying Rössing Formation consists almost exclusively of Lower and Upper Marble with thin bands of cordierite gneiss. These are found in the southern extremes of the SJ pit. The rock types that form the Rössing and Khan Formations are shown in Figure 9 and the SJ pit current and envisaged future profiles have been delineated thereon.

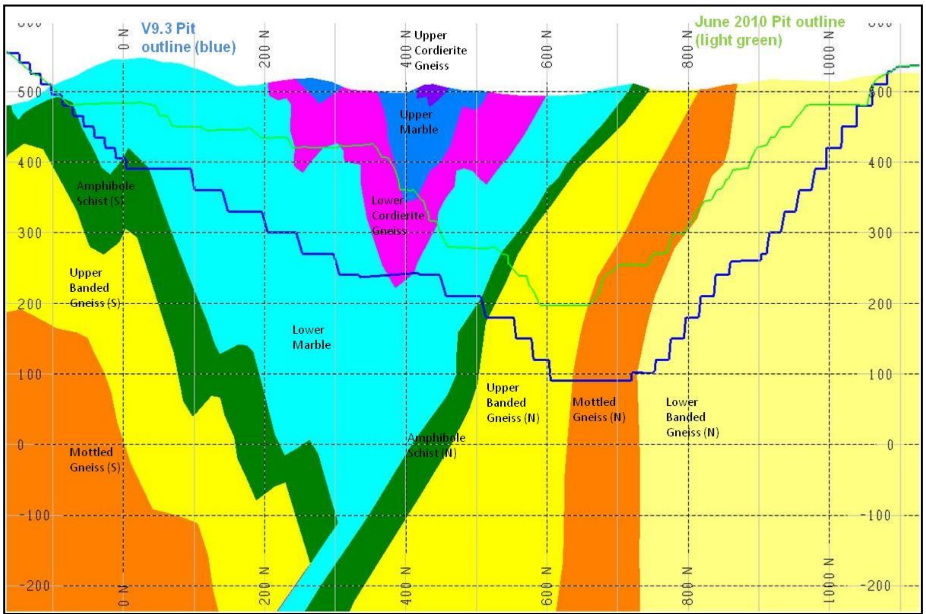


Figure 9: SJ pit geological section facing south west[12]

Exploration drilling has indicated uranium mineralisation up to 600m below the current pit. However, due to financial constraints of mining at such increased depths, it is economically more attractive to expand the pit horizontally rather than vertically. Due to the fact that the exact extent of the ore source is unknown, a scenario wherein mining could continue beyond 2026 is a possibility. As such, whilst there are still other suitable areas and methods available for the handling of waste rock, the infilling of the pit once depleted as a means of disposal of waste rock is not currently considered as a viable option.

[12] Source: Rössing Uranium.

Rössing Uranium's proposed expansion of the current SJ pit mining activity includes the horizontal expansion or push-back of the current pit into possible adjacent areas as follows:

- Phase 1 - T10: estimated ore volumes = 24Mt;
- Phase 2 - NW : estimated ore volumes = 294Mt; and
- Phase 3 - SW: estimated ore volumes = 296Mt.

The horizontal extent of the three pushbacks mentioned here, are represented in Figure 10.

As per the current mining operation, water will be required for drilling activities and dust suppression in the expanded areas. The current rate of water usage for these purposes for the mining operation is approximately 700m^3/day of 100m^3/day collected from the pit bottom sump. Together with water being provided for the expanded SJ areas, electricity will also be required, as per current operations. Limited additional infrastructure will be required for the supply of water and electricity to extend current supply to the new areas. Rössing Uranium discontinued all abstraction from the Khan River in 2010.

3.1.5.2 Expansion of the Waste Rock Disposal Dumps

The expansion of the SJ pit would lead to approximately 250Mt of additional waste rock requiring disposal. It is intended that this material be accommodated on the existing mineral waste sites. The principle applied was to retain the existing footprints and extend the dumps vertically. Although sufficient capacity for the additional material exists on the current waste rock dump sites it has to be planned with cognisance of long term implications such as seepage control, slope stability, wind and water erosion, rehabilitation of biodiversity, visual intrusion on elevated horizontal lines in the landscape and emission of dust and radon.

The waste dump and stockpile design considers and/or conforms to the following:

- The capacity of the final dump geometry needs to take the maximum expansion scenario (including potential future pushbacks) into account so that footprint changes can be prevented over the remaining life of mine;
- Extended footprints should be minimised and ideally remain as existing;
- Potential future pit limits (at higher metal prices);
- Location of known radiometric anomalies, such as SH in the west and SK and RB in the east;
- Khan River to the south;
- Infrastructure such as the mobile equipment workshop and primary crusher to the north;
- Visual impact from the national road to the north of the mine, restricting the elevation to 635mamsl;
- Stable landform configuration;
- Rössing Uranium guidance on land management and use;
- Potential changes in future mine plans;
- The visibility from key external observation points to the mine should be minimised; and
- Scheduling should be optimised to achieve the balance between economic and environmental factors.

The initial updated dumping strategy and plan was completed by the mine planning department towards the end of 2009 and a specialist company has since been appointed to assist with the strategy further development.

3.1.5.3 Construction of New Ore Crushing Plant

The proposed new heap leach facility requires crushing of the ore prior to processing, which is similar to the existing tank leach process, except that for heap leaching it need not be crushed as fine, as the proposed new process is designed for coarser material.

A new crushing line is to be added, next to and parallel to the existing, to feed the heap leach process and will result in doubling the total crusher capacity. It provides for a separate coarse ore stockpile following primary crushing, as well as secondary and tertiary crushing stages. Figure 11 indicates the proposed layout of the additional crushing line, next to the existing. Potential impacts to be considered here include dust and noise, similar to the existing crushing circuit.

Figure 10: SJ pit indicating proposed pushbacks or horizontal expansion areas

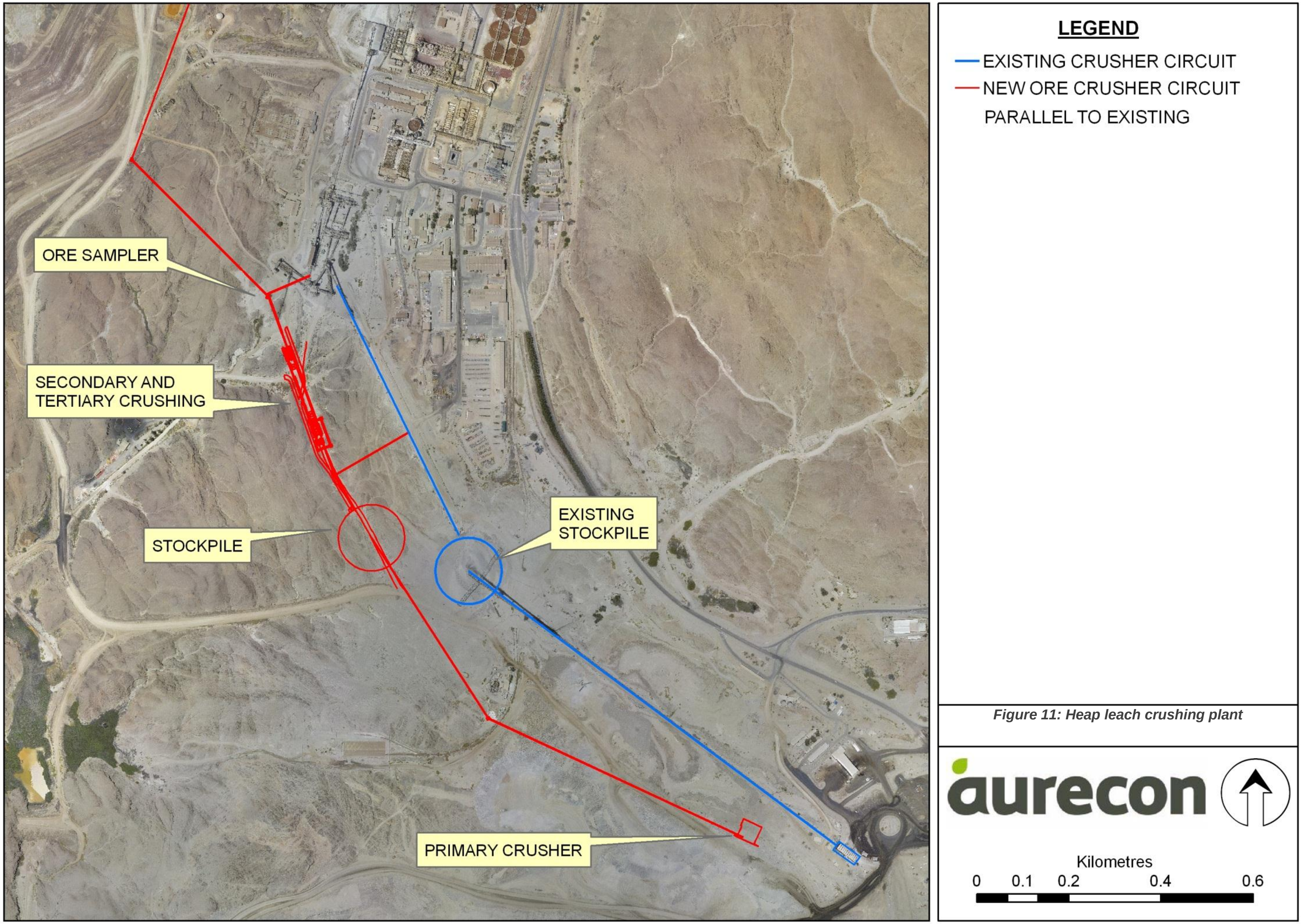


Figure 11: Heap leach crushing plant

3.1.5.4 Expansion of the Tailings Disposal Facility

Safe disposal of tailings at Rössing Mine is a significant management issue because of the high volumes involved. The original tailings dam or tailings storage facility (TSF) was designed to encircle an evaporation pond as a single entity, by means of a steeply angled ring berm constructed to the west of the Berning Range and mine processing area. However, the imperative of recycling water from the tailings pond resulted in the tailings dam being redesigned as a paddy system and considerable reductions in capital, operating and projected close-out costs realised.

The paddy deposition method commenced in 1988, reducing the wet beach area and, together with the decrease of pump speed to a minimum, produced a considerable reduction of water loss through evaporation. Tailings deposition planning is aided by the use of a model that allows the most cost-effective dam development in the short- and long term. The current TSF applies a simple spigot deposition system. Coarse ground tailings for dam building are discharged through spigots, or open pipe ends, onto the sand wall which is built above the original starter dam. Refer to Figure 12 for a view of the existing facility.

Seepage from the TSF is collected in a seepage dam with a plastic-lined wall core. Downstream from this, and in other drainage lines which emanate from the TSF area, trenches have been cut into the alluvium and dewatering wells have been sunk into the fracture zones to collect any water flow, enabling it to be pumped back to the seepage dam.

The quality of water drawn from these wells and trenches, as well as water drawn from wells in the Khan River lying within the MLA, is monitored routinely to ensure that groundwater systems beyond the MLA boundaries are unaffected by Rössing Uranium's mining activities.

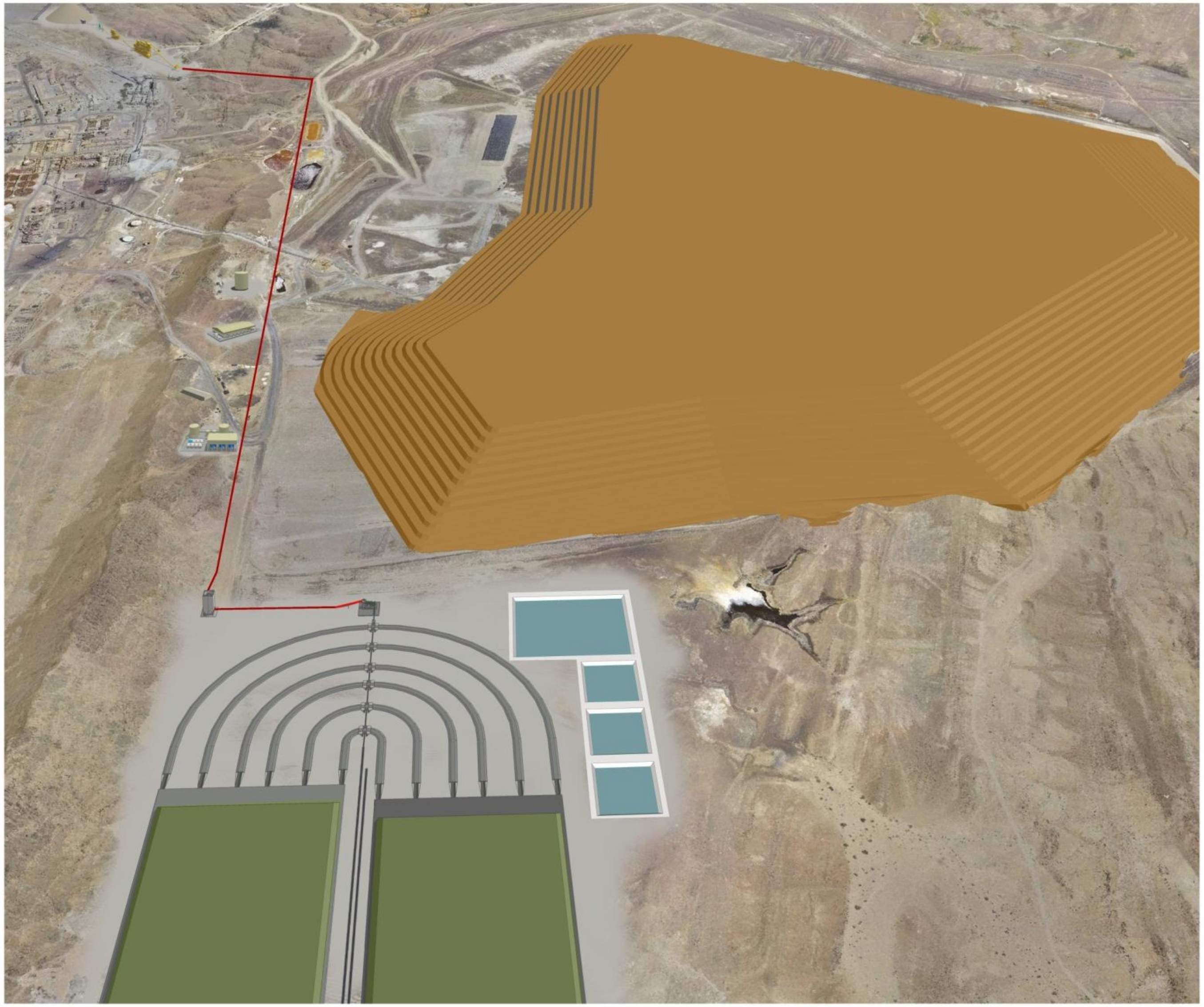
***Figure 12: Current tailings dam design showing paddy system, viewed from the west*[13]**

Techniques for short-term dust control include windrowing using tailings and waste rock and dust suppression spraying which is applied on a continual basis. As a long term dust control measure, the

[13] Source: Rössing Uranium

TSF would be fully covered with rock as is described in the decommissioning and closure plan (Rössing Uranium, 2005).

Volumetric modeling showed that with the proposed layout (providing for space for the heap leach plant on the northern part of the TSF) sufficient space would be available to accommodate the 200Mt tailings requirement for the tank leach operation over the life of mine. Figure 13 shows the final layout of the proposed conventional tailings facility on the central TSF to an elevation of 680m required for the tank leach process, up from the current 640m elevation. The current paddy system will be retained.



LEGEND

- TAILINGS FACILITY
- LEACHING SOLUTION COLLECTION PONDS
- HEAP LEACH PADS

Figure 13: Conventional tailings on the central Tailings Storage Facility

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Not to scale

3.1.5.5 Construction of an Acid Heap Leaching Facility

The proposed heap leach project is based on increasing the capacity of the ore processing facilities at Rössing Uranium from the current 13Mtpa level based on conventional tank leach processing with a maximum U_3O_8 output of 4,500tpa, up to 28Mtpa of Run of Mine ore with the addition of 15Mtpa destined for heap leaching to a maximum total U_3O_8 output of 8,000tpa under the maximum expansion scenario.

Heap leaching is a process by which ore is crushed to a certain size over which a leaching solution is applied, either by spraying or drip irrigation. The uranium is dissolved from the rock and filters through the heap and is collected on the underside of the heap in drains. The feed material (crushed ore) is crushed to achieve a uranium leach factor of above 50%. The "pregnant" solution (leachate solution containing uranium) is collected in drainage pipes within the base layer below the heap and stored in collection ponds. The uranium is then precipitated from this solution and the resulting uranium concentrate is piped to the conventional metallurgical processing plant.

Heap leaching is a well-established process for potentially also optimising the recovery of uranium from ore that is currently rejected (i.e. low grade ore) for feeding through the conventional tank leach extraction process and is being widely used by other mining operations globally. It is an economically attractive option as uranium that would otherwise have been sacrificed in waste rock, can be recovered relatively cost-effectively.

Rössing Uranium is investigating the implementation of this method as a new processing option to extract uranium from low grade ore from the pit. The option to process low grade and high calc stockpiles, an unutilised source of uranium arising from historical mining operations in the SJ pit will then also exist. Leaching can be achieved by using an acidic leaching solution.

The generation of two input streams, i.e. from the current tank leaching system and from the proposed heap leaching system, into the metallurgical circuit may potentially result in a range in composition of the two input streams. This will be fed into the final recovery plant separately, or mixed to obtain an optimum solution to feed into the plant.

With heap leaching, the "pregnant" solution can be recycled through the heap until an acceptable concentration is reached before pumping it to the processing plant. The estimated amount of water required in the leaching solution is determined by the volume of water required to entirely soak the heap and make up the evaporation losses from the surface. As mentioned previously, the management of water use for heap leaching will be integrated with existing systems, although the need exists for additional water supply to supplement the metallurgical processes. Rössing Uranium's existing practices to minimise resource use, as described in the HSE MS summary description (refer to Annexure B), will apply to the new process as well.

The new heap leach plant will be located on the north-eastern extension of the existing TSF. A separate storage facility will be constructed on the Rössing Dome to accommodate the spent ore (ripios) arising from the new heap leach facility. New workshop and office facilities have been allowed for close to the heap leach and proposed new crusher facilities for the operations and maintenance staff.

The general layout of the main components is depicted in Figure 14.

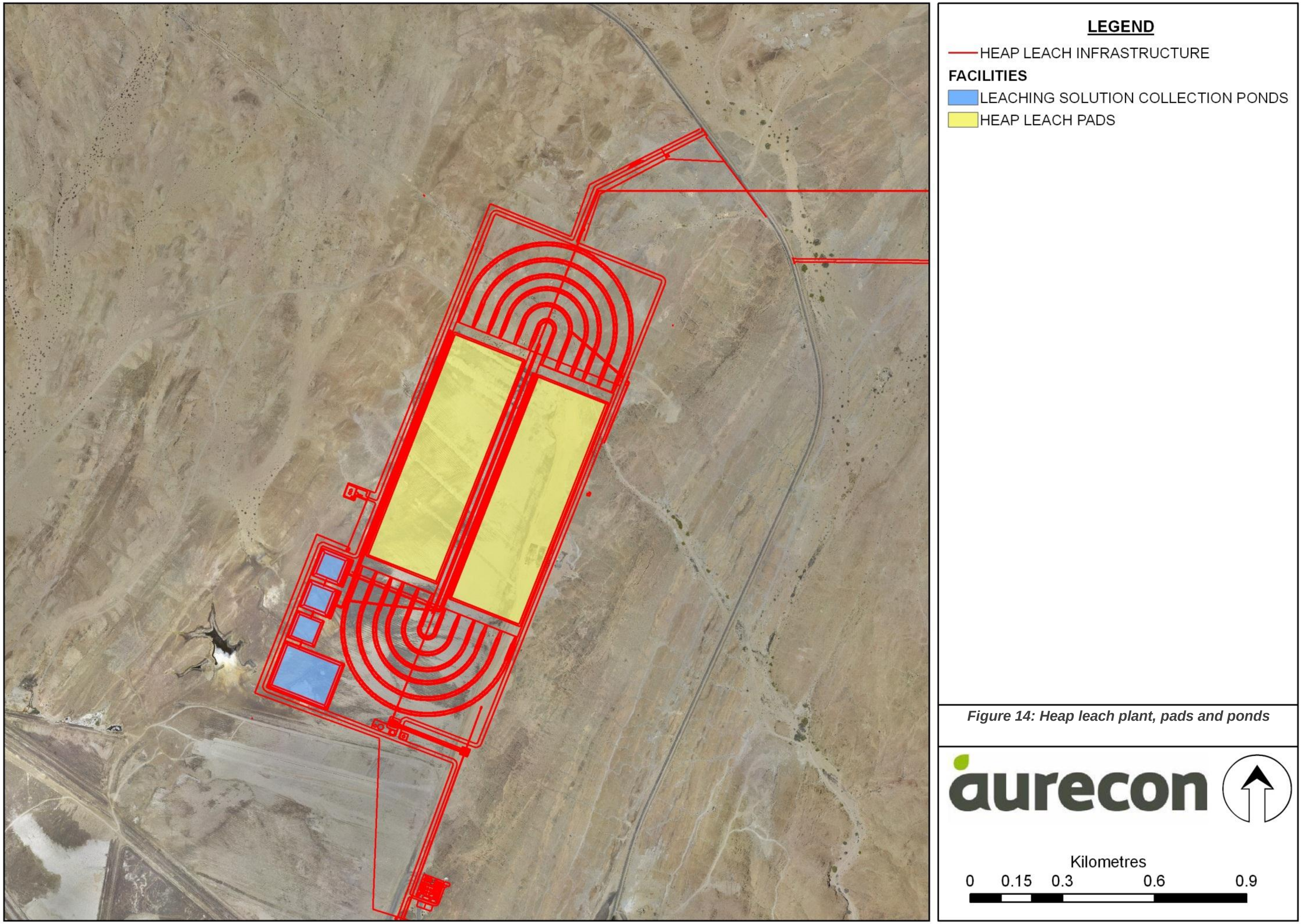

Figure 14: Heap leach plant, pads and ponds

The existing tank leach processing facility will remain unchanged with the exception of the following areas:

- Final product throughput will increase with additional feed from heap leach plant;
- Tank leach plant will be supplied with fresh water in place of the current return dam solution;
- Current return dam solution will redirected and utilised by the heap leach plant; and
- The tank leach tailings deposition will be constrained to the current footprint to make space for the heap leach pad on the north-eastern extension of the TSF.

The new heap leach facility will have its own dedicated carousel type ion exchange (CIX) and solvent extraction (SX) facilities. The site's existing final product recovery plant will be common to both the new heap leach and existing tank leach facilities. Facilities to transfer ore between the tank leach and heap leach circuits will also exist but the conveyors required will not be installed during the initial heap leach development project. Rather, provision will be left to allow installation of these conveyors at a later date should they be deemed necessary.

A process flow diagram of the heap leach plant is provided in Figure 15 and the main points of interest are:

- Primary (gyratory based) Run of Mine ore crushing is followed by crushed ore stockpiling;
- Fine ore crushing comprises sizing of primary crushed ore and is followed by re-crushing of oversized ore in an open circuit arrangement of secondary standard head cone crushers, followed by closed circuit tertiary crushing in short head cone crushers;
- Crushed ore agglomeration with concentrated sulphuric acid and return dam solution or barren solution in a rotary agglomeration drum;
- Agglomerate stacking and leaching then occurs along a "race track" type dynamic heap pad operation, utilising sequential phases of intermediate leach solution and barren solution irrigation to produce pregnant leach solution for collection;
- Once ore has undergone the 60-day leaching cycle, the heaps are reclaimed by means of a bucket wheel reclaimer and conveyor belt system from the pad for ripios (spent ore) stacking and disposal;
- Pregnant leachate solution is filtered to concentrate the leached uranium, following which the filtrate or barren solution is recycled back to the closed irrigation solution storage ponds for reuse in heap leach operations;
- Concentration of filtered pregnant leach solution in CIX units; and
- Purification and solution upgrading in a SX circuit results in raffinate, which is returned to the Ion Exchange Plant and from where the final liquor product is pumped to the existing Final Product Recovery Plant where U_3O_8 recovery is effected via stages of ammonia precipitation, precipitate thickening followed by final product dewatering and drying.

Figure 16 schematically indicates the proposed heap leach pad race track layout and the location of the various required infrastructure components.

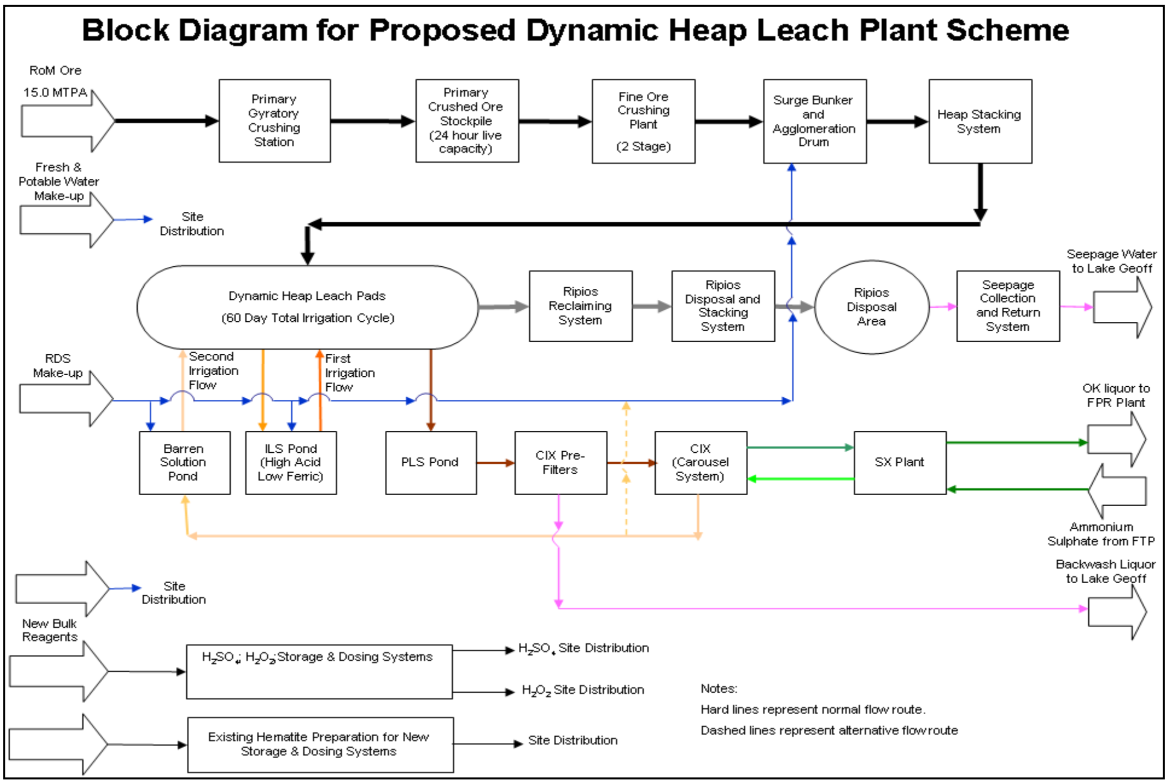

Figure 15: Heap leach process flow sheet[14]

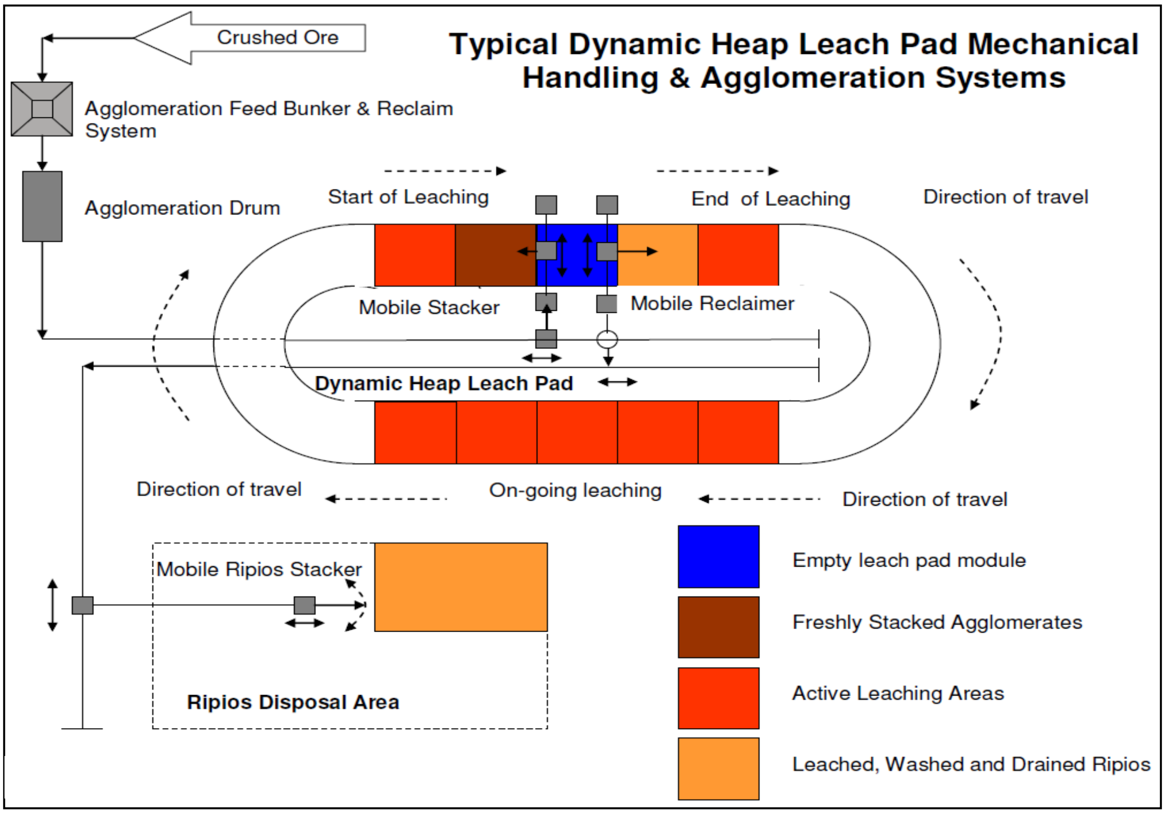

Figure 16: Heap leach diagrammatic layout[15]

[14] Source: Rössing Uranium.

3.1.5.6 Establishment of a ripios disposal area

Moving the ripios disposal onto the north-eastern portion of the Dome (the preferred alternative assessed) represents a higher cost due to the additional conveying distance in comparison to other options, but has the following social and environmental advantages:

- There are no capacity constraints caused by height restrictions and visual impacts;
- The associated main conveyors to transport and spread the spent ore are temporary features and will be removed entirely at closure; and
- Geohydrological work confirmed natural groundwater flow towards the SJ pit's cone of depression.

Figure 17 illustrates the proposed final shape of the ripios disposal area and position in relation to the heap leach pad.

As indicated in Figure 17, the minimal surface water drainage generated by residual drain down and percolating rain water infiltration is prevented from flowing as surface water or as groundwater through the alluvial aquifer of Dome Gorge by two seepage control dams and cut-off trenches.

The dam embankments will be formed using compacted alluvium excavated from within their basins (excavating within the footprint). The upstream faces of the embankments will be lined with 2mm HDPE geomembrane. The geomembrane will be anchored into a cut-off trench along the upstream toe as well as along the crest. Within the cut-off trench the alluvium will be excavated to bedrock.

[15] Source: Rössing Uranium.

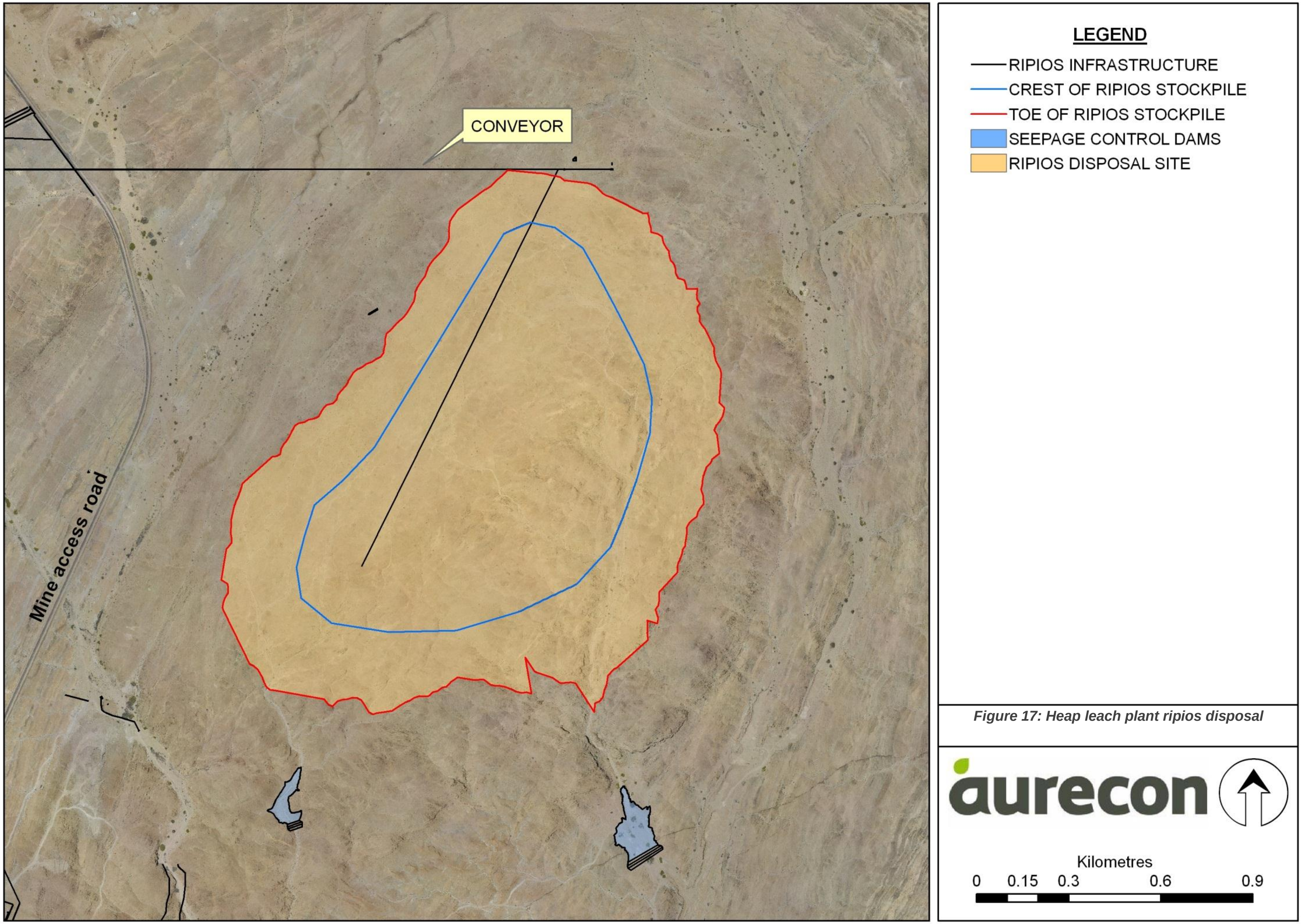

Figure 17: Heap leach plant ripios disposal

3.2 CONSIDERATION OF ALTERNATIVES

A key component of any thorough SEIA is the consideration of alternatives in the assessment process. Such alternatives may include strategic, as well as project level site (or arrangement of facilities / layout), or technology (process) alternatives. This section aims to describe the process embarked upon by Rössing Uranium to investigate, rank and prioritise different facility layout alternatives considered, in a study concluded as a pre-runner to this SEIA process, with the purpose of feeding into the alternatives assessment record.

The expansion project results in additional land disturbance due to increased capacity requirements for mineral waste disposal. Essential to any decision making processes to approve land use changes, is the understanding of the environmental values of the land in question. The initial layout chosen was largely based on environmental criteria, with biodiversity, archaeological and landscape character research taken into consideration in the land use decision making. A two year process of refining the decision criteria and technical information used to inform the decision on the preferred layout was undertaken with the following main objectives:

- To minimise the physical footprint of the proposed expansion;
- To optimise the use of areas where the sustainable development impacts are minimised;
- To find the best practical site for each of the facilities;
- To make the best use of newly impacted sites; and
- To ensure that the expansion follows a strategic life of mine approach.

Key decisions had to be taken about facility locations and overall site layout during the 'order of magnitude' stage. Two workshops were held to identify the most appropriate areas for new processing and waste disposal facilities by using multicriteria decision making methodologies. The mine's land use database developed in 2008 was an essential tool in the subsequent process used to identify the most appropriate layouts for the project. The first workshop in August 2008 had to use limited information regarding engineering design and construction cost and made basic recommendations as to where the new facilities should be located. The concept of locating the heap leach pad and ripios dumps on the existing tailings storage facility and creating a new tailings disposal area on the Dome was recommended as the preferred alternative. As more detailed project costing became available, the need for a review of the preferred alternative was identified and a number of new layout alternatives were added during a second workshop a year later in August 2009. However, the recommendation of the first exercise was confirmed and engineering studies continued accordingly.

Figure 18 compares the initial (2008) and then refined (2009) preferred facility layouts.

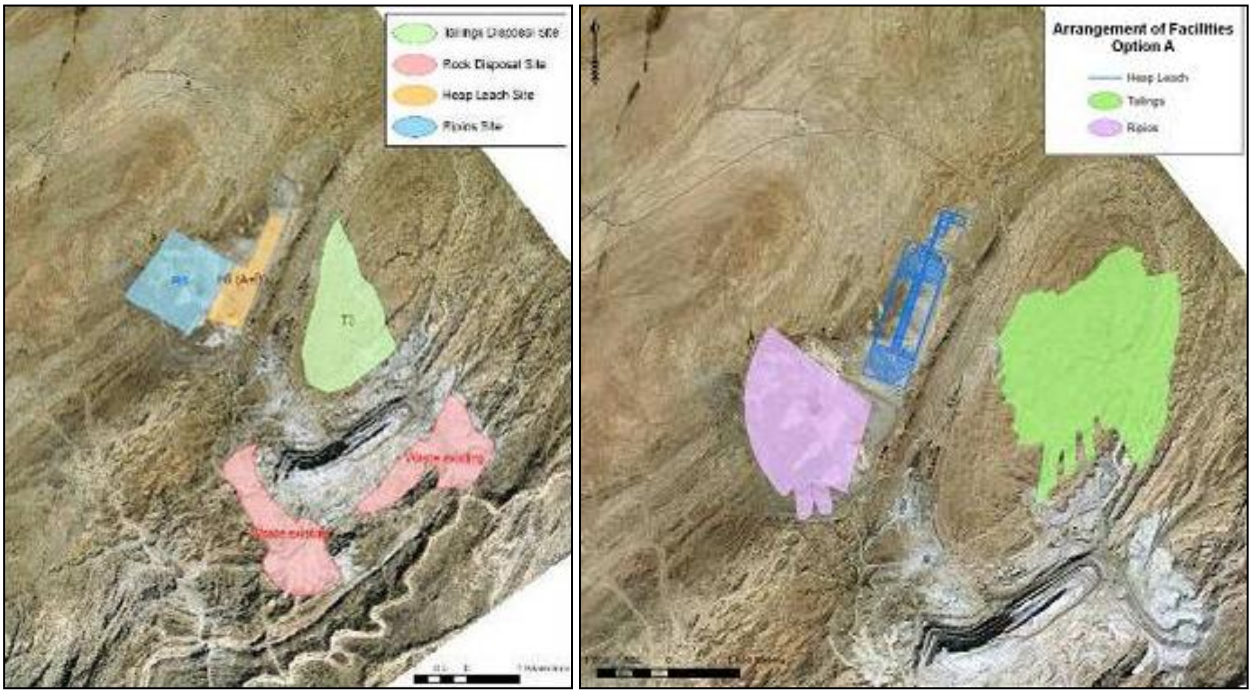

Figure 18: Comparison of the 2008 preferred layout and the 2009 refined layout

3.3 ALTERNATIVES ASSESSMENT METHODOLOGY

An overview of the selected model, referred to as the Ideal Mode Analytical Hierarchy Process Multicirteria Decision Making (MCDM) Model, is provided as Appendix D. It highlights the historical context of the development of the specific model and provides a summary of the mathematical formulae used in its application, not repeated herein. Specific advantages of this model in such applications are highlighted in Appendix E.

3.3.1 DESCRIPTION OF CRITERIA

The methodology was successfully implemented in 2008 and the application updated in 2009 (see Annexures E and F for the complete reports), as a pre-runner to the SEIA process. The main purpose of the criteria list was to define which aspects need to be considered in the evaluation of the individual facility site options, and later in the evaluation of the combined layouts, thus ensuring consistency in the evaluation process.

Rössing Uranium determined a list of criteria comprising four main categories for use with the land use optimisation MCDM. The objective was to ensure that the proposed extension is in line with its sustainable development approach. The three main pillars of sustainable development are economic viability, environmental sustainability, and social acceptability, which formed the basis from which these criteria categories were developed. Economic criteria were built into the technical (or engineering) category, since engineering solutions has budget implications. An additional criteria category was included, being Strategic Criteria, applied only to the evaluation of combined facility layouts. An overarching objective was to find the optimum arrangement (or layout) to limit the impacts on undisturbed ground. The four criteria categories for both the 2008 and 2009 workshops were very similar. Thus for the purpose of this report only the 2008 criteria are listed below. The 2009 criteria can be found under Annexure F. The extensive list of criteria follows:

TECHNICAL CRITERIA AND SUB-CRITERIA FOR CONSIDERATION INCLUDED:

- Height and distance from plant, heap leach or pit:
  - Conveyor/haul routes and cycle times, and
  - Power consumption, diesel consumption and general equipment wear-and-tear;
- Topography and elevation:
  - Terrain preparation;

- Cut-off grade and pit size (will affect volumes/leach recovery):
  - Volume and area footprint, and
  - Material profile (final);
- Settlement;
- Sufficient buffer for fly rock;
- Deposition method (conveyors, pipelines, paddies, thickened, dry stacking, race track, on-off);
- Geohydrology:
  - Subsurface stability,
  - Lining requirements,
  - Leachate management, and
  - Storm water permeability; and
- Closure:
  - Cover requirements, and
  - Long term stability.

ENVIRONMENTAL CRITERIA AND SUB-CRITERIA FOR CONSIDERATION COMPRISED:

- Ecology:
  - Biodiversity,
  - Flora and fauna (including red listed species),
  - Ecological services, and
  - Impact on habitat;
- Land use, footprint extension;
- Dust emissions due to wind erosion;
- Resource use (water, energy):
  - Water losses due to wind, and
  - Power consumption;
- Seepage impact and control options;
- Geohydrology and seepage:
  - Water quality; and
- Closure:
  - Rehabilitation, and
  - Long term leachate.

THE SOCIO-ECONOMIC CRITERIA AND SUB-CRITERIA INCLUDED:

- Dust impact and control options;
- Distance from Arandis (potential health impact on inhabitants);
- Surface area exposed (radon emissions);
- Visual impact, both with respect to colour and height;
- Archaeology;
- Geohydrology:
  - Resource use; and
- Closure:
  - Long term emissions (i.e. water, air).

STRATEGIC CRITERIA AND SUB-CRITERIA INCLUDED:

- Sterilisation of ore reserves and future drilling areas;
- Co-disposal with waste rock;
- Potential reuse of material;
- Surrounding land uses;
- Sequencing;
- Phased use of separate sites for the same process options e.g. ripios placed in a number of sites;
- Reputation:

  - Bad and good practice,
- Extension of operational footprint into undisturbed areas, and
- Impact on habitat (possible loss of Red Data species);
- Closure:
  - Sequencing; and
- Water storage on site.

The different potential site options considered for the land use were based on land availability and technical considerations associated with each of the facilities. This allowed for an overlap of sites, as the results of the land use optimisation process would indicate preference in cases of mutual exclusivity. The four different activities included[16]: heap leach; ripios, waste rock dumps and tailings. Eight different site options were identified for each of the activities, except for the tailings which allowed for six potential site options.

3.3.2 OPTIONS ASSESSED IN 2008

The MCDM model was adapted to allow for a more focused approach to determine the overall criteria weighting categories. This was achieved by selecting three key criteria from each category and populating the evaluation matrix with these, rather than just using the three main categories. The relative weight per category was then calculated by adding the priority vectors (or priorities) of the three criteria selected from that specific category.

The specific criteria selected were in some instances adapted slightly or combinations from the original list. Although only nine criteria are listed here for the purpose of determining criteria category weighting, all criteria were considered in the MCDM model application. The key criteria selected and overall resultant weighting were the following (Ninham Shand, 2008):

Table 1: Summary of the key selected criteria in 2008 model application for individual facility sites

Criteria Category	Key Selected Criteria	Weighting
Technical	Height, distance & topography	34.4%
	Deposition	
	Grade & pit size	
Environmental	Ecology & footprint	25.3%
	Resource use	
	Geohydrology & seepage	
Socio-Economic	Archaeology	40.3%
	Air quality	
	Visual	

Each potential facility site was assessed against the three criteria categories. The top three ranked sites per facility were then used to define potential combined layouts. This resulted in a total of 81 layout options.

The 81 layout options were narrowed down through a filtering process. Mutually exclusive facility site combinations (cannot be established on the same site without sequencing implications) and impractical layouts (based on energy costs associated with the increased distances between facilities) were excluded. The following filters were applied:

- Mutually exclusive combinations of heap leach, ripios and tailings facility options;

[16] Only project components with footprint implications of which the position is not fixed (such as expansion of SJ pit) were included.

- Mutually exclusive combinations of waste rock dump and heap leach facility options; and
- Heap leach and ripios sites too remote from one another.

These allowed for a noteworthy reduction in the number of combined layouts. In addition, the waste site selections were excluded from the assessment, as none of the final potential waste sites overlapped with any of the other potential sites. The result was seven potential combined layouts that could be effectively implemented with any of the top three waste site options. In addition, since the existing waste rock dumps have sufficient capacity for the extended life of mine operations, it was decided to limit the waste rock dump options to the existing, for the purposes of optimisation of potential combined layouts. As such, seven potential combined layouts fed into the next application of the MCDM model to rank combined layouts and these were weighted and ranked using a similar process as above, by selecting key criteria from each criteria category and populating the matrix with these. All four criteria categories were now considered (inclusive of strategic criteria), with two key criteria per category. The table below indicates the key selected criteria used to determine the overall criteria category weighting:

Table 2: Summary of key selected criteria in 2008 model application for combined layouts

Criteria Category	Key Selected Criteria	Weighting
Technical	Height, distance & topography	21.44%
	Grade & pit size	
Environmental	Ecology & footprint	14.53%
	Resource use	
Socio-Economic	Archaeology	26.40%
	Air quality	
Strategic	Sterilisation & sequence	37.63%
	Reputation & closure	

The combined layouts were considered against the four criteria categories with the top four ranked layouts (Layouts 25, 13, 33 and 3) being those illustrated in Figure 19.

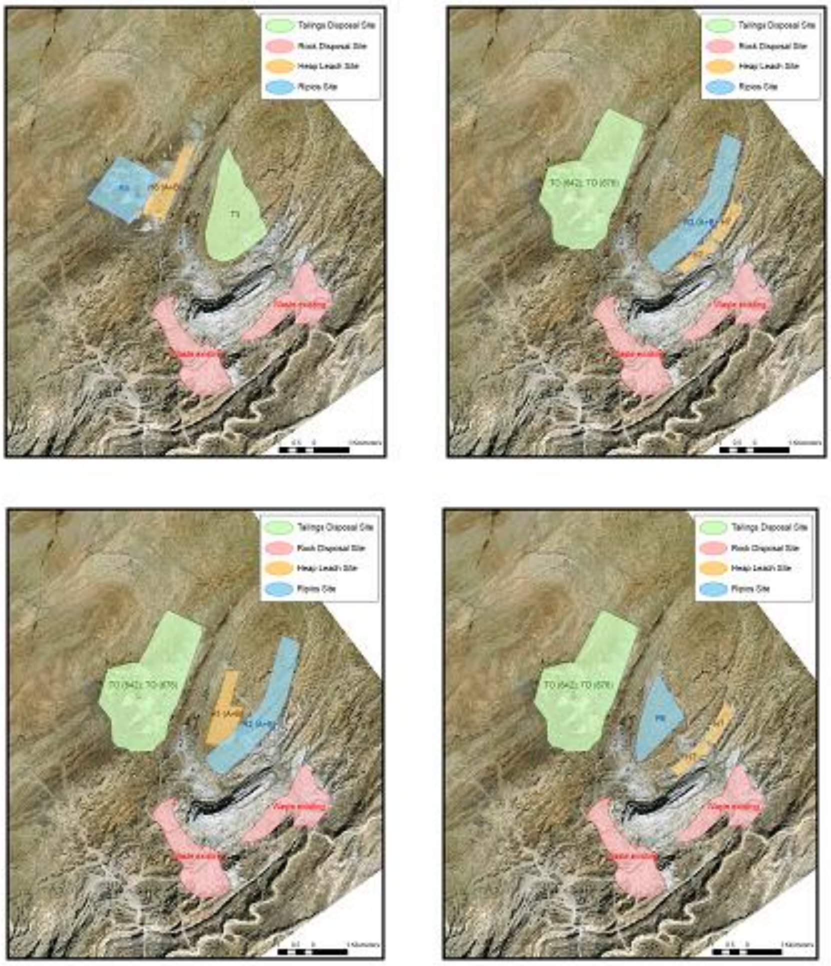

Figure 19: Top four combined layouts in order of preference for 2008

A sensitivity analysis was undertaken to test the findings against various scenarios by changing the weighting applied to the four criteria categories. The top four layouts were confirmed as the preferred options, even though the sensitivity analysis resulted in different layouts being included in the top four in limited cases. Had the sensitivity analysis consistently prioritised the same layout not included in the top four ranked layouts, further investigation would have been required.

3.3.3 OPTIONS ASSESSED IN 2009

Given the technical developments and refining of cost projections since the 2008 workshop, the need was identified to repeat the ranking for four layouts (including some with facilities on previously unconsidered areas) of heap leach, ripios and tailings facilities. Waste dump sites were excluded. There were a number of key technical developments that had changed since the 2008 workshop, which are summarised below:

- The proposed heap leach process had been modelled and preliminary designs completed which defined the heap leach scale (throughput was estimated at 12Mt/a, and the associated footprint requirements). The design included site preparation investigations and costing, specifications for the drainage layer material (and confirmation that gneiss from the Khan formation, that could be sourced in the SJ pit, would be suitable), and confirmation of the racetrack layout given that the on/off method is preferred. The recent detailed aerial survey allowed a higher level of accuracy of costing than previously possible.
- The High Density Tailings (HDT) option was better understood following preliminary engineering design and costing. As such, the capacities, footprints and associated infrastructure required had been defined and capital and operational expenditure estimated and Net Present Value (NPV) calculations were done for different options. The HDT option holds additional benefits in that iron and uranium in solution can be fed back into the process, rather than being disposed of as tailings.

- The Life of Mine (LoM) scheduling had been updated following recalculation of the ore body reserve which in turn influences mine design and LoM planning. This included production rate modelling for different scenarios (a range of cost and exchange rate variations) to identify the most attractive NPV option. In addition to current reserves, Rössing Uranium is now also a shareholder in the Rössing South deposit, approximately 7km south of the current operations and this potential development was included in the 2009 MCDM criteria list. This deposit lies within the Namib Naukluft Park, but is similar or larger in extent than the current Rössing ore body and is potentially of a higher grade.
- Strategic considerations related to the sterilisation of reserves (drilling programme confirmed that establishing facilities on the dome will not sterilise ore reserves) and sequencing of operations, specifically new processes such as heap leach and HDT disposal, were better understood and planning for prevention of potential operational interruptions was on-going.

The criteria used in the 2009 workshop were similar to that of 2008. For the full list of 2009 criteria see Annexure F. The most significant changes in the weighting scenario were the increased weight of the environmental category and associated reduced weight of the strategic and technical categories. The final weighting was applied as the "base case", against which a sensitivity analysis was later conducted using different weighting scenarios.

Similar to the 2008 application, the two most critical sub-criteria under each main criteria category were selected and ranked it to obtain overall criteria category weight by adding the resultant weights of each pair of criteria from the particular category. Note that in 2009, different sub-criteria were identified as being most significant from some of the main criteria categories.

The top four different layouts that were evaluated and ranked are schematically represented in Figure 20.

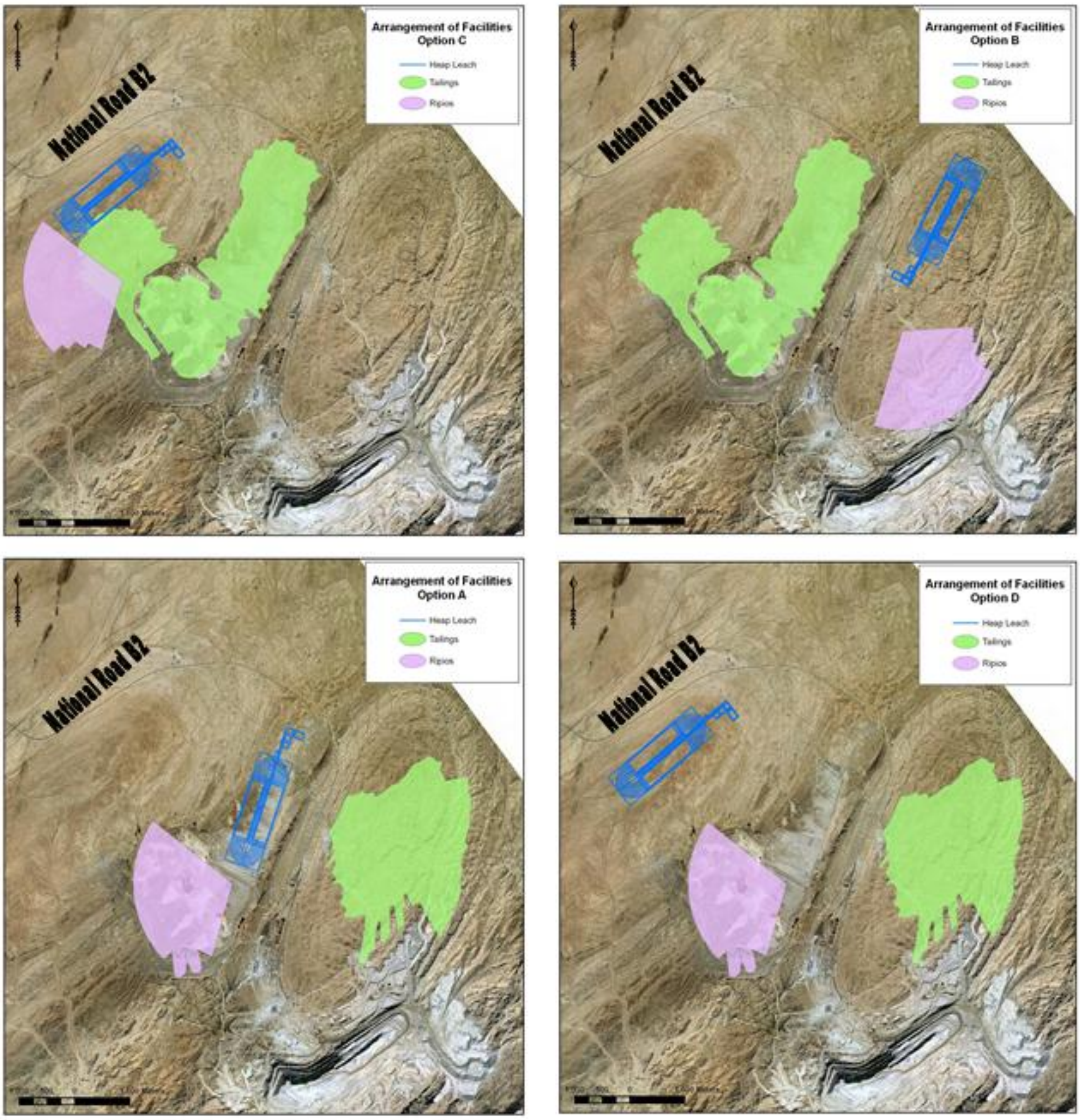

Figure 20: Top four combined layouts in 2009

The results to the individual matrices indicated an overall preference for Layout A, followed by Layouts C, D and B. A sensitivity analysis was conducted to test the outcome of the application with different weighting scenarios. The sensitivity analysis confirmed the overall preference was for Layout A.

The conclusion of the 2009 workshop was that the strategic acceptability of Layout A has to be established and confirmed, given that the Dome area had been identified as an area of biodiversity importance. Opting for Layout A would inevitably impact on the current habitat on the Dome, although this is not considered unique. Rössing Uranium needed to prioritise biodiversity fieldwork to clarify the significance of this habitat and species to be potentially impacted upon, possibly through studying similar habitats further afield in Erongo.

It was decided that the final outcome in terms of layout preference will feed into the SEIA Phase 2 process for the expansion project, to assess its associated social and environmental impacts in detail. It was further decided that Layout A would in all likelihood feed into the SEIA as the design freeze layout, unless further technical analysis raises questions as to its sustainability, as was the case. Refer to the following section for details in this regard.

3.3.4 TAILINGS AND RIPIOS SPECIFIC CONSIDERATIONS

This section provides further background on the considerations that informed the alternative assessment related to the tailings and ripios disposal, and ultimately the design freeze layout selection. Several studies have been undertaken in the past to quantify the tailings composition and volumes related to the various disposal techniques investigated.

Three alternative methods of tailings disposal were investigated for the mine expansion project, namely:

- Dry disposal method;
- High density tailings placement; and
- Current conventional paddy system.

Dry disposal will require the installation of a belt filter plant, an effective dewatering technology enabling more water and process chemicals to be retained in the water management system and recycled for use within the plant. A reduction in water disposed of on the tailings dam results in a reduction in evaporation losses.

The tailings dam site in its present form would offer sufficient capacity until 2026 for disposal of tailings resulting from the dry disposal method. If the high density method is adopted, the tailings dam capacity will have a reduced lifespan until approximately 2019. The current paddy system will also not be able to be accommodated on the dam footprint until 2026 with this option.

However, for all three processing methods, the lifespan of the current site can be extended by increasing the height of the support walls, thus allowing the capacity of the tailings facility to extend vertically. The visual intrusion of such an elevated tailings dam would need to be weighed up against the potential impacts on biodiversity when establishing the facility in an undisturbed area.

The possibility to establish a new tailings disposal facility in the Dome area was considered. This is a viable option from an engineering cost perspective due to its close proximity to the current SJ pit and satellite SK4 pit. The financial benefits of shared engineering expenses during the construction phase has been one of the criteria applied in the site selection process and resulted in the consideration of the possibility of also using the site for the placement of waste rock and the heap leach facility.

From a biophysical impact point of view, managing the seepage from a tailings facility and rock dumps in the Dome area could pose reduced risk as the drainage would be via Dome Gorge and, by eventually extending the eastern wall of the SJ pit to intersect this gorge, seepage could be collected and managed within the extended SJ pit. The biophysical impact of the footprint of these facilities on an undisturbed area remains a drawback.

The option of high density thickened tailings disposed on the Rössing Dome was also considered. A few key advantages were associated with this:

- The ability to deposit ripios on the current (central) TSF with associated economic and environmental benefits as outlined above;
- The opportunity to upgrade the current tailings system by dewatering as investigated in various studies between 2000 and 2005 to lower operating costs (water and reagents);
- The ability of high density thickened tailings to be deposited into the relatively rugged terrain of the Dome due to its beaching characteristics that would minimise the requirement for containment structures; and
- The lower elevation and space available on the Dome that would allow a far greater capacity of tailings to be stored there than on the current TSF footprint that is constrained by elevation (particularly related to the visual impact) as well as biodiversity considerations to the north and aquifers to the south west.

After investigating high density thickened tailings in more detail however, it was concluded that this option would be economically unfavourable. Alternatives were then considered to extend the current TSF footprint into already disturbed areas to the south west (refer to Figure 21) but these were all ultimately discarded for the following reasons:

- A lined facility was considered impractical due to the rough topography that would require smoothing by pushing tailings materials into the valleys before lining.
- An unlined extension could not overlap the Panner Gorge catchment without risk of contaminated groundwater seepage finding its way into the Khan. This leaves only the area over the Pinnacle Gorge catchment which is currently covered by the existing seepage controls but is much smaller and would also require a repositioning of the national power line running through the plant area.
- The concept of co-disposing tailings and ripios onto an unlined area was also briefly considered in mid-March 2010. The supposition was that a mix of high density thickened tailings and ripios would have sufficient capillarity to prevent seepage and avoid the need for a lining. After testing such a mixture in the columns and seeing that it did generate seepage, it was decided to discard this concept.

In March 2010, following further expert input on heap leach and re-considering the location for a smaller pad (allowing for a 60-day leach period) enabled required tailings capacity to be planned on the current TSF. Volumetric modeling showed that with this new layout, sufficient space would be available to accommodate the 200Mt tailings requirement for the tank leach operation over the life of mine. It was therefore decided to retain tailings facility in its current location and move ripios disposal to the Dome which represents the preferred layout assessed herein as the design freeze layout. The current conventional paddy disposal system will be retained.

The selection of the final design freeze layout resulted in significant cost implications arising from the following, all of which had to be included in the project planning and costing:

- Moving the heap leach pad further north-east on the existing TSF to provide sufficient capacity on the TSF footprint for an additional 200Mt of tailings in the current Life of Mine plan. This resulted in additional civil construction costs due to the less favourable topography and also from the need to divert the water pipeline from the Rössing Uranium reservoirs in this area.
- Conveying the ripios a longer distance across the mine access road to its disposal site on the Dome. The current proposal for this overland conveyor is to use the Doppelmayr RopeCon© system or similar which is seen as more suitable than conventional conveying and holds significant environmental benefits (limited footprint and ease of rehabilitation after decommissioning).

Refer to Figure 8 on page 26 for the final design freeze layout.

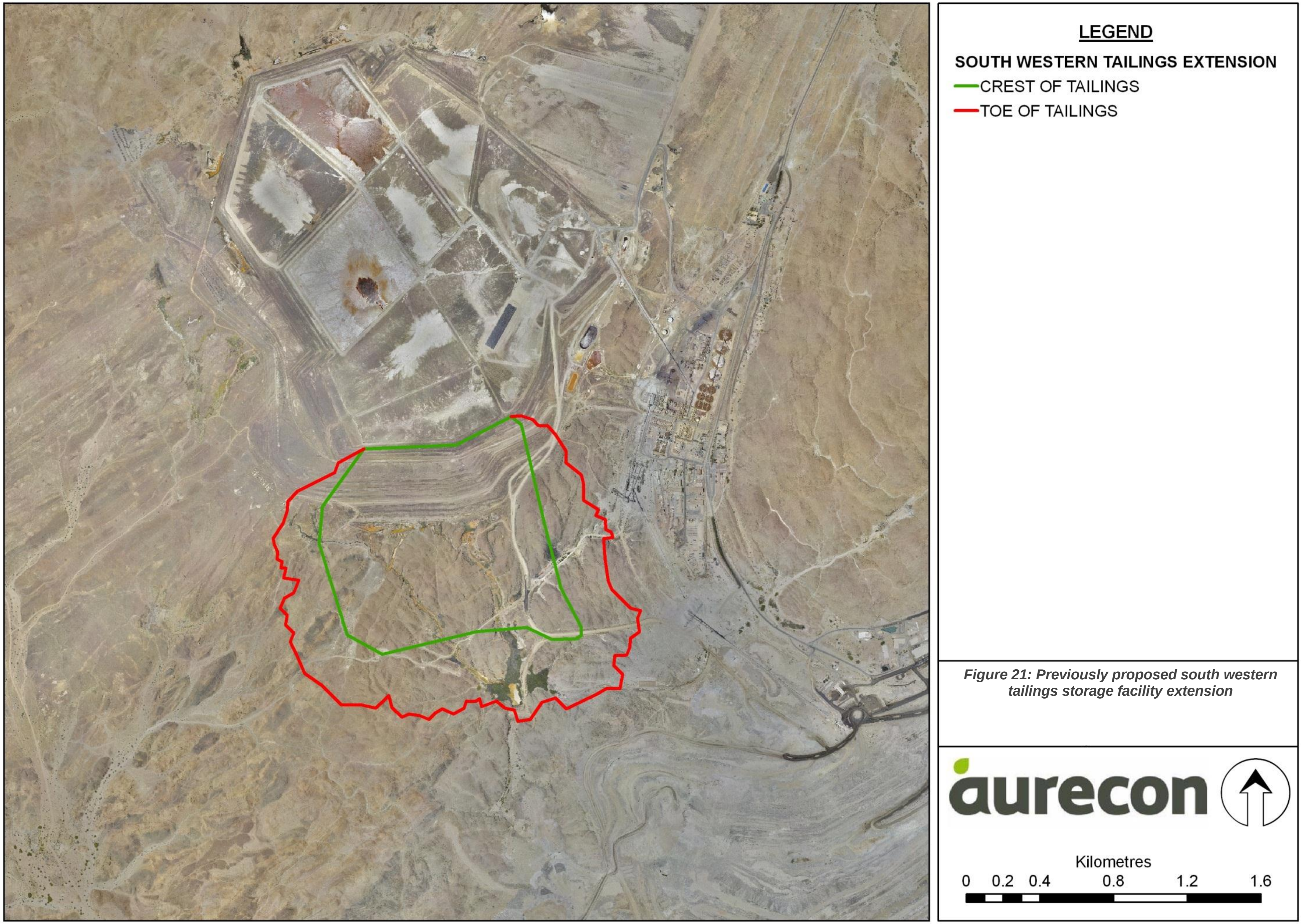

Figure 21: Previously proposed south western tailings storage facility extension

3.3.5 TRAFFIC COMMUTER ALTERNATIVES

The projected future growth in employee numbers is expected to result in an increase in the demand for commuter transportation and Rössing Uranium investigated and assessed options to cater for this demand.

Although the existing railway network has the capacity to provide transport to additional mining employees, this option is not practically feasible due to the frustrations associated with low operational speeds and the delays in travel times, due to the absence of signalling on the network. Additional buses will therefore be required to transport staff. It is expected that a total of five buses will initially be required which will increase to eight buses with the projected peak in staff numbers.

Similarly, the Uranium Rush SEA considered the use of rail transport as an alternative to alleviate peak traffic congestion but concluded that such new venture would have to be a private or public-private partnership (SAIEA, 2010).

Rössing Uranium has an excellent safety record with the commuter buses with no major incident recorded to date, as a result of the high safety standard maintained. The safety, cost and convenience of bus transport outweighs the benefits of switching to rail transport. It is recommended that the B2 route rather be upgraded to benefit not only mine staff, but road users in general. The upgrading of the B2 road was also recommended by the SEA (SAIEA, 2010). The transportation of staff by bus would adhere to the current strict measures in place, as per the HSE MS summary description in Annexure B.

3.4 POTENTIAL IMPACTS IDENTIFIED DURING THE SCOPING STAGE

During the Scoping stage several potential impacts were identified which are being assessed and reported on during the SEIA phase. Each of these impacts or issues was subjected to a specialist study. The following potential impacts were identified during the Scoping phase and assessed in detail during the SEIA stage:

- Disturbance of biodiversity resources;
- Impacts on heritage sites and areas of archaeological importance;
- Impacts on water resources, namely groundwater occurrences and surface water resources;
- Socio-economic impacts; e.g. temporary housing, in-migration of work seekers;
- Increase in traffic volumes to the mine and in the vicinity of the sites;
- Windblown dust and concomitant release of radioactive materials from exposed substrate;
- Noise pollution and vibration;
- Pollution from waste and other contaminants; and
- Visual impact on the area.

One of the main purposes of the SEIA process is to understand the significance of the potential impacts associated with the proposed mine expansion and its associated activities and infrastructure, and to determine if the available project alternatives are potentially more beneficial to the socio-economic and biophysical environment. A further objective of the SEIA is to determine if the potential impacts associated with the activity can be minimised or mitigated. This section of the SEIA Report identifies the range of potential impacts. It should be noted that the identification of the impacts described in the sections to follow emerged as concerns from the stakeholders, as well as input from the project team and Rössing Uranium personnel.

3.4.1 CONSTRUCTION PHASE IMPACTS

These are impacts on the socio-economic and biophysical environment that would occur during the construction phases of the proposed mine expansion project. They are inherently temporary in duration, but may have longer-lasting effects. Construction phase impacts could potentially include:

- The extent of employment opportunities created as a consequence of the proposed developments, both for permanent and contracted workers;
- Impacts on water resources, namely groundwater and surface water resources;
- Interference with current commercial activities in the port in the vicinity of the construction site;
- Management of materials required for construction or establishment;
- Increase in traffic volumes to the port and in the vicinity of the construction sites;
- Windblown dust;
- Noise pollution and vibration; and
- Pollution from construction waste and other contaminants.

Based on the temporary duration of the construction phase and the fact that negative impacts of construction can, in general, be reliably predicted and mitigated, more attention is given to the operational phase impacts of the proposed mine expansion project than to the construction phase impacts. Moreover, the construction phase impacts related to the expansion activities are assessed as being of low significance. These construction-related impacts can easily be accommodated within a Social and Environmental Management Plan (SEMP), industry norms and standards and Rössing Uranium's own best practice.

It should be noted that a SEMP in draft form has been developed and its implementation will regulate and minimise the impacts during the construction phase. This SEMP has been developed as part of the SEIA Report phase and is included as Annexure O.

3.4.2 OPERATIONAL PHASE IMPACTS

Given their long term nature, operational phase impacts are given closer scrutiny in the SEIA stage of this assessment process. Impacts detailed in this section are effectively prompted by the stakeholder meeting held in Walvis Bay on 7 February 2008, Focus Group Meetings, public input on the Scoping Report and input from the project team, Rössing Uranium personnel and other stakeholders. Specialist studies have identified and assessed the implications of the key impacts and have included measures to minimise predicted negative impacts and maximise positive impacts. The assessment of potential impacts will help to inform Rössing Uranium's selection of preferred alternatives or to confirm that the best available technologies have been identified and selected, and for these to be submitted to MET:DEA for their clearance. In turn, MET:DEA's decision on the environmental acceptability of the proposed project and the setting of any conditions will be informed by the assessment of alternatives and selection of technologies, together with the specialist studies, amongst other informants, contained in this SEIA Report. The potential operational phase issues associated with the proposed mine expansion project include:

- Permanent employment creation;
- The potential increase in noise and vibration and the associated impact on the nearby residential areas;
- The potential visual impact of extended waste disposal facility, ripios and tailings storage facilities and new heap leach facility;
- Impacts on water resources, namely groundwater and surface water resources;
- Interference with current commercial activities in the port in the vicinity of the construction site;
- Increase in traffic volumes to the mine and between the mine and Swakopmund and Arandis;
- Windblown dust;
- Noise pollution and vibration; and
- Pollution from construction waste and other contaminants.

It is normal practice that, should the proposed mine expansions be authorised, the development, and implementation of an operational SEMP would be required. The SEMP is designed to mitigate negative impacts associated with the operational phase of the project and have been informed by the mitigation measures that have emerged from the SEIA process. A SEMP is attached as Annexure O. Not all the impacts assessed herein have been identified at scoping stage, hence additions to those listed above.

4 BASELINE DESCRIPTION OF THE RECEIVING ENVIRONMENT

This section provides a brief overview of the receiving socio-economic and biophysical environment. It is based on information extracted from a previous impact assessment done for Rössing Uranium (CSIR, 1991) and supplemented with updated information form the various specialist studies done as part of this SEIA Phase 2, where relevant. The proposed expansion project is located on the existing operational mine brownfield site. Where required for the better understanding of specific impacts, more detailed baseline descriptions are included in the impact assessment descriptions in Section 7.

Namibia is situated on the southwestern portion of the African continent, bordered by Angola, Zambia, Botswana and South Africa. The western parts of the country is characterised by an extremely arid climate and desert landscape. Namibia is sparsely populated, with a population of approximately 1.83 million[17], of which 27% live in urban areas[18]. The economy is based on mining, fishing and agriculture, accounting for 15%, 12% and 10% of the Namibian GDP respectively.

The Erongo Region is one of four coastal regions of Namibia and covers an area of approximately 64,000km^2. Two large urban centres, Swakopmund and the fishing and port town of Walvis Bay, as well as the smaller towns of Arandis, Henties Bay, Omaruru, Uis, Karibib and Usakos, are located within the Erongo Region. The region is a significant economic hub for Namibia and Southern Africa at large. Continued growth in the tourism industry, recent upsurges in the mining sector as well as the development of strategic regional infrastructure is such that the Erongo Region, particularly the coastal centres of Walvis Bay and Swakopmund, are likely to undergo rapid and significant growth in the years ahead.

4.1 DEMOGRAPHICS, SOCIO-ECONOMICS AND PATTERNS OF LAND USE

4.1.1 DEMOGRAPHICS AND SOCIO-ECONOMICS

Erongo is Namibia's sixth largest region, extending approximately 64,000km^2. An estimated 61.6% of the region's population lives in urban settlements. The region has the second highest income per capita in the country after Khomas Region, and its relative prosperity is derived from mining, fishing, and tourism.

An influx of job seekers can be expected from the northern labour-sending regions, where unemployment rates are of the highest in the country. Formal accommodation is not available for the large numbers of unemployed people who migrate to Erongo. The focal destinations of Swakopmund, Walvis Bay, and Arandis are experiencing the rapid growth of informal accommodation such as backyard shacks, informal settlements, multiple occupation and garage squatting.

[17] Source: Census, 2001.
[18] Source: The Official SADC Trade, Industry and Investment Review 2007/2008.

Erongo is considered to have some of the best schools in Namibia, but these are generally full. The region has 45 state schools and 13 private schools. Adult literacy rates are high compared to the national average: 92% of people older than 15 years are literate. Literacy rates are the lowest in remote rural areas such as the Brandberg and Omaruru. These statistics do not take into account the large numbers of migrant work seekers, as information on their levels of literacy, as well as on other social indicators, is not available.

Social welfare and community development have progressed relatively well in Erongo. After Khomas, the region has the highest rate of development, and the second lowest rate of human poverty in Namibia. However, the unemployment rate of 34.3% is still high, and there is a large disparity between unemployment of men and women at 28.9% and 41.7% respectively.

Health services in the region are relatively good. New health facilities have brought health services closer to the communities. Omaruru, Usakos, Swakopmund and Walvis Bay each have a state hospital. Swakopmund and Walvis Bay have a private hospital each, and numerous clinics serve both the urban and rural population. Clinic services are in adequate, as it is difficult to attract staff to rural areas, and the renovation of existing facilities has been very slow (Ninham Shand, 2009). An estimated 95.7% of the population of Erongo has access to safe potable water.

A 2008 survey showed that HIV prevalence has decreased in the region. Nonetheless, the disease remains a threat to the region's development. Erongo has a skewed gender representation and a mobile population, factors which favour the spread of HIV/AIDS. The region also has the third highest tuberculosis rate in the country. The two most impacted communities are the coastal towns of Swakopmund and Walvis Bay. The poor housing conditions under which many people live contribute to deterioration of living standards and the spread of tuberculosis and HIV/AIDS (Marie Hoadley, 2010).

Life expectancy in the Erongo region may be higher than the rest of the country but it has declined from 61 years in 1991 to 43 years in 2000. Reduction in adult life expectancy is largely attributable to communicable diseases of which the most significant (67%) is HIV/AIDS. HIV/AIDS prevalence is very high at 20%, no doubt much more prevalent in specific groups. This has major implications for the Uranium Rush due to decimating effect it has on the workforce and skills availability, the increased pressure on facilities and the psychosocial impacts on communities as a whole. It also contributes to the high and rising maternal mortality rates of 4.49 per 100,000 as well as high rates of infant mortality (3.8%), both exacerbated by poor obstetric services (SAIEA, 2010).

Other health indicators in Erongo relate to infectious diseases especially in the young, including tuberculosis (1,380 per 100,000 with 400 new cases per quarter). Tuberculosis rates are amongst the highest in the world, particularly related to HIV/AIDS, but also because of poor living conditions, high levels of malnutrition, poor public health infrastructure and difficulties in accessing regular treatment on account of distance. Amongst the older population, stroke and heart failure account for most of the mortality (SAIEA, 2010).

Swakopmund and Walvis Bay comprise more than 50% of the region's economic base, and contribute more than 25% of national GDP. Approximately 11% of people in Erongo depend on pensions for cash income, in line with the national average. Women have few employment opportunities outside the home and the majority work as domestic servants.

Industrial activity is limited and based on mining and mining-related industries and fish processing, concentrated in Walvis Bay. After mining and manufacturing, the fishing industry is the second largest employer in the Erongo region.

Small to medium enterprise activity is limited and is concentrated mainly in trade, services and, to a lesser extent, manufacturing. Growth potential in this sector in Erongo is closely linked to growth in the manufacturing and transport sectors and to the fishing, tourism, and mining sectors.

Significant agricultural activity is not possible, due to the aridity of the soil and a lack of water. Potential for agricultural development is believed to lie in the commercialisation of non-traditional, high value agricultural products, such as olives, olive oil and asparagus. Farmers along the Swakop River practice such agriculture on a small scale.

The region has good access to the infrastructure necessary for economic development. The port at Walvis Bay recorded positive growth during recent years, and is one of the key economic features in the region. The Walvis Bay Corridor connects the port to the rest of Southern Africa via the Trans-Caprivi and Trans-Kalahari Highways. Rooikop airport, near Walvis Bay, provides links to neighbouring countries (Marie Hoadley, 2010).

4.1.2 THE MINERALS SECTOR

The minerals sector plays a key role in economic and social development in Erongo with new mines planned and existing mines proposing expansion projects. It is a substantial employer of labour, and its service and goods requirements, together with the consumer needs of employees, stimulate secondary industries and further job creation. Figure 22 illustrates some of the benefits generated by the sector.

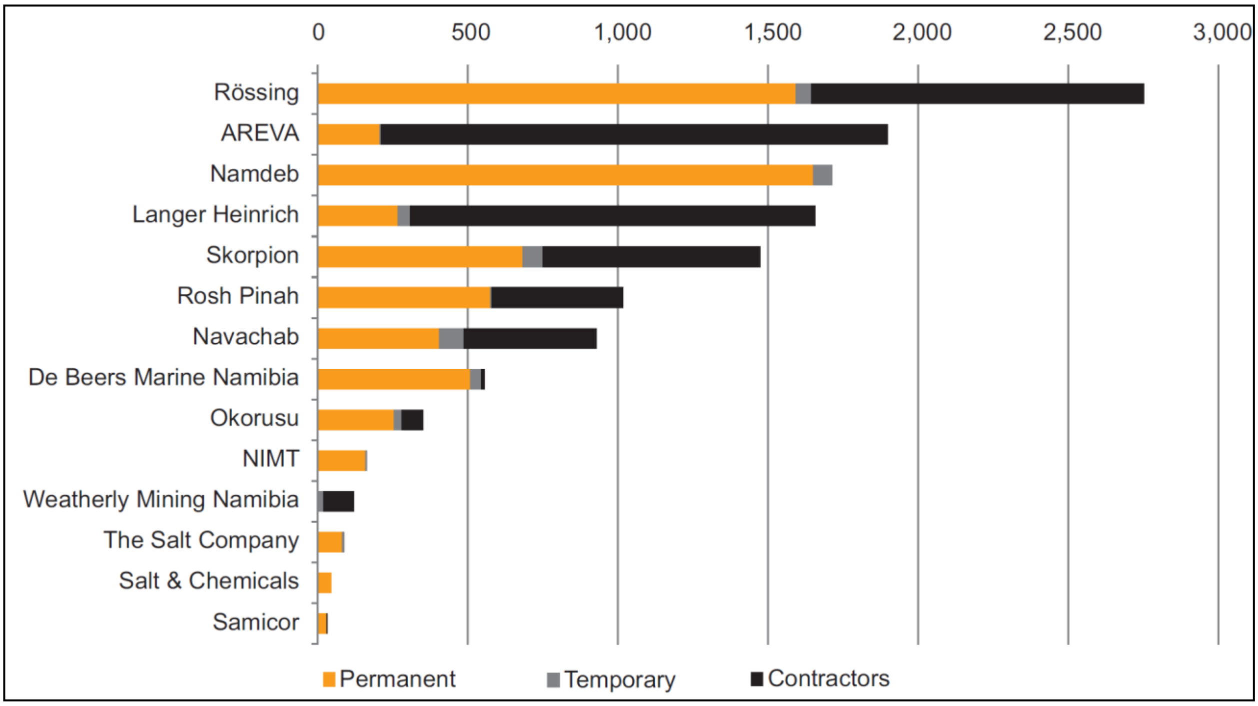

Figure 22: Employment in the mineral sector in 2010[19]

The considerable employment created by mines at pre-production stages is not reflected in the above. Substantial benefits accrue to local communities from mining operations. Contributions to local and regional economies include procurement of goods and services, and remittances sent back to the areas of origin of employees.

[19] Source: Chamber of Mines.

The increasing activity in the uranium sector is resulting in the growth of service and support industries, and some import replacement. The anticipated development of an industrial zone in the region should see further similar growth, and go some way to addressing a critical constraint on economic growth – that of a high dependence on imported goods and services.

4.1.3 FISHING AND MARINE RESOURCES

The fisheries sector is in decline in Erongo. Analysts ascribe the decline in the sector's economic contribution to government's policy of concessions which results in numerous small operators struggling to make a living. Capacity issues and disintegration within the various ministries have also contributed to inefficiencies and duplication of initiatives. The consolidation of the sector, paving the way for economies of scale, aims to counteract the decline (Marie Hoadley, 2010).

4.1.4 TOURISM

A large number of tourists pass through the region annually, which is an important link between attractions such as Etosha National Park and Sossusvlei. In 2007 Erongo recorded the second highest number of bednights sold, and in January-February 2008, the third-highest bed occupancy in the country. The region also has the highest number of registered tourist accommodation establishments (Marie Hoadley, 2010).

4.1.5 ENERGY

Namibia is currently overly dependent on external sources for electricity. The current domestic generation capacity of NamPower is 393MW, which is not sufficient to meet peak demand of 450MW. Approximately 50% of electricity available in the country is imported from South Africa and Zimbabwe. The mining sector is a large consumer of power, but is also one of the most important drivers of economic development in Namibia (Marie Hoadley, 2010).

4.1.6 ARCHAEOLOGY

Rössing Uranium commissioned an archaeological assessment of the MLA in 2006/7. The assessment (Quaternary Research Services, 2007) documented a total of 49 archaeological and historical sites. Although there is some evidence of upper Pleistocene occupation, most of the archaeological sites date to within the last 5,000 years. The historical sites relate to the narrow gauge railway that operated between Khan Mine and Arandis siding until about 1918.

The archaeological record has two distinct components: a dense cluster of stone artefact scatters and quarry sites in the vicinity of Panner Gorge, dating from between 2,800 BC and AD 380, and a cluster of grass seed digging sites estimated to post-date AD 1,000. The first cluster is specifically related to the availability of high-quality chert for stone artefact manufacture, and the strategic use of Panner Gorge as a hunting area. The second cluster is also fairly specific in that seed digging sites tend to occur on well-drained soils derived from weathered granite, mainly in the northern and north-eastern parts of the mine tenement.

Intensive disturbance has taken place in the core of the mining area, to the extent that it was not considered worthwhile to survey. Undisturbed parts of the mining area were found to be poor in archaeological remains. The majority of archaeological sites were found in the surrounding area which is moderately disturbed. The site distribution therefore suggests that the most important part of the archaeological record falls outside the main focus of mining operations. This means that it is unlikely that important archaeological sites were destroyed in the course of mining activity, although verification is not possible.

The archaeological and historical sites in the tenement area are an important component of the national heritage. While there are no specific links between the older archaeological sites, such as in Panner Gorge, and modern communities in the Namib, the more recent sites, including the grass seed diggings relate to land-use practices that still exist among Damara-speaking Namibians. Cultural significance attaches to the Khan Mine railway which is part of the early enterprise history of the European settler community. Definite steps should be taken to conserve the archaeological sites for further study and appropriate mitigation measures should be taken where mining will encroach on the sites. The historical Khan Mine railway embankment should be conserved as part of a possible visitor attraction based at the restored mine.

4.2 LOCATION AND TOPOGRAPHY

The Rössing Mine is located in the Erongo Region of Namibia. The Erongo Region comprises the central western part of Namibia. It is bordered by the Atlantic Ocean to the west, the Kunene Region to the north, Otjozondjupa Region to the north east, Khomas Region to the east and the Hardap Region to the south.

The Erongo Region consists of seven constituencies and is home to almost 108,000 people, representing approximately 6% of Namibia's populace in 2001. By 2007 the Erongo Region's population was estimated at 147,441 people, representing a massive influx. The majority of this population reside in the two urban centres, namely, the tourist town of Swakopmund (the closest large centre to the mine) and Walvis Bay south of Swakopmund. Refer to Figure 5 for the mine's location in context with the Erongo region.

The Rössing Mine site itself is found at 15° 27' 50" East and 22° 02' 30" South, approximately 65km east north east and inland from Swakopmund and the Atlantic Ocean, in the Arandis Constituency. The 18,411ha mine licence area (MLA) and accessory works area is bordered by the town of Arandis, approximately 12km to the north west, and by the incised Khan River valley, approximately 4.5km to the south-east. The site is located on the generally south east-facing, rough and undulating slopes between the Khan River valley (at 350mamsl) and the gravel plains closer to Arandis (at 600mamsl), near the edge of the Central Namib Desert. The topography of the area is typically characterised by a series of steeply incised valleys, tributaries of the Khan River, intersecting the site and running in a northwest to southeast alignment.

Of the MLA and accessory works area, approximately 2,165ha (11.4%) has been disturbed by mining activity, mining waste disposal and mine infrastructure to date. The Rössing Mine is situated amongst a number of other existing uranium mining operations in the Erongo Region. These and the locations of the nearby towns are shown in Figure 5.

4.3 CLIMATE

The general climate in the region of Rössing Mine is determined by variations in rainfall, the gross evaporation rate, minimum, mean, and maximum air temperatures and the prevailing wind direction. Daytime, seasonal, and long term variations of climatic conditions interact to regulate the occurrence and distribution patterns of fauna and flora and determine the diffusion and transport of atmospheric properties and pollutants. An understanding of climatic features and their variability is therefore essential for any evaluation of environmental impacts caused by mine-related activities and the development of pollution control measures.

4.3.1 WIND

At Rössing Mine, statistically, the wind predominantly blows from the north-northeast direction and is characterised by high wind speeds that can exceed 10m/s. During the day the winds from the south-westerly can increase and night time is dominated by north-westerly winds of low speeds. Dominant wind direction varies from season to season. Summer and spring are dominated by westerly winds and autumn and winter are dominated by north-northeast and northeast winds (Airshed, 2010). The wind speed determines both the distance of downward transport and the rate of dilution of airborne pollutants.

Three meso-scale thermo topographic wind systems characterise the Rössing Mine environment:

- A sea breeze - land breeze system induced by the interface between the cold sea and warm desert;
- A mountain - valley wind system induced by the Khan and other rivers which drain from the escarpment towards the coast; and
- A mountain - plain system induced by the existence of the desert and plateau surfaces, separated by the escarpment.

The distinguishing features of these local winds are the strength of the near-surface circulation and the interactions between winds of the interior desert with the sea breeze regime and with regional winds. The strength of these local winds is sufficient to mobilise fine sand and mica particles from the ground surface and this gives rise to the dusty conditions that are frequently recorded.

Although they are not part of the thermo topographic wind family, berg winds are the only other wind system that is of importance at Rössing Mine. These are formed when air displaced from the plateau to the coast becomes heated adiabatically due to a drop in altitude. Berg winds occur approximately 50 times per year, mainly from April to September, and give rise to the curious anomaly that the coastal areas frequently experience their highest temperature during the winter months. They can prevail from a few hours to a few days depending on the synoptic pressure gradients. The strength of these winds allows them to carry great quantities of dust, sand, and fine gravel and they are a very important mechanism in wind erosion and the development of the dust storms so characteristic of the Namib Desert.

4.3.2 PRECIPITATION

4.3.2.1 Rainfall

In Namibia the mean annual rainfall decreases from east to west and from north to south. In the Central Namib Desert rainfall is low and its distribution is highly erratic. The long term average for the entire region is less than 100mm, with much of the area receiving less than 50mm per year. In addition, the reliability of rainfall varies greatly and variability increases sharply to the west.

Rainfall measurements at Rössing Mine indicate that the mine receives on average some 35mm to 40mm per year. Much of this rainfall occurs as late summer and autumn showers or thunderstorms of high intensity and short duration. Virtually no rainfall is recorded during the winter months, though occasional falls of up to 1mm per month have been recorded.

4.3.2.2 Fog

Fog is a highly significant source of water for the coastal vegetation of the Namib Desert but the quantity of water derived from fog is difficult to measure.

Fog is probably an effective source of moisture for plants up to approximately 35km inland from the coast. The distribution of some well-known fog-dependant plants such as *Arthaeura leubnitzia* corresponds largely to that of the fog zone. Since this species is represented by a few scattered individuals confined to a few of the west-facing ridges at Rössing Mine, fog would appear to account for an insignificant cmponent of the total precipitation at the mine.

4.3.2.3 Evaporation

Evaporation is a main cause of water loss with an average daily rate of 7mm, which is why it needs to be monitored by Rössing Uranium. On an annual basis evaporation significantly exceeds rainfall (SRK, 2010).

4.3.3 TEMPERATURE

Air temperature is important, both for determining the effect of plume buoyancy (the larger the temperature difference between the plume and the ambient air, the higher the plume is able to rise), and determining the development of the mixing and inversion layers. As the earth cools during night-time the air in direct contact with the earth's surface are forced to cool accordingly. This is evident from the diurnal temperature profiles at Rössing Mine.

The annual maximum, minimum, and mean temperatures are recorded as 32.7°C, 16.4°C and 23.2°C respectively. Maximum temperature can reach 40°C and minimum temperature can be as low as 5°C. The coldest time of the day appears to be between 04h00 and 07h00, which is just before or after sunrise. After sunrise surface heating occurs and as a consequence the air temperature gradually increases to reach a maximum at approximately 14h00 in the afternoon.

4.3.4 HUMIDITY

Atmospheric humidity levels at Rössing Mine are very variable on both an hour-to-hour and day-to-day basis. The lowest values (5% to 8%) are recorded during midday whilst the highest values (up to 84%) are usually recorded during the early morning. Humidity levels rise rapidly immediately after one of the infrequent rainfall events and the afternoon sea breezes also contain appreciable humidity levels. However, these high humidity levels are usually of short duration and the diurnal average humidity level is usually below 15%.

4.3.5 INSOLATION

As could be expected, insolation levels at Rössing Mine are very high and cloudy or overcast periods have a very short duration. The presence of early morning fog, which can extend to Rössing Mine from the coast during the winter months, leads to a slight reduction in the effective day length on approximately 50 days per year. However, these fog patches are relatively thin and have dissipated completely by mid-morning. The absence of appreciable cloud cover for sustained periods ensures that most days are bright. However, the mean daily insolation values recorded during summer are usually slightly lower than winter values due to the higher frequency of cloudy periods.

4.4 GEOLOGY

4.4.1 GEOLOGICAL SETTING

The Rössing Mine lies within the crystalline core of Damara Orogens Central Zone and is characterised by major northeast to southwest trending tecto-stratigraphical metasedimentary rocks of the Khan and Rössing Formations. The sequence is intensely folded resulting in the development of anticlinical (dome) structures and synclinal (basin) structures. The Rössing orebody is interpreted as a migmatite zone (Ordovician in age) with uraniferous alaskite as small intrusive lenses to large replacement bodies which have been preferentially emplaced into the gneiss and biotite amphibolite schist units of the Khan Formation in the northern ore zone and into the lower marble and biotite cordierite gneiss of the Rossing Formation in the central ore zone (SRK, 2010).

Vertical oblique-slip faults feature in the core of the mine synclinorium and are younger than the alaskites but older than Karoo dolerites which are also abundant in the region.

Some of the noteworthy geological horizons or features are:

- The prominent dome feature on which the Ripios will be deposited is composed of metamorphic gneisses of the Etusis Formation.
- The SJ Fault is a 10m thick zone with higher permeability with a northeast-southwest orientation which passes through the SJ open pit, acting as a hydrological interception drain.

- The Rössing Marbles (on the southern side of the pit) are considered to be less competent and more weathered than the adjacent Khan Formation (on the northern side of the pit) and there is discordant amphibole schist horizon (up to several metres thick) associated with this contact. The Karibib Marble of the overlying Swakop Group is less weathered and forms a distinctive ridge adjacent to the Khan River.
- Unconsolidated sediments form alluvial fill in the drainage network, particularly in the gorges on the Mine (SRK, 2010).

4.4.2 URANIUM MINERALOGY

Uraninite is the dominant radioactive mineral present and it occurs as grains ranging in size from a few microns to 0.3mm, while betafite contains a minor proportion of the uranium in the ore. The primary uranium minerals uraninite and betafite give rise to secondary minerals that are usually bright yellow in colour. These occur either in situ, replacing the original uraninite grains from which they were formed, or along cracks as thin films and occasional discrete crystals. Of these secondary uranium minerals, beta-uranophane is by far the most abundant. This mineral is not always confined to the alaskite but may also be dispersed into the enveloping country rocks along cracks and fracture lines.

Ore-grades at the Rössing Mine are very low, averaging 0.035%. Uraninite comprises about 55% of the uranium minerals present in the orebody, while betafite contributes less than 5% and the secondary minerals account for 40%.

4.5 SOILS

Saline soils are a feature of most deserts and the Namib Desert is no exception. Rocks are broken down first by physical and chemical weathering processes, after which chemical decomposition processes transform the stone fragments to progressively finer particles. The predominance of chemical weathering processes is accentuated by the dry climate and the occasional deposition of wind-blown salt of marine origin.

The soils in the vicinity of the Rössing Mine are generally very shallow (<25cm) and greyish or ochre in colour, with a large proportion of coarse fragments and occasional calcium carbonate concentrations. In areas with surface calcrete or limestone deposits, "schaumboden" or "foam soils" are frequently found. These are characterised by high soil pH values and the formation of a crusted surface layer. Hard surface crusts, often bound by an overlying layer of blue-green algae (cyanobacteria), are found in lower Panner Gorge. These surface soil crusts can reduce rainfall infiltration rates and accentuate runoff.

Aeolian sand deposits of varying depth are found in sheltered areas in the upper gorges and are particular prominent on the leeward (wind protected) slopes of Rössing Mountain. These sands are a mixture of dark to light brown grit, quartz and feldspar fragments, and biotite flakes.

Colluvium has been deposited on the shallower slopes of some hills, as well as at the base of steeper hills. The colluvium slope wash varies in thickness up to a maximum of about 1.5m. The material consists of a mixture of grey-brown silty sand with an open, angular pebble layer and its consistency varies from medium-dense to dense. Alluvial silty sands and gravels form an almost horizontal fan in the valley bottoms, having been laid down during the infrequent flash floods. The material is laminated, consisting of layers of slightly coarse sand interspersed with layers of angular gravel and pebbles, in a matrix of grey-brown silty coarse sand. In the gorges, the alluvial deposits are estimated to vary in thickness up to about 8m.

Alluvial deposits up to about 20m in thickness are also found in the bed of the Khan River, with a composition very similar to those found in the gorges. However, successive layers of gravels, sands, and silts are visible in flood-cut terraces, which vary in width from a few metres to several tens of metres. These stratification patterns indicate successive settling out of transported material with decreasing flood-water velocities. An important distinction of these Khan River bed deposits is the presence of conspicuous laminations of mid-brown or ochre, fine silt clay, reflecting the higher silt loads that are brought down by occasional surface floods.

4.6 HYDROLOGY AND SURFACE WATER QUALITY

4.6.1 GENERAL FEATURES OF THE REGION

Virtually the whole of the Central Namib Desert is drained by four river systems, namely the Omaruru, Khan, Swakop and Kuiseb rivers that flow westwards to the Atlantic Ocean. Each of these rivers has its source in the high interior plateau of Namibia. Because of the rapid decrease in rainfall from east to west, these rivers function mainly as runoff courses for the precipitation that falls in the interior. The erratic and episodic nature of regional rainfall patterns combined with high rates of evaporation limit both the quantity of water carried by these rivers and the duration of flows.

4.6.2 SURFACE WATER RESOURCES IN THE RÖSSING AREA

Prior to the onset of mining activities, three sources of surface water were important in the Rössing area, namely the Khan River and the ephemeral and permanent springs.

The Khan River down to Rössing Mine has a catchment of approximately 8,200km^2, of which only 6,000km^2 is considered to generate runoff. Approximately 25km downstream of the Rössing Mine, the Khan River flows into the Swakop River which then flows westwards to the Atlantic Ocean at the town of Swakopmund. The mine is situated within the catchment of four main tributaries of the Khan River, namely Dome Gorge, Boulder Gorge, Panner Gorge and Pinnacle Gorge.

The Dome Gorge flows in a south easterly direction draining runoff from the catchment upstream of the main water supply line situated to the east of the tailings facility. The Boulder Gorge catchment contains the bulk of the mine plant and the watercourse drains to the east of the plant. Panner Gorge is orientated in a southerly direction and drains to the west of the mine. Pinnacle Gorge has its catchment to the southern part of the tailings facility and flows along the south western side of the open pit (SRK, 2010).

Only one natural perennial spring is known to occur in the Rössing area and this is located in a side-arm of Panner Gorge. The slow-flowing outflow from the spring fills a small (approximately 1.5m by 4.0m), shallow (maximum depth 10cm) pool before overflowing. The overflow consists of a shallow (<5cm) stream that meanders over a sand and gravel bed for some 15m before disappearing underground. Occasionally the spring does not overflow though the water level in the pool remains more or less constant. Several highly saline permanent springs occur at various points around the margin of the gravel plains of the Namib Desert and provide important sources of drinking water for animals, despite their salinity.

Several ephemeral springs occur at points along the Khan River and in the gorges that drain into the Khan River, apparently at local fracture points or at the interface of porous and impervious rocks. Their flows are insignificant and persist for short periods after local rainfalls only.

4.6.3 WATER QUALITY

The Khan River water is naturally brackish and unsuitable for most purposes other than livestock watering and sustaining hardy vegetation. Table 3 shows typical selected analyses of Khan River water abstracted from boreholes in the river bed, compared with the Namibian guidelines for stock watering. These boreholes have consistently provided water in full compliance with this guideline (SRK, 2010).

Table 3: Typical Khan River Water quality compared with the Namibian Stock-watering Guidelines

Determinant	Stock Watering Standard (maximum concentration)	Khan River Borehole (BH1.6A)
Conductivity (mS/m)	3500	720
Sodium (mg/ℓ)	2000	845
Calcium (mg/ℓ)	1000	390
Magnesium (mg/ℓ)	500	158
Chloride (mg/ℓ)	3000	1850
Sulfate (mg/ℓ)	700	668
Nitrate (as N mg/ℓ)	400	2.1
Fluoride (mg/ℓ)	6	1.1

4.6.4 PATTERNS OF WATER UTILISATION

Due to the high salinity of ambient groundwater the only beneficial uses are for industrial and ecological purposes, such as for dust suppression and maintaining the natural vegetation. The area around Rössing Mine contains limited surface water resources and only groundwater potentially suitable for agricultural use is found in the Khan River.

There are several salt springs which occur within the mine area, which are used by fauna and these are located to the south and west of the open pit.

4.7 GEOHYDROLOGY AND GROUNDWATER QUALITY

In addition to what has been noted above, a prominent amphibole schist structure, several meters thick, occurs on the contact between the Rössing Marble and the Khan Formation and is also considered to be more permeable than the host rock. This unit has been explicitly incorporated into the updated groundwater model as it passes through Dome Gorge and the pit and as such could effectively act as a cut off drain to seepage from the TSF in Dome Gorge, conveying it to the open pit.

All other rock types comprising metasediments such as schist, gneiss, migmatite, quartzite and calc-silicates have low permeability. The upper horizons have undergone various degrees of weathering and resulted in fracture enhancement, weathering and structural disintegration resulting in a greater permeability. The preferential flow along major faults due to the higher permeability than the surrounding rock has resulted in the formation of the gorges.

The Karibib Marble ridge adjacent to the Khan River has relatively low permeability and is considered a barrier to flow, except where this formation is transected by the Dome, Pinnacle, and Panner gorges.

The alluvial fill in the drainage networks (particularly in the gorges) is characterised by high hydraulic conductivity and high specific yields (SRK, 2010).

4.7.1 SUB-SURFACE FLOW PATTERNS

The general direction of the regional groundwater flow is from northeast to southwest towards the Khan River, conforming to the general drainage pattern. Groundwater levels are highly variable ranging from several metres below ground level due to mounding from the tailings facility to more than 150m below ground level in the vicinity of the open pit which has a very steep drawdown cone due to the low hydraulic conductivity of the host rocks. The groundwater head typically drops by over 300m between the current TSF and the open pit, over a distance of less than 2km (SRK, 2010).

4.7.2 GROUNDWATER ABSTRACTION

Groundwater abstraction takes place within and around the existing TSF and in the alluvium of the Khan River and its tributaries. Abstraction from the well fields around the TSF is about 1,500m³/day.

Rössing Mine used to abstract brackish water from the Khan River for dust suppression and to supplement fresh water make-up for mine operations. Five production boreholes in the Khan alluvial aquifer supplied approximately 600m³/day to the mine and the maximum permitted abstraction is 0.87Mm³ per year as per the abstraction permit issued by the Department of Water Affairs (SRK, 2010). This was discontinued in 2010.

4.8 ECOLOGICAL FEATURES

Ecological observations in the Central Namib Desert only received considerable attention since the early 1960s. The ecological features surrounding the present Rössing Mine were only described in detail after mining operations had commenced and any unique features of the habitats or organisms which may have been present at the site are unknown. The baseline descriptions of the site, conducted by the National Museum, are mostly hypothetical conditions that could have prevailed prior to the onset of mining operations.

4.8.1 FLORA / VEGETATION

The vegetation of the Central Namib Desert is related to the prevailing climatic conditions of the region, which are influenced by the South Atlantic anticyclone, the Benguela Current, and the south-east Trade Winds along the coast. The Rössing Mine is situated towards the eastern edge of the Central Namib Desert vegetation zone. This zone extends southwards to the Kuiseb River, and to the east, known as the Escarpment Zone. Even though the Central Namib Desert is considered to be a distinct vegetation zone, there is a distinctive east-west distribution pattern within this zone. This pattern is closely related to the inland distribution of coastal fog. The fog can reach as far as the Rössing Mine. However, all of the plant species found within this region are considered to be drought-tolerant, drought-resistant or succulents.

The relevant plant species are often widely dispersed. The predominant species are primarily *Zygophyllum stapffi* and *Arthraerua leubnitzae,* along with a few *Hypertelis caespitose.* Lichens are fairly common on the large gravel and gypsum plains. Some of the lichen species include *Parmelia* spp., *Telochistes capensis* and *Usnea* spp. The lichens attach themselves to small fragments of stone or gypsum flakes, with *Arthrarua leubnitzae* forming thick stands in shallow depressions or on slopes of low ridges. These lichen, microfungi, green algae, and cynanobacteria surfaces are also referred to as biological soil crusts, and are important features of the desert environment. These are thin layers on the surface to a few millimetres into the ground or even under translucent stones.

These crusts are important features in the barren landscape, as it stabilises soil surfaces, and thus protect these surfaces from erosion. In addition, it contributes towards seed germination and nitrogen and carbon fixing, and acts as good biological indicators of the condition of the surrounding environment.

At Rössing Mine, the frequency of lichen was insignificant, and was mostly limited to watercourses and rocky hillsides. This is essentially due to the dust produced as a result of the mining activities.

The vegetation further inland, within water courses or river beds is distinctively denser than on the plains. Species such as *Asclepias buchenaviana* is fairly common, with *Acacia reficiens* becoming more prominent closer to the coast. Many annuals sprout following some rainfall, with the more common species being of the *Stipagrostis* species. Grassy plains can be found between the desert and the escarpment.

The western portion of the Escarpment Zone is characterised by species with succulent stems or leaves, whereas further east shrubs and half-shrub species are common and eventually woody species are found. Woody species are also common within the drainage lines. The episodic rivers drain from the interior plateau down towards the coast, resulting in deep channels. This has allowed for species characteristic of the escarpment to colonise areas within the Central Namib Desert which otherwise would not be feasible. Some of the species found within or along the river beds include the following woody species: *Acacia erioloba, A. albida, Tamarix usneoides, Euclea pseudebenus, Ziziphus mucronata, Salvadora persica* and *Prosopis glandulosa*.

The riverine vegetation is an important feature in the landscape as is provides habitat, sustenance, and shelter for a number of game species, particularly during extended dry periods. However, the riverine vegetation is variable in terms of structure, as the intensity, frequency and duration of rainfall determines the severity of flood periods. The floods also provide corridors for flora species to spread. Many annual species are washed down from the escarpment and colonise the river beds downstream. The lifespan of these species is limited, as they are dependent on a shallow water table.

The first comprehensive botanical study was conducted around Rössing Mine in 1984, following the first rainfall event in many years. Mining operations had already commenced prior to the study being conducted, thus the species recorded in the surrounding areas are assumed to be representative to the species that occurred on the mining site. The vegetation structure and diversity at Rössing Mine is dependent on rainfall periods. Botanical assessments were again taken in 1991, 2005, and again in 2011 by Dr. Antje Burke, in which the following key findings were reported:

- An exceptional rainy season in 2011 in Namibia prompted a re-assessment of Rössing Uranium's biodiversity management tool in this year.
- Some 21 biotopes were mapped and classified using the conservation status of plant species as indicators.
- Four, largely hilly and mountainous habitats, were rated as "critical" biotopes: Euphorbia virosa belt, undulating granite hills, Khan River Mountains and south-east gneiss hills.
- Due to the exceptional season, species richness in the MLA increased from 140 in 2005 (compared to 26 in 1984) to 253 in 2011, making the Rössing Uranium MLA one of the most comprehensive inventories of flora in the Central Namib.
- Species of conservation importance in the MLA increased from 24 to 68 plant species, partly due to the new distribution records, and partly due to inclusion of protected species.
- The biotope assessment is a dynamic tool which needs to incorporate new insights in biodiversity management when these become available. A re-assessment sometime in the future should, if feasible, strive to also include indicators of ecological functioning.

The 1984 study revealed four different habitat types, namely depressions and washes; flat areas of ground; hills, rocky outcrops and inselbergs; and riverbeds. Each of these habitats were characterised by a specific collection of species, with only two species recorded throughout all of the habitats. In total the study revealed 196 plant species, comprising one fern species, 35 monocotyledons, and 160 dicotyledons. This included nine alien invasive plants, three exotic species and ten rare species, the latter which are protected in Namibia.

Many of the gullies and river beds have alluvial soils and these depressions collect subsurface water and provide suitable habitats for plants to grow in an otherwise barren and harsh environment, allowing perennial species to persist.

The seasonal summer rainfall that the interior plateau receives is a water source for many of the riverine species in the Namib Desert, contributing to the seasonal variations of the vegetation.

4.8.1.1 Habitats

The habitats in the Rössing Mine area can be broadly divided into three broad habitat types, namely:

- Rocky Hillsides: Least vegetated habitat due to the very shallow soils or no soil, and loose surface rocks.

- Open Plains: Features scattered bushes and shrubs due to the deeper soils. The plains are interrupted with rocky outcrops of varying sizes.
- Watercourses: More vegetation in the form of larger bushes and trees along the length of the course, due to the more frequent availability of water. Water is usually only available for short periods of time. The soil is usually sandy and loose.

4.8.1.2 Aquatic vegetation

Aquatic plants in the Namib Desert are rare, with *Ruppia maritime* being recorded in pools on odd occasions. This species has also been recorded in man-made crusher and seepage ponds at Rössing Mine. There is, however, no evidence that this species would have occurred here originally. Some species that have been recorded at the mine are emergent species, which include *Cyperus marginatus, Phragmites australis* and *Typha capensis*, which have been found growing in the wetter soils in the Khan and Swakop Rivers.

The only other aquatic plants within the Rössing Mine area include a low diversity of microscopic diatoms and other algae species, due to the relatively high salinity levels of the water bodies.

4.8.1.3 Introduced species

Eight invasive species were recorded mainly along the Kuiseb and Swakop rivers in a study conducted in the Namib Naukluft Park. Nine invasive and three introduced species were however recorded within the Rössing Mine area. The majority of the invasive species were found along the water courses. The chances of survival further away from the riverbeds are dependent on the resilience of the species and the climatic conditions that prevail, particularly the amount of rainfall. Such favourable conditions result in the indigenous and introduced species competing for the same resources.

4.8.2 FAUNA

4.8.2.1 Large Mammals

Large mammal surveys had been conducted in the Namib Naukluft Park, and 29 species were counted, with more than half being carnivores. Due to the harsh desert environment, many of the species observed are considered to be nomadic in nature, and only entering the park following good rains. The only species considered to be permanent is the Klipspringer, which occurs in the Khan River gorges. Three species that were traditionally hunted (to extinction) include *Loxodonta Africana (*African elephant), *Lycaon pictus* (wild dog), and *Panthera leo* (lion).

Studies conducted at Rössing Mine concluded that kudu and baboon were previously present in the vicinity. The mammal list now includes 6 hoofed mammals and 9 carnivores. The majority of the larger mammals, as for the small mammals, are classified as being uncommon to rare. In addition, eight of the mammal species are classified as near-threatened, vulnerable, or endangered. The African wild cat is vulnerable due to hybridization with domestic cats, which may occur where people reside.

4.8.2.2 Small Mammals

Surveys conducted in the Namib Naukluft Park recorded four species of shrew, six species of bat, two species of hare and 16 species of indigenous rodent. It was believed that these species may also occur within the Rössing Mine site. It has been confirmed that two rodent species have been introduced to the site due to human activity, being *Mus musculus* (house mouse) and *Rattus rattus* (brown rat).

A later survey on the mine recorded 11 bat species and 16 small mammals, including rodents, one shrew, sengi, hare, dassie and hedgehogs. The majority of these species are uncommon, except for the hedgehogs and fruitbats which are common in the vegetated areas along the river courses.

4.8.2.3 Birds

The harsh environment of the desert has limited the number of avian species that are able to survive. A number of bird species have adapted their feeding and reproductive habits in order to survive within the desert environment. Their reproductive cycle coincides with seasonal rainfall, in order to take advantage of the increase in insect and plant numbers. The Rössing Mine area holds a high diversity of bird species. This is mainly influenced by the close proximity of the Khan River and its associated tributaries.

4.8.2.4 Reptiles and Amphibians

A survey conducted in the mid-1980s recorded a total of 34 species of reptiles and two amphibian species. It was believed that another seven to ten species may occur within the mining area, although unconfirmed. It is expected that 33 lizard species occur in the area, which comprises 15 geckos, two agamas, the Namaqua chameleon, seven skinks, seven sand lizards, and one plated lizard. Eight of these species are endemic to the Namib and the Husab Sand Lizard is restricted to the Rössing-Husab mountainous region. All of these lizard species are classified as being of least concern, except for the Husab Sand Lizard and another species, which are not classified due to insufficient data.

4.8.2.5 Aquatic Fauna

In the Rössing Mine area only one natural pool exists, although aquatic fauna also exist in man-made water bodies. The species that had been recorded included the following taxa: *Copepoda*, *Ostracoda* (seed shrimps), *Hydracarina* (water mites), *Ephemeroptera* (mayflies), *Odontat* (dragonflies), *Hemiptera* (bugs), *Coleoptera* (beetles), and *Diptera* (flies).

4.8.2.6 Insects

The diversity of the insect fauna in the region is vast. A total of 271 species have been identified at the mine. The species identified include ground-living and winged species. Moths, butterflies (lepidoptera) and lacewings (neuroptera) have not been studied in depth, and thus there is insufficient data on the occurrence of these species within the area.

4.8.2.7 Arachnids and Non-Insect Vertebrates

During surveys conducted in the mid-1980s different species were collected, which included 89 species of scorpions form three families, two species of pseudoscorpions, and one species of opiliones. The habitat preference of spiders is dry water courses, whilst the solifuges prefer rocky hillsides. Colder conditions results in decreased activity of both the spiders and solifuges. The scorpions did not show any particular habitat preference, however, they are most active following rainfall events.

Mites and ticks (*Acari*) were considered in later studies in which four species of mites were discovered to occur at Rössing Mine. Water mites were also discovered in the water bodies, but were not identified. Ticks are present on the mammals, but have also not been identified.

Recent studies in 2007 identified 79 species of spiders at Rössing Mine. The diversity of species is less than that of comparable areas of the Namib.

5 PUBLIC PARTICIPATION PROCESS

Engagement with the public and stakeholders interested in, or affected by, development proposals, forms an integral component of the Environmental Assessment Process. I&APs have had several opportunities at various stages throughout the SEIA process to gain more knowledge about the proposed project, to provide input and to voice any issues of concern.

5.1 IDENTIFICATION OF STAKEHOLDERS

The following stakeholder groups were identified as the key ones to be consulted throughout the SEIA process:

- Central Government ~ Ministries of:
    - Mines and Energy,
    - Health and Social Services,
    - Labour and Social Welfare,
    - Environment and Tourism,
    - Agriculture, Water and Forestry,
    - Regional and Local Government and Housing, and
    - Education;
- Regional and local government:
    - Erongo Regional Council,
    - Swakopmund Town Council,
    - Walvis Bay Town Council, and
    - Arandis Town Council;
- The !Oe#Gan Traditional Authority;
- Other uranium mines in the Erongo Region;
- Rössing Uranium;
- The Rössing Foundation;
- Organised labour;
- The media;
- NamPort;
- NamWater;
- NamPower;
- TransNamib;
- Roads Authority;
- The farming community, both small-scale and commercial;
- Economic sectors which may be affected by mineral exploitation, e.g. tourism;
- Community groups and social institutions in Swakopmund, Walvis Bay and Arandis; and
- Service providers.

5.2 PUBLIC PARTICIPATION DURING PHASE 1 OF THE EXPANSION PROJECT SEIA

The proposed expansion project was initially advertised between 14 and 20 August 2007 in national, regional and local newspapers and on Rössing Uranium's website, in order to make as many people as possible aware of the project and associated SEIA process. This was done to elicit comment and register I&APs from as broad a spectrum of the public as possible. Once an I&AP is registered, he or she is kept informed of progress throughout the SEIA process.

A Public Information Document (PID) was widely distributed during the initial public participation process and was also available on the Rössing Uranium and Aurecon (then Ninham Shand) websites. In addition to the advertising and PID, public and key stakeholder meetings were held with a wide array of interest groups and organisations during August 2007.

Public meetings were again held between 22 and 24 January 2008 in Arandis, Swakopmund and Walvis Bay and were advertised in national, regional and local newspapers between 16 and 22 January 2008. Copies of the report were lodged for public viewing at libraries in these same centres, as well as in Windhoek, and the report was also placed on the Rössing Uranium and Aurecon (then Ninham Shand) websites. The purpose of this series of meetings was the release of the Phase 1 Draft SEIA Report, as well as the introduction of the Phase 2 Scoping stage of the SEIA process.

5.3 PUBLIC PARTICIPATION DURING PHASE 2 – SCOPING PHASE

The following meetings were arranged (as mentioned above) to introduce the scoping stage of the SEIA Phase 2 process to the stakeholders and the general public:

- Alte Brücke, Swakopmund: 22 January 2008;
- Pelican Bay Hotel, Walvis Bay: 23 January 2008; and
- Arandis Town Hall, Arandis: 24 January 2008.

The table below reflects the placement of press notices for these meetings.

Table 4: Schedule of newspaper advertisements Phase 2 Scoping, January 2008

Newspaper	Placement Dates
Namib Times	18 & 22 January 2008
Republikein	16, 17 & 18 January 2008
Namibian	16, 17 & 18 January 2008

Notices of these meetings were also posted in public places in Swakopmund, Walvis Bay and Arandis.

The Draft Phase 2 Scoping Report was made available for I&APs and stakeholders to review at the same libraries that the Phase 1 SEIA Report was lodged, and was again uploaded to the Rössing Uranium website, as well as to the Aurecon (then Ninham Shand) website. Public input received during the comment period after release of the Draft Phase 2 Scoping Report was taken into account in the final report before submission to MET:DEA.

Issues relevant to the expansion project components covered in this SEIA Phase 2 that were raised during the meetings held from 22 to 24 January 2008 were captured and responses provided in the form of a stakeholder issues report, included in this Report as Annexure M.

During the public comment period for the draft Phase 2 Scoping Report, the Rössing Uranium website was visited 90 times to view the report, and 150 times to download specific sections of the report.

5.4 PUBLIC PARTICIPATION DURING THE SEIA PHASE 2a

An SEIA was completed in 2009 for the construction of a sulphur handling facility in the Port of Walvis Bay. Originally, the sulphur handling in the Port of Walvis Bay was excluded from the SEIA Phase 1 due to the fact that the lessee and operator of the bulk handling terminal in the Port of Walvis Bay had embarked on an environmental assessment for a sulphur handling facility themselves. However, since that time, Rössing Uranium identified additional potential locations for such a facility, that required assessment as to the suitability of these locations which fall outside the scope of the first assessment, and the facility was therefore included in the SEIA Phase 2 process (then referred to as Phase 2a).

Due to the sulphuric acid manufacturing plant on the mine receiving clearance from MET:DEA during the SEIA Phase 1, and its reliance on elemental sulphur as feedstock to operate, it was decided to separate the sulphur handling component in the port from the remainder of the SEIA Phase 2 process. It was thus subjected to an individual SEIA process in the interests of time and to allow for an earlier clearance than the remaining SEIA Phase 2b components addressed in this report. The Final SEIA for the sulphur handling facility was submitted to MET:DEA for a decision in December 2009 and subsequently approved.

A focus group meeting was held on 7 February 2008 in Walvis Bay. Attendees received Public Information Documents (PIDs) aimed at informing interested and affected parties (I&APs) and stakeholders about the proposed development by Rössing Uranium and to promote participation in the SEIA process. This focus group meeting was attended by eighteen stakeholders. The meeting was co-ordinated by Marie Hoadley, the public participation manager for the SEIA process, and three delegated representatives from Rössing Uranium were present to respond to queries and provide insight into the technical workings of the proposed sulphur handling facility.

5.5 PUBLIC PARTICIPATION DURING THE SEIA PHASE 2b

To initiate the Phase 2b public participation process, meetings were scheduled in October 2008 to discuss concerns with two particular interest groups that are located at closest proximity to the Rössing Mine. The first meeting was with the Arandis community on 22 October 2008, and the second on 23 October 2008 with the farming community in the vicinity of the mine. The comments and concerns that were raised at these meetings relate mostly to air blast and ground vibration, as well as air quality and have been captured in the stakeholder issues trail, included as Annexure M of this report.

Follow-up meetings were scheduled in February 2009 to provide feedback to these groups, specifically related to the air blast and ground vibration study:

- 25 February 2009 at the Arandis Community Development Centre; and
- 26 February 2009 at the Rössmund Offices.

The Arandis community was notified by means of a flyer that was distributed in the town, and the farming community was invited by letter.

The general low attendance of I&APs at public meetings and the lack of comments on the draft Phase 2 Scoping Report caused concern that the public was not accessing information about the expansion project, and that the concerns and recommendations of I&APs were not being articulated and recorded. It was hoped that a new approach would reach a broader audience than before and result in I&APs with a better and more detailed understanding of the project. This would, in turn, lead to more comprehensive input into the impact assessment. The difficulties in engaging with marginalised groups also needed to be addressed. A decision was accordingly taken to change the format of the public participation process for the launch of the SEIA Phase 2b, by moving away from large open house public meetings to specific focus groups based on stakeholder categories.

The final stakeholder mapping process was revisited in 2010 to address the concerns listed above, and stakeholders were categorised into interest groups. These were:

- Developmental agencies;
- Labour Unions – branch and regional;
- Local authorities;

- Parastatals and the Coastal Bulk Water Users' Forum;
- Environmentalists, tourism operators and the farming community in the vicinity of Rössing Uranium;
- The media;
- The Arandis community;
- The Swakopmund community; and
- The Mondesa and DRC communities.

During August 2010, focus group meetings were held with the first six interest groups. The meetings were preceded by a tour of the Rössing Mine and a visit to the site of the proposed expansion project components, for those who elected to partake. This contextualised the discussions at the meetings, and facilitated more informed and in-depth questions and comments. Meetings focused on issues which had been identified as of interest to each particular group and presentations and specialist attendance were arranged to match.

A public meeting was conducted in Arandis, and two road shows were held, one in the Swakopmund central business district, and one in Mondesa. Details of these meetings are included in this report as Annexures H, I, K and L.

Table 5 below reflects the placement of press notices of meetings that were held during August 2010. Refer to Annexure I for an example.

Table 5: Schedule of newspaper advertisements, August 2010

Newspaper	Placement Dates
Namib Times	20 August 2010
Republikein	11 & 16 August 2010
Namibian	11 & 16 August 2010

The new format proved to be extremely productive and a great deal of information was asked for and provided. All the stakeholder groups were involved in the consultation process, and the inclusion of marginalised groups was particularly successful. I&APs freely voiced their concerns, questions and recommendations. These are captured in the stakeholder issues trail included in this report as Annexure M and a comprehensive attendance register of all participants in these meetings, as well as the earlier two focus group meetings held in October 2008, are included as Annexure K.

During the SEIA phase of the process, public participation comprised the following:

- engagement with I&APs who did not register in the scoping stage process;
- disseminating an updated Background Information Document (BID) to participants at Focus Group Meetings, Public Meetings and Road Shows (refer Annexure G);
- disseminating a document summarising the results of the specialist studies undertaken for Phase 2 of the Expansion Project to participants at Focus Group Meetings, Public Meetings and Road Shows (refer Annexure M);
- presenting the findings of the specialist studies completed for the SEIA Phase 2b Report (refer to Annexure J);
- registering additional I&APs;
- noting and responding to questions and/or issues of concern; and

- investigating issues at greater depth where the need for this was indicated.

All I&APs and stakeholders were informed of the availability of the draft SEIA Phase 2b Report, the period for review and the venues and websites where the report was available. Copies of the advertisements are included in Appendix I. The same notification was emailed to all registered I&APs. Comments received in the comment period are included in the updated Final Stakeholder Issues Trail in Appendix M. Where relevant, changes have been effected in this Final SEIA Phase 2 report.

Annexure L provides a list of all I&APs who have been on the project Stakeholder Database since the initiation of this project and all public consultation activities to date is summarised in Table 6. Rössing Uranium provided statistics of the number of hits per report component on their website during the comment period. The annexures to the report recorded the highest numbers of hits, with Annexure B[20] (46 hits), Annexure N1[21] (15 hits), and Annexures N13[22] and N10[23] (10 hits each) recording the most hits. No similar statistics are available for hits recorded on the Aurecon website.

5.6 ISSUES IDENTIFIED

The useful inputs received from I&APs are acknowledged. Listed below are the most noteworthy of the issues raised by I&APs to date, as derived from public consultation and stakeholder engagement. The most noteworthy issues raised during public consultation are:

- creation of employment opportunities;
- workplace health and safety concerns;
- housing implications;
- the nature and locality of construction camps;
- the sustainability of Arandis;
- negative social impacts due to newcomers seeking work;
- services such as schools, medical care and water availability;
- effects on the regional and local economy, including tourism;
- possible dust and noise threats to humans resulting from the expansion project;
- the effects of dust on flora and fauna;
- concerns about possible pollution of the Khan River from the heap leach pad and the ripios facility;
- biodiversity implications, particularly in the SK mining area and the Dome area;
- supply, storage, application, runoff and reuse of water resulting from the expansion project;
- regional implications of bulk water supply;
- visual impacts resulting from the expansion project;
- energy use; and
- the possible effects of blasting at Rössing Uranium on Arandis and on farm infrastructure in the vicinity of the mine.

Participants at meetings also showed great interest in the technical details of the proposed new acid heap leaching process.

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[20] Annexure B: Rössing Uranium HSE Summary.
[21] Annexure N1: Air Quality Study by Airshed Planning Professionals.
[22] Annexure N13: Groundwater Seepage Modeling Studies by Aquaterra.
[23] Annexure N10: Traffic Study by Burmeister and Partners.

The objectives of public participation were maintained throughout this SEIA process, which are to provide information to the public, identify key issues and concerns at an early stage, respond to the issues and concerns raised, provide a review opportunity, and document the process accurately.

5.7 MEDIA REACTION

The focus meeting held on 20 August 2010 to brief the media was particularly successful and stimulated a number of articles that were subsequently published in a variety of media forms, including newspapers and websites. These discussed a variety of concerns and positive effects expected from the expansion project, all of which had been raised before:

- economic "bloom" in Arandis (construction, small businesses);
- concern about the future sustainability of Arandis when Rössing Uranium reaches closure stage;
- increased traffic on the B2 with associated infrastructure burden and safety issues;
- water shortages;
- archaeological heritage threats;
- employment opportunities from the expansion project;
- increase in property values due to housing demand;
- positive impact on Erongo's economy as well as local economy;
- concern regarding influx of work seekers putting pressure on infrastructure and services, including education and health facilities; and
- visual impact, particularly cumulative as a result of expanding mining operations in the region, with resulting impact on Erongo's tourism economy.

5.8 THE WAY FORWARD

This Final SEIA Phase 2b Report will be submitted to MET:DEA for review and a record copy made available again to the public.

Should MET:DEA believe that the final submission contains information that is sufficiently comprehensive for sound decision-making, they will consider issuing a clearance for the project. Such clearance will probably include certain conditions, e.g. the implementation of mitigation as stipulated in the SEMP that accompanies the SEIA Phase 2b Report.

All registered I&APs and stakeholders will be informed of MET:DEA's decision once it is made available.

Table 6: Summary of public consultation activities up to draft SEIA Phase 2 report stage

Project Activity	Dates	Notices	Letters	Documents	Meetings
Project Preparation – all phases	14 June 2007			Minutes of meeting	Multistakeholder Risk Identification Workshop for the SK4 project, Swakopmund.
Project Initiation – all phases	August 2007				Meetings with authorities.
Initiation of Public Participation – all phases		Newspaper adverts. Notices in public places in Arandis, Swakopmund and Walvis Bay. Rössing Uranium's website.	Notification of project & invitation to stakeholders' meeting.	PID	Meeting with media.
	20-22 August 2007			Stakeholder Issues Sheet (1)	Public Participation meetings in Swakopmund, Walvis Bay and Arandis.
	23 August – 22 September 2007			Minutes of meetings. Stakeholder Issues Sheet (2)	Key informant and focus group meetings.
Notification of Phase 1 Scoping Report	13-14 November 2007	Notification of release of Phase 1 Scoping Report in print media and on Rössing Uranium's website.	Letters to I&APs notifying them of release of Phase 1 Scoping Report.	Phase 1 Scoping Report.	Key stakeholder meetings.
Focus group participation	13-14 November 2007			Minutes of meetings.	Meetings held with identified stakeholders.
	6 December 2007			Minutes of meeting.	Meeting with farmers.
Notification of Draft Phase 1 Social and Environmental Impact Assessment (SEIA) Report for comment	12 - 16 January 2008	Notification of release of Draft SEIA Phase 1 Report in print media and on Rössing Uranium's website.	Letters to I&APs notifying them of release of Draft SEIA Phase 1 Report.	Draft Social and Environmental Impact Assessment Phase 1 Report.	
Public Participation introduction of Phase 2 project components	22 – 24 January 2008	Newspaper notifications Notices in public places in Arandis, Swakopmund and Walvis Bay, and Rössing Uranium website.	Notification of public meetings.	Phase 2 Stakeholder Issues Trail	Public Participation meetings in Swakopmund, Walvis Bay and Arandis.
Phase 2a Focus Group Meeting	7 February 2008			Minutes of the meeting	Walvis Bay Port Focus Group Meeting

Project Activity	Dates	Notices	Letters	Documents	Meetings
Public review	10 April 2008		Notification to I&APs of review period for the Final Scoping Report of the SEIA for Phase 2 of the Expansion Project	Draft Scoping Report of the SEIA for Phase 2 of the Expansion Project	
Notification of submission of final Scoping Report of the SEAI to MET:DEA.	14 May 2008		Notification to I&APs of lodging of final Scoping Report with MET:DEA	Final Scoping Report of the SEIA for Phase 2 of the Expansion Project	
Stakeholder engagement	21 October 2008	Flyers posted on public notice boards in Arandis	Notification of and invitations to meetings	Minutes Updated stakeholder issues trail	Community meeting with Arandis Community
Stakeholder engagement	23 October 2008		Notification of and invitations to meetings	Minutes Updated stakeholder issues trail	Focus Group meeting with Farming community
Stakeholder engagement, Road Show, Mondesa, Swakopmund	14 August 2010	Newspaper notifications, notice in e-Rössing Bulletin		2nd Public Information Document Summary of the results of specialist studies for Phase 2 of the Mine Expansion Project Updated stakeholder issues trail	Road Show – Mondesa and DRC communities
Stakeholder engagement Focus Group Meeting	13 August 2010		Notification of and invitations to meetings	2nd Public Information Document Summary of the results of specialist studies for Phase 2 of the Mine Expansion Project Minutes Updated stakeholder issues trail	Focus Group Meeting – Developmental Agencies

Project Activity	Dates	Notices	Letters	Documents	Meetings
Stakeholder engagement Focus Group Meeting	16 August 2010		Notification of and invitations to meetings	2nd Public Information Document Summary of the results of specialist studies for Phase 2 of the Mine Expansion Project Minutes Updated stakeholder issues trail	Focus Group Meeting – Labour Unions – Regional and Rössing Branch.
Stakeholder engagement Focus Group Meeting	17 August 2010		Notification of and invitations to meetings	2nd Public Information Document Summary of the results of specialist studies for Phase 2 of the Mine Expansion Project Minutes Updated stakeholder issues trail	Focus Group Meeting – Local Authorities
Stakeholder engagement Focus Group Meeting	18 August 2010		Notification of and invitations to meetings	2nd Public Information Document Summary of the results of specialist studies for Phase 2 of the Mine Expansion Project Minutes Updated stakeholder issues trail	Focus Group Meeting – Parastatals
Stakeholder engagement Public Participation Meeting	18 August 2010	Newspaper adverts, posters in public places in Arandis and notice in e-Rössing Bulletin	Notification of and invitations to meetings	2nd Public Information Document Summary of the results of specialist studies for Phase 2 of the Mine Expansion Project Updated stakeholder issues trail	Public Participation meeting in Arandis

Project Activity	Dates	Notices	Letters	Documents	Meetings
Stakeholder engagement Focus Group Meeting	19 August 2010		Notification of and invitations to meetings	2nd Public Information Document Summary of the results of specialist studies for Phase 2 of the Mine Expansion Project Minutes Updated stakeholder issues trail	Focus Group Meeting – Environmentalists, Tourism and Farming Community
Stakeholder engagement Focus Group Meeting	20 August 2010		Notification of and invitations to meetings	2nd Public Information Document Summary of the results of specialist studies for Phase 2 of the Mine Expansion Project Minutes Updated stakeholder issues trail Presentation	Focus Group Meeting – Erongo Regional Council
Stakeholder engagement Focus Group Meeting	20 August 2010		Notification of and invitations to meetings	2nd Public Information Document Summary of the results of specialist studies for Phase 2 of the Mine Expansion Project Minutes Updated stakeholder issues trail	Focus Group Meeting - Media
Stakeholder engagement Road Show	21 August 2010	Newspaper notification, notice in e-Rössing Bulletin		2nd Public Information Document Summary of the results of specialist studies for Phase 2 of the Mine Expansion Project Updated stakeholder issues trail	Road show – Swakopmund community

6 ASSESSMENT METHODOLOGY

The purpose of this chapter is to describe the assessment methodology utilised in determining the significance of the construction, operational and closure impacts associated with the proposed expansion to the existing mining activities on the socio-economic and biophysical environment. It also addresses the challenge of subjectivity and the means of assessing cumulative impacts.

6.1 ASSESSMENT METHODOLOGY

A standardised and internationally recognised methodology[24] has been applied to assess the significance of the potential environmental impacts of Rössing Uranium's expansion project, outlined as follows:

For each impact, the EXTENT (spatial scale), MAGNITUDE (size or degree scale) and DURATION (time scale) are described. These criteria are used to ascertain the SIGNIFICANCE of the impact, firstly in the case of no mitigation and then with the most effective mitigation measure(s) in place. The decision as to which combination of alternatives and mitigation measures to apply for lies with Rössing Uranium as the proponent, and their acceptance and approval ultimately with MET:DEA. The tables on the following pages show the scale used to assess these variables, and defines each of the rating categories.

Table 7: Assessment criteria for the evaluation of impacts

CRITERIA	CATEGORY	DESCRIPTION
Extent or spatial influence of impact	National	Within Namibia
	Regional	Within the Erongo Region
	Local	Mine Licence Area and Mine Accessory Works Area
Magnitude of impact (at the indicated spatial scale)	High	Social and/or natural functions and/ or processes are *severely* altered
	Medium	Social and/or natural functions and/ or processes are *notably* altered
	Low	Social and/or natural functions and/ or processes are *slightly* altered
	Very Low	Social and/or natural functions and/ or processes are *negligibly* altered
	Zero	Social and/or natural functions and/ or processes remain *unaltered*
Duration of impact	Long Term	More than 10 years
	Medium Term	Between 3 and 10 years
	Short term	Up to 3 years

The SIGNIFICANCE of an impact is derived by taking into account the temporal and spatial scales and magnitude. Such significance is also informed by the context of the impact, i.e. the character and identity of the receptor of the impact. The means of arriving at the different significance ratings is explained in the following table, developed by Aurecon (then Ninham Shand) in 1995. This model is widely accepted and used nationally in South Africa, as well as internationally on large EIA projects for various funding agencies

[24] As described, *inter alia*, in the South African Department of Environmental Affairs and Tourism's Integrated Environmental Management Information Series (Government of SA, 2004).

and private clients and is generally endorsed by authorities as a reliable methodology to minimise subjectivity in such evaluations, i.e. to allow for replicability in the determination of significance.

Table 8: Definition of significance ratings

SIGNIFICANCE RATINGS	LEVEL OF CRITERIA REQUIRED
High	High magnitude with a regional extent and long term duration High magnitude with either a regional extent and medium term duration or a local extent and long term duration Medium magnitude with a regional extent and long term duration
Medium	High magnitude with a local extent and medium term duration High magnitude with a regional extent and short term or a site specific extent and long term duration High magnitude with either a local extent and short term duration or a site specific extent and medium term duration Medium magnitude with any combination of extent and duration except site specific and short term or regional and long term Low magnitude with a regional extent and long term duration
Low	High magnitude with a site specific extent and short term duration Medium magnitude with a site specific extent and short term duration Low magnitude with any combination of extent and duration except site specific and short term or regional and long term Very low magnitude with a regional extent and long term duration
Very low	Low magnitude with a site specific extent and short term duration Very low magnitude with any combination of extent and duration except regional and long term
Neutral	Zero magnitude with any combination of extent and duration

Once the significance of an impact has been determined, the PROBABILITY of this impact occurring as well as the CONFIDENCE in the assessment of the impact has been determined using the rating systems outlined in the following two tables. It is important to note that the significance of an impact should always be considered in context with the probability of that impact occurring.

Table 9: Definition of probability ratings

PROBABILITY RATINGS	CRITERIA
Definite	Estimated greater than 95% chance of the impact occurring.
Probable	Estimated 5 to 95% chance of the impact occurring.
Unlikely	Estimated less than 5% chance of the impact occurring.

Table 10: Definition of confidence ratings

CONFIDENCE RATINGS	CRITERIA
Certain	Wealth of information on and sound understanding of the environmental factors potentially influencing the impact.
Sure	Reasonable amount of useful information on and relatively sound understanding of the environmental factors potentially influencing the impact.
Unsure	Limited useful information on and understanding of the environmental factors potentially influencing this impact.

Lastly, the REVERSIBILITY of the impact has been estimated using the rating system outlined in the following table.

Table 11: Definition of reversibility ratings

REVERSIBILITY RATINGS	CRITERIA
Irreversible	The activity will lead to an impact that is permanent.
Reversible	The impact is reversible, within a period of 10 years.

6.2 SUBJECTIVITY IN ASSIGNING SIGNIFICANCE

Despite attempts at providing a completely objective and impartial assessment of the environmental implications of development activities, environmental assessment processes can never escape the subjectivity inherent in attempting to define significance. The determination of the significance of an impact depends on both the context (spatial scale and temporal duration) and intensity of such an impact. Since the rationalisation of context and intensity will ultimately be prejudiced by the observer, there can be no wholly objective measure by which to judge the components of significance, let alone how they are integrated into a single comparable measure.

This notwithstanding, in order to facilitate informed decision-making, environmental assessments should endeavour to come to terms with the significance of the potential environmental impacts associated with particular development activities. Recognising this, Aurecon has attempted to address potential subjectivity in the current SEIA Phase 2 process as follows:

- Being explicit about the difficulty of being completely objective in the determination of significance, as outlined above;
- Developing an explicit methodology for assigning significance to impacts and outlining this methodology in detail. Having an explicit methodology not only forces the assessor to come to terms with the various facets contributing towards the determination of significance, thereby avoiding arbitrary assignment, but also provides the reader of the SEIA Report with a clear summary of how the assessor derived the assigned significance;
- Wherever possible, differentiating between the likely significance of potential environmental impacts as experienced by the various affected parties; and
- Utilising a team approach and internal review of the assessment to facilitate a more rigorous and defendable system.

Although these measures may not totally eliminate subjectivity, they provide an explicit context within which to review the assessment of impacts.

6.3 CONSIDERATION OF CUMULATIVE IMPACTS

Namibia's Environmental Assessment Policy requires that, "as far as is practicable", cumulative environmental impacts should be taken into account in all environmental assessment processes. Environmental impact assessments have traditionally, however, failed to come to terms with such impacts, largely as a result of the following considerations:

- Cumulative effects may be local, regional or global in scale and dealing with such impacts requires co-ordinated institutional arrangements; and
- Environmental assessments are typically carried out on specific developments, whereas cumulative impacts result from broader biophysical, social and economic considerations, which typically cannot be addressed at the project level.

However, when assessing the significance of the project level impacts in the next chapter, cumulative effects have been considered as far as it is possible in striving for best practice. This has been achieved through:

- Requesting the specialists to not only assess the impacts of the SEIA Phase 2 expansion project components in isolation, but to do so against the background of what has been proposed in Phase 1, as well as the current "uranium rush" experienced in the Erongo Region resulting in the establishment of more uranium mines in particular; and
- Relying on the recently completed Strategic Environmental Assessment (SEA) for the Central Namib Uranium Rush (SAIEA, 2010), to provide insight into the potential cumulative effects associated with the current boom in mining activity.

7 ASSESSMENT OF POTENTIAL IMPACTS AND POSSIBLE MITIGATION MEASURES

This chapter forms the focus of the SEIA process. It contains a detailed assessment of the operational (or long term) impacts as well as the construction phase impacts on the affected socio-economic and biophysical environment, using the methodology described in the previous chapter.

7.1 INTRODUCTION

This section describes the potential impacts on the socio-economic and biophysical environments which may occur due to the proposed activities described in Section 3.

The full range of potential impacts identified during the Scoping Stage of this project is described in Section 3.4. From these, those that are clearly of minor significance have been screened out, after consideration of the specialist studies and other available information. Those identified as significant and any others identified since through the process are assessed in this chapter.

The presentation of the assessments that follows begins with the socio-economic impacts that are common to all of the project components. Thereafter, the impacts related to the specific expansion project facilities are assessed, preferably in a cumulative fashion for ease of reference (i.e. the total visual impact of all proposed facilities is assessed, rather than the visual impact of each individual proposed facility).

Each of these is assessed in detail and the significance determined in the following sections. The methodology used in the assessment is detailed in Section 6 of this report. The terms 'No mitigation' and 'Mitigation' reflected in the assessment tables in this chapter refer to the significance with no mitigation or environmental controls in place and with mitigation when the recommendations are being followed, where these are available. The tables provide a rating according to a scale of low, medium or high, and whether it would be positive or negative. Where possible, the assessment links to the Strategic Environment Assessment for the Central Namib Uranium Rush (SAIEA, 2010) to provide cumulative assessment context and background. Refer to Annexure B for information in the existing mitigation management systems in place at Rössing Uranium.

The full and detailed specialist studies upon which this section is based are appended to this document for reference purposes as Appendix N. The prescribed mitigation has been carried through to the SEMP, included herewith as Appendix O.

7.2 OPERATIONAL PHASE IMPACTS ON THE SOCIO-ECONOMIC ENVIRONMENT

A socio-economic assessment was undertaken to assess the potential impacts arising from the proposed mine expansion project. The assessment includes the analysis, monitoring and managing of intended and unintended social consequences, both positive and negative, and proposed interventions in the form of policies, programs, plans, and projects to address any social changes. The purpose is to bring about a more sustainable human and biophysical environment.

The expansion of the mine operations will have certain consequences or changes on the social make-up or characteristics of the existing communities settled in the area. It is expected that some of the consequences on the communities' social structures and well-being, as well as their economic conditions may be both positive and negative.

This section is largely derived from the specialist study undertaken by Marie Hoadley titled Socio-economic Component of the Social and Environmental Assessment Report for the Rössing Uranium Mine Expansion Project: Socio-economic Impact Assessment and Recommendations for a Socio-economic Management Plan and is structured accordingly. A copy of the report is included as Annexure N9 of this SEIA Report.

The expansion project will result in an increase in company revenue and national socio-economic contribution, a need for more workforce housing, increased resource consumption and finally local land use changes due to increased mineral waste disposal capacities for tailings, waste rock and spent heap leach ore (ripios).

The expansion project requires additional closure measures and costs. Strategies have been developed addressing the closure aspects of employee retrenchments and socio-economic exit from the financially dependent Arandis community. These impacts are described in the sections to follow.

7.2.1 IMPACT ON THE SUSTAINABILITY OF ARANDIS

IMPACT STATEMENT

The town of Arandis is currently financially dependent and supported by the mine and mine salaries represent a significant percentage of the economy of the town. This financial dependence may leave the town unable to support or sustain itself after the Rössing Mine closes and financial support is terminated.

DISCUSSION

The financial strength and stability of the town of Arandis will ensure that it will continue to support and sustain itself even after closure of the mine in the future. Currently the town is financially dependent on and supported by the mine. Initiatives aimed at moving towards financial independence include the phasing out of the mine's property ownership in Arandis and continuing the assistance for capacity building and the support of service providers in the town. The impact will be felt locally and nationally. The loss of employment with mine closure will impact locally on individuals, families, local authorities and the local economy in general. Nationally, contributions to the Social Security Fund will decrease but demands on the Fund will increase. The magnitude of the impact is regarded as high, as the expansion project could intensify the effect of closure or significant downscale. The duration of the impact is long-term, and it will be experienced during closure and decommissioning.

The sustainability of Arandis cannot be addressed in isolation, since other mining initiatives in the region will also potentially impact on the town. The Uranium Rush SEA (SAIEA, 2010) proposed the promotion of Arandis as a transport hub and for the development of a recycling centre, in addition to other potential industrial development, such as the proposed soda ash plant outside the town. If planned and managed properly, it is believed that such initiatives could steer the town toward a more sustainable economic base and initiatives to diversify the economy should specifically be promoted.

The mitigation measures below are aimed at what Rössing Uranium can do to achieve such diversification though selective focused spending in Arandis, and is in line with the desired outcome of optimising income and economic opportunities from the uranium rush as per the SEA. Arandis has been particularly resistant to developing self-reliance and economic diversity in the past.

MITIGATION

The mine's activities should be aligned to ensure the sustainability of the town of Arandis e.g. phasing out mine property ownership in Arandis, continuing the assistance for capacity building, support of service providers in the town of Arandis and informing the Arandis community as soon as downscaling and/or closure become possibilities. It is believed that these measures would swing the impact significance from high negative to medium positive. With specific reference to capacity building, Rössing Uranium established the Rössing Foundation in 1978 to implement and facilitate its corporate social responsibility activities within the communities and has spent more than N$120 million since in this regard. The foundation currently focuses on higher educational requirements such as teaching mathematics, science, English and information and communication technology skills.

In 2010, a total amount of N$23 million was spent on the Rössing Foundation's activities, focusing on education, enterprise development and the Arandis Sustainable Develoment Project (Rössing Uranium Limited, 2011). The Arandis Sustainable Development Project aims specifically to support the town in becoming a town of choice through smart partnerships with the goal to reach self-sustainability by 2016. During 2010 the project focused on agriculture development, capacity building support to the Arandis Town Council, community education, recreation and culture and support to local economic development initiatives.

The table below provides a summary of the significance ranking.

Sustainability of Arandis		
	No mitigation	**Mitigation**
Extent	National	National
Magnitude	High(-)	Low(+)
Duration	Long term	Long term
SIGNIFICANCE	**HIGH(-)**	**MEDIUM(+)**
Probability	Definite	Definite
Confidence	Certain	Certain
Reversibility	Reversible	Reversible

7.2.2 IMPACT ON EMPLOYMENT CREATION DURING OPERATIONAL PHASE

IMPACT STATEMENT

The operational phase of the mine expansion will provide long term employment opportunities and development benefits.

DISCUSSION

The operational phase of the mine's expansion project will provide long term employment opportunities and development benefits. Figure 23 below indicates projected employment figures, inclusive of allowance for the construction phase. The number of employees is likely to peak at just over 1,800 in 2016, but the first significant drop down is expected from 2020 onwards.

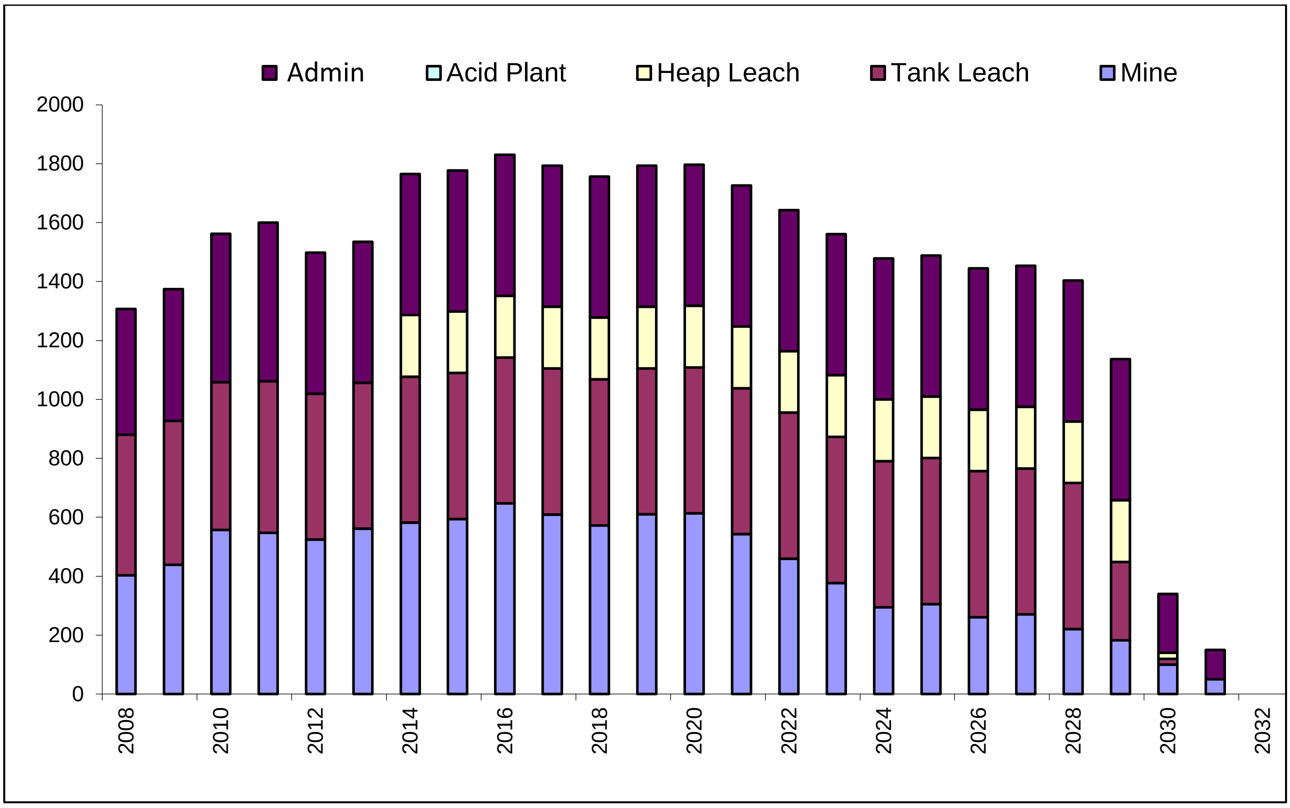


Figure 23: Number of Rössing Uranium Employees between 2008 and 2032

Namibia has a very low level of skilled or trained workers in relation to unskilled workers and this is also reflected in Erongo (SAIEA, 2010). Modern mining operations require the service of predominantly skilled labours and are thus beyond the immediate reach of the majority of the unemployed in the Erongo Region. The benefit of the employment created by the expansion project will be magnified through the economy by the multiplier effect whereby one job on the mine potentially results in several secondary or tertiary sector jobs which creates further employment and stimulates development. Secondary industries and commercial enterprises will also bloom to meet the needs of the mine for contract services and the needs of consumers as more expendable cash becomes available in the town.

Mines and industries are forced to resort to either poaching skilled workers from each other or from government sectors, or employing higher paid non-Namibians to satisfy their skills needs. The negative impacts caused by these actions are destabilisation and distortion of the job market, the undermining of the ability of government to manage the Uranium Rush and the potential for xenophobia (SAIEA, 2010). It has been calculated that the Uranium Rush will have a considerable impact on the lives of people in the Erongo Region, representing an additional 6,000 permanent direct jobs in the Uranium Rush industries, which could result in approximately 48,000 new jobs in the Namibian economy.

MITIGATION

Rössing Uranium has an established and transparent recruitment policy and system, with a permanent labour desk where prospective jobseekers can apply or place enquiries.

Long term employment opportunities and development benefits should be provided by the mine through its recruitment policy, equitable employment opportunities, skills and capacity development programme and ongoing training of the mine workforce.

The Namibian Industry for Mining Technology (NIMT) is located in Arandis but its output cannot satisfy the current, let alone the Uranium Rush, demand, and the scope of training provided needs to be expanded. The SEA recommended that a satellite campus should be established in Walvis Bay, and/or a similar accessible and flexible training institution should be established, which should be supported by the Uranium Rush industries (such as Rössing Uranium) by means of funding and skilled trainers (SAIEA, 2010).

The table below provides a summary of the significance ranking.

Employment creation during operational phase		
	No mitigation	**Mitigation**
Extent	National	National
Magnitude	Medium(+)	High(+)
Duration	Long term	Long term
SIGNIFICANCE	**HIGH(+)**	**HIGH(+)**
Probability	Definite	Definite
Confidence	Certain	Certain
Reversibility	N/a	Reversible

7.2.3 IMPACT ON PUBLIC HEALTH AND SAFETY

IMPACT STATEMENT

The mining activities may impact on the quality of life of members of the public by raising fears and unease about their health and safety. This impact relates to a public perception rather than actual impact and has to be seen in context of the fact that the mine has been in existence for such a long period.

The SEA commented that large-scale mining has health consequences, positive and negative, for workers and the community. Negative health impacts on workers are most commonly accidents, dust-related lung disease and metal toxicity, and positive impacts related to better economic prospects but sometimes this comes with a separation from family. Negative health impacts on the public include new diseases and social problems carried by the influx of population but again, balanced against this, is the increased prosperity and health care brought by the mining industry (SAIEA, 2010).

DISCUSSION

The mining activities and operations may impact or be perceived to impact on public health, safety and livelihoods. The public health and safety impacts can arise from either on-site or off-site hazards.

The risk of on-site safety hazards is normally lower, because the public is not involved in work on site and impacts are effectively managed by applying rigorous visitor induction programmes and strict Occupational Health and Safety Standards, such as those described in Annexure B (a summary of the Rössing Uranium HSE Management System).

If not controlled, secondary impacts may arise from dust generation, potential migration of pollutants down the Khan and Swakop Rivers, transport of material and product to and from the mine, operational hazards (i.e. blasting) and catastrophic failure (i.e. collapse of the tailings dam). Public health and safety programmes are currently in place to ensure the health and safety of people. These include programmes to manage dust associated with blasting operations, emergency response plans and monitoring the air quality in the nearby town of Arandis. Refer to Annexure B for more detail on these programmes. It is suggested that a health surveillance programme be developed for Arandis and this recommendation is in line with a recommendation in the SEA that the Atomic Energy Board should urgently complete its upgrade of the national cancer registry to provide a solid baseline against which future potential impacts on cancer from the Uranium Rush can be assessed (SAIEA, 2010).

MITIGATION

Public health and safety should be ensured by continuation and improvement of programmes to manage dust and blasting operations, emergency response plans and monitoring air quality in Arandis. Where emergency response plans involve local communities, Rössing Uranium needs to ensure that such communities are aware of the contents of the plans and what is expected of them. A health baseline and surveillance programme should be developed for Arandis and residents should be notified of blasting events.

The SEA (SAIEA, 2010) concluded that the two currently operating uranium mines (Rössing Uranium and Langer Heinrich) both have a zero harm objective for their workers and that they have comprehensive medical services and have excellent safety records. It further recommended that all new mines should use this as a benchmark to implement the same level of standard. In addition it recommended that local authorities should embark on a major health awareness and disease prevention campaign and all Uranium Rush industries should be obligated to support this effort with their own health programmes and preventative efforts, as Rössing Uranium is already doing.

The table below provides a summary of the significance ranking.

Public health and safety		
	No mitigation	**Mitigation**
Extent	Local	Local
Magnitude	Medium	Low
Duration	Long term	Long term
SIGNIFICANCE	**MEDIUM(-)**	**LOW(-)**
Probability	Definite	Probable
Confidence	Sure	Certain
Reversibility	Reversible	Reversible

7.2.4 IMPACT OF HOUSING ON PROPERTY MARKETS

IMPACT STATEMENT

The requirements for housing the mine's workforce will destabilise property markets in the towns in the study area, as a shortage in housing will inflate house prices in anticipation of the mine's need to provide additional housing and other mines.

DISCUSSION

The increased workforce (refer to Figure 23) will require a projected 400 additional accommodation units. The towns in the vicinity of the mine have a shortage of available accommodation, whether for sale or rent.

Property markets may be affected by the requirement for additional housing for the mine's workforce and an inflation in house prices may be experienced in anticipation of this housing demand.

The SEA came to a similar conclusion and added that the situation may lead to more informal settlements and resultant pressure on municipalities for service delivery (SAIEA, 2010), although the situation is expected to stabilise in the longer term, as current property development plans come to fruition.

MITIGATION

Destabilisation of property markets in towns in the study area should be avoided by keeping the cost of housing for employees as low as possible and avoiding the use of property developers and estate agents. Houses should be designed to maximise the possibility for post-closure use. The number of mine-owned houses in Arandis should be limited.

The table below provides a summary of the significance ranking.

Effect of housing on property markets		
	No mitigation	**Mitigation**
Extent	Regional	Regional
Magnitude	High(-)	Medium(-)
Duration	Medium Term	Medium Term
SIGNIFICANCE	**HIGH(-)**	**MEDIUM(-)**
Probability	Definite	Probable
Confidence	Sure	Certain
Reversibility	Reversible	Reversible

7.2.5 IMPACT OF INCREASED DEMAND FOR HOUSING ON ARANDIS AND SWAKOPMUND

IMPACT STATEMENT

Rössing Uranium's increasing workforce may impact negatively on the social and community processes in Arandis and Swakopmund.

DISCUSSION

This impact is related to the previous impact. A lack of accommodation for the increase in workforce may negatively impact on employees and communities in Swakopmund and Arandis. Employees may not be able to bring their families along which will disrupt family units, while social and community processes will be notably altered in local communities.

MITIGATION

The shortage of housing and impact on communities in Swakopmund and Arandis may be limited by identifying available temporary accommodation for rent through consultation with the municipalities, providing housing in the Progressive Development Area in Swakopmund, or considering the provision of mobile homes as a temporary last resort measure only. Should the provision of housing in the Progressive Development Area in Swakopmund, which is ready for such development, be implemented, it should be done with a view to later sell the units off again. The SEA (SAIEA, 2010) stated that existing, proclaimed towns are to be supported through housing most employees in such. It recommended that the mines do not create mine-only townships or suburbs and that on-site hostels not be considered in the interest of promotion of integration of society. These views are supported by Rössing Uranium.

The table below provides a summary of the significance ranking.

Effect of housing on Arandis and Swakopmund		
	No mitigation	**Mitigation**
Extent	Regional	Regional
Magnitude	High	Medium
Duration	Medium Term	Medium Term
SIGNIFICANCE	**HIGH(-)**	**MEDIUM(-)**
Probability	Definite	Probable
Confidence	Sure	Certain
Reversibility	Reversible	Reversible

7.2.6 IMPACT ON LOCAL ECONOMIES

IMPACT STATEMENT

Local and regional economies will be positively impacted by increased spending by Rössing Uranium and its workforce.

DISCUSSION

Although modern mines employ fewer people than in the past, they continue to be significant economic engines, capable of stimulating economies well beyond their site boundaries. Secondary industries and commercial enterprises will be required to meet the needs of the mine for goods and services, and the needs of consumers as more expendable cash becomes available in the towns, as well as the needs of the building and construction industries.

During 2010, Rössing Uranium spent a total of N$2.4 billion on goods and services to run the mine. Many of these purchases were for items that are not locally available, such as sulphuric acid, manganese and iron oxide. Rössing Uranium aims to balance the need to buy from the best suppliers worldwide, with maximising contribution to the local economy and in 2010 procurement expenditure on Namibian-registered suppliers amounted to N$1.6 billion, or 67% of the total (Rio Tinto, 2011).

MITIGATION

The SEA noted that in 2008, uranium mining contributed 3.3% of the total Gross Domestic Product (GDP) and that the medium growth scenario could see this figure increase to a peak in 2012 of 7.2%, which represents a GDP growth rate of 5.1% in 2008, to 8.2% in 2012, based on likely minimum and maximum prices for uranium oxide (SAIEA, 2010).

In addition, it predicted that uranium mining companies can become a significant source of income to the government, presenting a total contribution of 3.2% (N$697 million) in 2008 to an estimated peak of 8.2% in 2015 (N$3 billion), with the growth rate peaking in 2013 at 9.6% compared to 8.3% in 2008, based on likely corporate taxes, royalties and individual income tax payments.

The local economies will benefit from this expansion and growth through Rössing Uranium's policy of local procurement to promote small, Namibian companies and encourage their diversification. The promotion of mechanisms to support women in the local economy should be investigated. In the event of downscaling or closure, service providers should, however, be advised well in time.

The prioritisation of local procurement is in line with recommendations put forward by the SEA to ensure that economic opportunities from the Uranium Rush are optimised (SAIEA, 2010).

The SEA further noted that the main economic sectors in the Erongo Region are mining, tourism, fisheries and agriculture, around which a number of service industries have developed and that the overall impact of the Uranium Rush on these linked industries is the generation of a great number of opportunities and benefits and despite the increased consumption of water and energy, the Uranium Rush has already contributed to solving existing problems, and will continue to do so (SAIEA, 2010). It further recommended increased social spending by mines in less fortunate communities to maximise potential benefit to unskilled workers and rural households, which are less likely to benefit directly from mine salary income, as well as the coordination of such initiatives by the established SEMP office. Such programmes are supported by Rössing Uranium.

The table below provides a summary of the significance ranking.

Local economies		
	No mitigation	**Mitigation**
Extent	Regional	Regional
Magnitude	Medium	Medium
Duration	Medium Term	Long Term
SIGNIFICANCE	**MEDIUM(+)**	**HIGH(+)**
Probability	Definite	Probable
Confidence	Certain	Certain
Reversibility	n/a	Reversible

7.2.7 IMPACT ON INWARD MIGRATION

IMPACT STATEMENT

Inward migration of work seekers to Erongo Region will increase as a result of the perceived job opportunities offered by the proposed expansions to the mine.

DISCUSSION

Unemployment levels in Namibia are high and inward migration of work seekers to Erongo Region will increase as a result of the perceived job opportunities offered by the mine. The study concluded that there is no real management intervention that can stem inward migration. The impacts of such an influx of job seekers (e.g. backyard shack dwelling, informal housing and the resultant health and social problems) could possibly be alleviated by a number of social support initiatives as mentioned below.

MITIGATION

Attempts should be made to stem the effects of inward migration by preventing backyard shack dwelling, informal housing and the attendant health and social problems by promoting home ownership and ensuring, as far as feasible, that the workforce lives in formal housing. In addition, Rössing Uranium could develop programmes addressing social ills, such as alcohol abuse and violence against women and children and extend these programmes into the communities of interest through the Peer Educator Programme.

The table below provides a summary of the significance ranking.

Inward migration		
	No mitigation	**Mitigation**
Extent	Regional	Regional
Magnitude	Medium(-)	Medium(-)
Duration	Long Term	Long Term
SIGNIFICANCE	**HIGH(-)**	**HIGH(-)**
Probability	Definite	Probable
Confidence	Certain	Certain
Reversibility	Irreversible	Reversible

7.2.8 IMPACT ON SOCIAL SERVICES

Impact Statement

With current capacity, the schools in Swakopmund and Walvis Bay may not be able to accommodate the schooling requirements of an enlarged workforce at Rössing Uranium. Within the mine's communities of impact, there are large numbers of people who do not have the option to send their children to private schools, and as the numbers of such people increase, their reliance on state services places severe strain on the capacity of the service providers.

Discussion

Communities, and their individual members, need access to a number of services to lead healthy, productive lives. These services include access to basic necessities, such as water, healthcare and education services. With current capacity[25], the schools in Swakopmund, Walvis Bay and Arandis will not be able to accommodate the schooling requirements of Rössing Uranium's additional workforce. Although social services in Erongo are of a generally high standard, access to these services is not evenly spread across the population.

This impact specifically addresses the availability of schooling in Swakopmund, Walvis Bay and Arandis, as it emerged as a major concern to stakeholders through the public participation process. The Erongo Regional Office of the Ministry of Education has calculated that, in 2013 an additional 5,250 pupils will require schooling as a result of increased mining activity only. Currently Swakopmund and Walvis Bay are short of places for in excess of 2,000 pupils. Schools have experienced a growth in learner numbers ranging from 28.3% to 53.8% since 2005. Arandis had spare classroom capacity in 2007, but currently the schools need five extra classrooms.

A further potential impact, which is not analysed here, is the impact on Rössing Uranium. Employees who are not assured of schooling for their children may choose not to come to the region, and this would apply particularly to skilled workers, who are in short supply and high demand, and can find work elsewhere.

Mitigation

A shortage of schooling facilities may be addressed by building extra classrooms at schools where the shortage is most critical and by considering the building of a new school. Such initiatives have to be planned and executed in consultation with the Ministry of Education. Rössing Uranium may also have to negotiate preferential placement for the children of their employees at schools assisted as such. The SEA on the other hand, underlined the need for improved quality of school education and increased availability of technical

[25] Refer to the Socio-Economic Baseline Study included in Appendix N9 for a breakdown of capacity in schools (public and private) in the local towns.

skills in the Erongo Region (SAIEA, 2010), and provided targets and indicators against which such could be measured, but both of these would be dependent on provision of sufficient capacity in schools.

The table below provides a summary of the significance ranking.

Social services		
	No mitigation	**Mitigation**
Extent	Regional	Regional
Magnitude	High	Medium
Duration	Long Term	Medium Term
SIGNIFICANCE	**HIGH(-)**	**MEDIUM(-)**
Probability	Definite	Probable
Confidence	Certain	Certain
Reversibility	Irreversible	Reversible

7.2.9 AIR QUALITY AND THE IMPACT ON HUMAN HEALTH DUE TO DUST (ARANDIS)

An Air Quality Assessment was conducted by Airshed Planning Professionals and is attached as Annexure N1.

IMPACT STATEMENT

Mine emissions from vehicle movement, materials loading and transportation, wind erosion, drilling and blasting activities and emissions from on-site stacks (i.e. at the roasters, scrubbers and baghouse), will have an impact on ambient air quality as these are sources of dust[26]. The main pollutant of concern is dust particles suspended in the air, especially smaller particles called PM10. These particles are inhaled via the respiratory system and may impact on human health. The closest residential area to the mine is Arandis. This impact excludes mine employees as they operate within strict health and safety procedures as described in the HSE summary included as Annexure B. This document provides a description of the existing systems and procedures in place at Rössing Uranium.

DISCUSSION

Particulates represent the main pollutant of concern given the nature of the operations. Particulate matter is classified as a criteria pollutant, meaning that ambient air quality guidelines and standards have been established by various countries to regulate ambient concentrations of this pollutant and is often used as one of the criteria to measure or express air quality. Air quality guidelines and standards for particulates are given for various particle size fractions, including Total Suspended Particulates (TSP), and thoracic (which can be inhaled) particulates or PM10 (i.e. particulate matter with an aerodynamic diameter of <10µm). PM10 standards are usually expressed in both daily and annual average figures.

As mentioned, the on-site impacts of exposure to PM10 on human health are covered by the occupational health and safety guidelines promulgated under the Occupational Health and Safety Act and are therefore excluded from the impact evaluation. Ambient air quality guidelines and standards (for example the World Health Organization (WHO) Air Quality Guideline, South African Standards or European Community standards) aim to protect human health beyond the activity footprint. Arandis is the closest residential area to the mine and this impact relates to Arandis in particular, as the impact will be significantly reduced further away.

[26] The air quality model took consideration of the easterly winds and the potential impact that the TSF may have on dust volumes.

Figure 24: Dust emanating from the pit

Emissions inventories provide the source input required for the simulation of ambient air concentrations and dust deposition rates. During current and proposed activities, fugitive emissions from vehicle movement, materials handling, wind erosion and drilling and blasting activities were quantified. Figure 24 illustrates dust emissions from the open pit. Emissions from on-site stacks (i.e. roasters, scrubbers and baghouse) were estimated from the relevant process data provided for proposed operating conditions. The impact assessment focused on airborne particulates (including TSP and PM10) and although the proposed activities will also emit gaseous pollutants from vehicle exhausts, these were omitted because the impacts of these compounds are regarded to be low.

Particulate concentrations and deposition rates due to the operational activities were simulated using the United States Environmental Protection Agency (US-EPA) approved AERMET/AERMOD dispersion modelling suite. Ambient concentrations were simulated to ascertain highest daily and annual averaging levels occurring as a result of the current and proposed (i.e. existing and proposed maximum future expanded) operations.

A two month monitoring campaign was undertaken to assist in the understanding of baseline and background ambient air quality levels, and to form a basis against which the calculated and modelled concentrations for the proposed operations could be compared.

The predicted daily PM10 ground level concentration due to proposed expansion project operations at Rössing Uranium was predicted to be 440µg/m³ at the mine boundary exceeding all relevant ambient guidelines. The highest predicted annual average PM10 ground level concentration for the expansion project at the mine boundary (45µg/m³) was within the South African annual standard of 50µg/m³ but exceeded the South African annual standard (applicable in 2015) and European Community (EC) limit of 40µg/m³, as well as the World Health Organization (WHO) annual PM10 guideline of 20µg/m³.

At Arandis, the predicted daily PM10 ground level concentration due to Rössing Uranium's expansion project was 80µg/m³, which is within the US-EPA guideline and South African standards. Although same is predicted to have exceedences when compared to the WHO, South African limit (applicable in 2015) and the EC standards, the number of exceedences for the latter two are predicted to be only 1 and 2 respectively, being well below the allowed number of exceedences (i.e. for instance 35 exceedences allowed by the EC and only 2 predicted). The highest predicted annual average PM10 concentrations at Arandis (5.4µg/m³) were well within all relevant ambient guidelines. Figure 25 indicates the predicted annual average PM10 concentrations for the proposed expansion project. The predicted maximum deposition directly off-site due to proposed routine operations at Rössing Uranium was below all relevant guidelines.

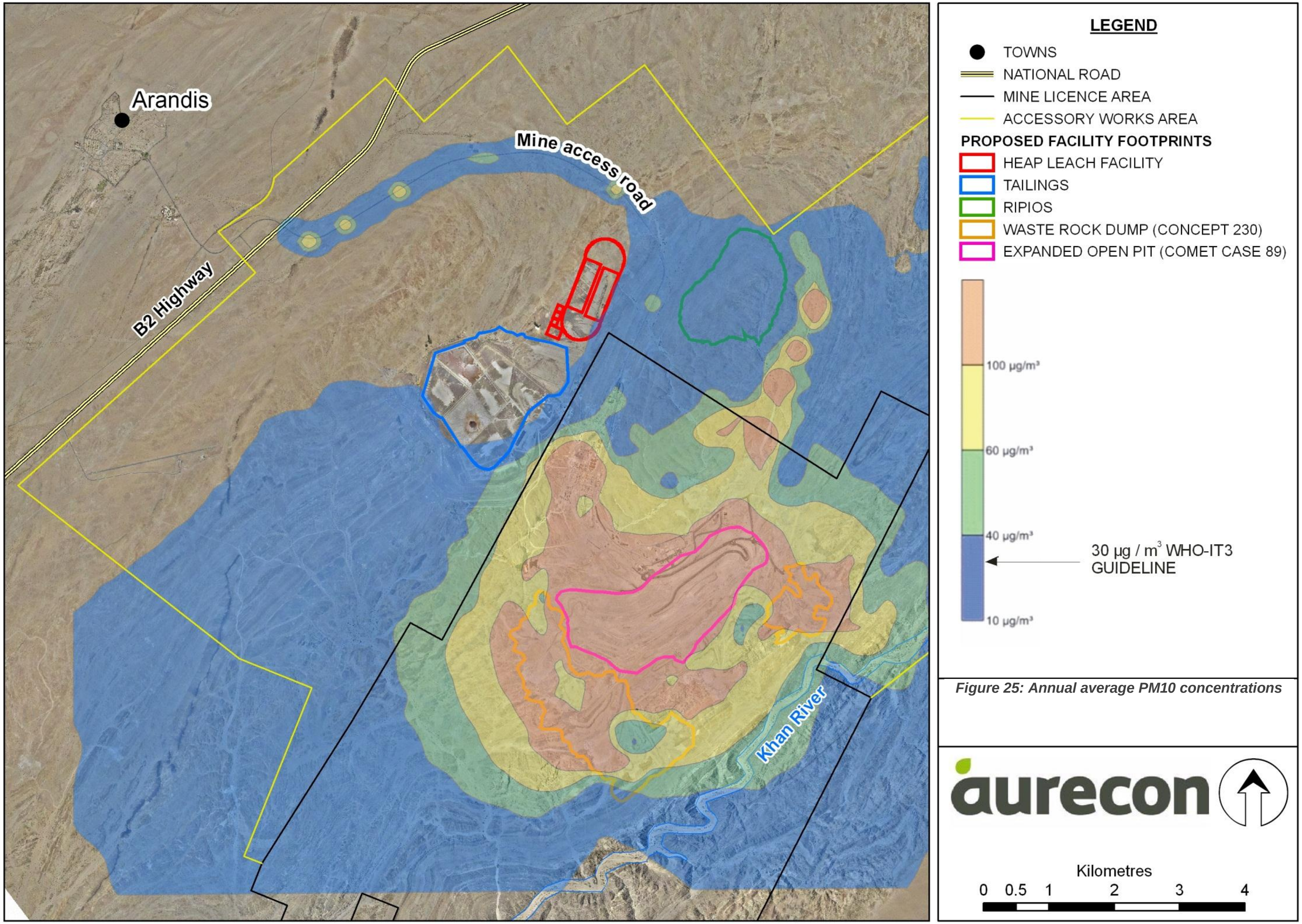


Figure 25: Annual average PM10 concentrations

As part of the Erongo Uranium Rush SEA, Airshed also completed an air quality study and noted that during the 1990s the WHO stated that no safe thresholds could be determined for exposures to suspend particular matter and responded by publishing linear dose-response relationships for PM10 and PM2.5 concentrations (Airshed, 2010b). This approach was not well accepted by air quality managers and policy makers. As a result the WHO Working Group of Air Quality Guidelines recommended that the updated WHO air quality document contain guidelines that define concentrations which, if achieved, would be expected to result in significantly reduced rates of adverse health effects. These guidelines would provide air quality managers and policy makers with an explicit objective when they were tasked with setting national air quality standards. Given that air pollution levels in developing countries frequently far exceed the recommended WHO Air Quality Guidelines (AQGs), the Working Group also proposed interim target (IT) levels, in excess of the WHO AQGs themselves, to promote steady progress towards meeting the WHO AQGs.

In Namibia and specifically in the Erongo Region where the baseline concentrations already exceed the WHO AQG at places such as Swakopmund, merely adopting these guidelines is unrealistic and will result in continuous non-compliance. For this reason the WHO IT-3 guidelines for PM10 of 75µg/m^3 and 30µg/m^3 for daily and annual average limits respectively were selected as indicators. The WHO IT-3 correlates with the newly developed South African limit that was developed based on similar environmental, social and economic conditions. The WHO allows four days where the daily guideline can be exceeded per calendar year as does South Africa. The desired state of ambient PM10 concentrations should remain as close to the baseline as possible, given the already elevated baseline PM10 concentrations.

In 2007 the World Bank developed Environmental, Health and Safety (EHS) Guidelines as part of a two and a half year review process. The EHS Guidelines are intended to be 'living documents', and will be updated on a regular basis going forward.

The EHS Guidelines provide a general approach to air quality management for the mine and include technical reference documents with general and industry-specific examples of good international industry practice (GIIP). The EHS Guidelines contain the performance levels and measurements that are generally considered to be achievable in new facilities by existing technology at reasonable costs. Application of the EHS Guidelines to existing facilities may involve the establishment of site-specific targets, with an appropriate timetable for achieving such. The applicability of the EHS Guidelines should be tailored to the hazards and risks established for each project on the basis of the results of an environmental assessment in which site-specific variable, such as host country context, assimilative capacity of the environment, and other project factors, are taken into account.

It should be noted that although non-conformances with the proposed new South African and EC standards were recorded (concentrations and exceedances), the impact could probably have been rated less significant against standards such as the current WHO IT-3 Levels standards mentioned above.

MITIGATION

Although the assessment included an analysis of all potential sources of dust associated with the proposed expansion project, the main source of fugitive particulate emissions is from vehicle dust on unpaved road surfaces within and around the open pit. It is recommended that dust control products such as Hydro Tac, Hydro Sperse or similar be investigated to further reduce emissions from this fugitive dust source. This recommendation corresponds with a SEA recommendation that mines should implement best practice mitigation measures for known dust generating sources, such as chemical suppressants on permanent haul roads and water sprays (in combination with chemicals to optimise water utilisation) on non-permanent unpaved roads (SAIEA, 2010).

It is further recommended that the dust fallout network, established for the two month monitoring campaign, be continued to monitor increases in dust fallout in the surrounding area due to the proposed expansion activities. Continued PM10 monitoring should be undertaken at Arandis to establish emission contributions from Rössing Uranium. This is in line with a SEA recommendation that ambient monitoring of PM10 concentrations and dust fallout (i.e. TSP) should be conducted for a period of at least one year to inform the baseline scenario and to provide a comprehensive dataset for dispersion model results evaluation (SAIEA, 2010).

The SEA (SAIEA, 2010) further recommended the installation of an accredited meteorological station in Swakopmund, further research into the quantification and stimulation of wind erosion and ultimately the development of air quality guidelines for the Erongo Region, although the responsibility for these measures do not rest with any particular mine.

The table below provides a summary of the significance ranking.

Impact on human health due to PM10 (Arandis)		
	No mitigation	**Mitigation**
Extent	Regional	Regional
Magnitude	Medium(-)	Low(-)
Duration	Long term	Long term
SIGNIFICANCE	**HIGH(-)**	**MEDIUM(-)**
Probability	Probable	Probable
Confidence	Sure	Sure
Reversibility	Reversible	Reversible

7.3 OPERATIONAL PHASE IMPACTS ON THE BIOPHYSICAL ENVIRONMENT

7.3.1 IMPACT ON ARCHAEOLOGICAL RESOURCES

An archaeological assessment was conducted by Quaternary Research Services and a copy of the report is attached as Annexure N2.

IMPACT STATEMENT

An archaeological assessment identified a number of archaeological sites, which will be destroyed with the extension of waste disposal activities to the Dome area. These sites were identified as archaeological remains of grass and seed gathering and honey harvesting during the hunter-gatherer era in the second millennium AD.

DISCUSSION

Five archaeological sites were located during an archaeological survey of the Dome area. The sites were found to be of low archaeological significance as seed digging sites are very common on the edge of the Namib, and occasionally more than 600 are found in a single square kilometre. The proposed plan to develop mine infrastructure on the Dome will in all likelihood destroy the sites. Figure 26 shows a typical seed digging site.

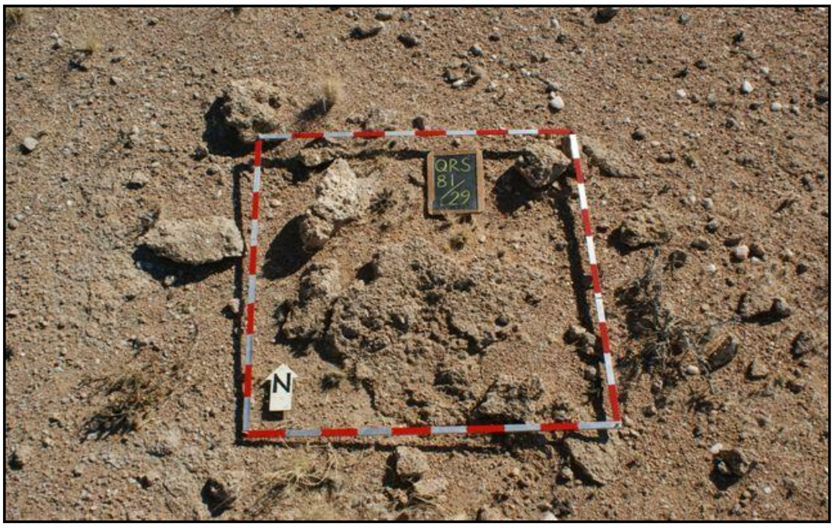


Figure 26: Typical seed digging site

The SEA found that as a large part of the Erongo region is either currently under uranium exploration or mining licences, or has renewals pending, detailed studies have been carried out for a large part of the area. These form a good basis to identify archaeological landscapes that can be flagged as areas of differing archaeological significance (similar to tourism and biodiversity) where specific care would need to be taken in considering applications for mining activities (SAIEA, 2010).

In addition the SEA concluded that there is a general lack of education regarding archaeological and historical resources in Namibia and the increase in knowledge brought about by the uranium industries' surveys, such as this specialist study undertaken by Rössing Uranium, is an opportunity to improve the general awareness about Namibia's heritage.

The Namib Desert Archaeological Survey Project combines the results of the numerous surveys that have been done for mining applications, allowing for a general assessment of archaeological resources, research opportunities, and identification of potential offset reserves. This in turn not only provides physical offsets in the form of reserve areas, but also creates a "knowledge offset". One of the key functions is to characterise the regional archaeological value of heritage resources so that mitigation measures for cumulative impacts can be applied in a broader fashion than to the individual mine or related industry (SAIEA, 2010). Rössing Uranium supports such initiatives and will make the results and findings of this specialist archaeological study available to contribute to the project.

MITIGATION

Impacts on archaeological sites are always irreversible and no specific mitigation measures are suggested, given the overall very low significance of this particular impact. A permit from the National Heritage Council will however be required before a recorded archaeological site can be destroyed.

The table below provides a summary of the significance ranking.

Impact on archaeological sites		
	No mitigation	**Mitigation**
Extent	Local	Local
Magnitude	Very low(-)	Very low(-)
Duration	Long term	Long term
SIGNIFICANCE	**VERY LOW(-)**	**VERY LOW(-)**
Probability	Probable	Probable
Confidence	Certain	Certain
Reversibility	Irreversible	Irreversible

7.3.2 IMPACT ON BIODIVERSITY

Several biodiversity surveys were previously undertaken at the Rössing mine site to develop a framework for managing biodiversity and assessing specific biodiversity risks associated with mine infrastructure development. The surveys covered all areas potentially affected by the proposed expansion project resulting in a comprehensive record of species and habitats identified in the area. Figure 27 indicates the identified biotypes around the mine.

In 2008 the Environmental Evaluation Associates of Namibia (EEAN) reported on the findings of a biodiversity assessment conducted within the wider Rössing Uranium MLA and the surrounding areas. A brief review of the findings of this report, as well as other surveys were conducted and reported on by Fauna and Flora International in 2009. The findings of these surveys were considered and incorporated herein, since these studies, although completed as part of the SEIA Phase 1 process, evaluated the possibility of establishing mine infrastructure on the Dome area currently being considered for the disposal of ripios. Copies of the biodiversity assessment reports are attached as Annexure N3.

Two significant impacts resulting from the proposed mine expansion were identified and are discussed below.

7.3.2.1 POSSIBLE SPECIES LOSS IN THE DOME AREA

IMPACT STATEMENT

Although it is unlikely, the establishment of a ripios disposal area measuring approximately 1.8km^2 on the Dome area will potentially result in the loss of endemic animal species.

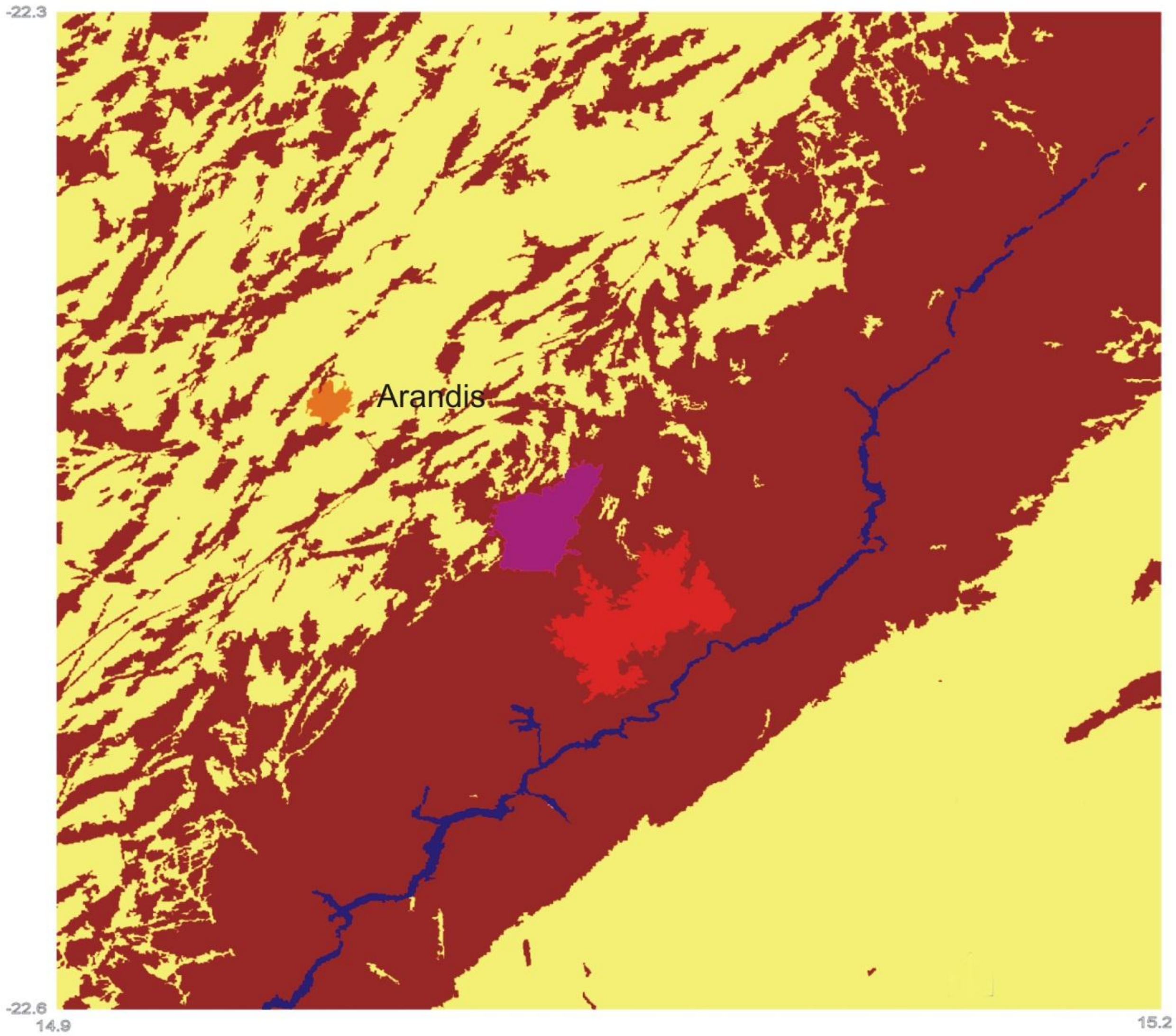
DISCUSSION

The Dome area constitutes rocky hillside habitat, a habitat type well represented within the greater area as the extent of this habitat is estimated as at least 850km^2. Refer to Figure 27 for a distribution of similar habitat around the mine. Covering the Dome area with ripios will decrease the available habitat of certain species identified as having priority conservation status through localised habitat loss. As a direct proportion the lost area will represent approximately 0.2% of this habitat type.

Seven species were identified as threatened and occurring on rocky habitat in the Rössing Dome area only. They are:

- Tingle trapdoor spider ~ *Moggridgea eremicola;*
- Prodidomid spider ~ *Namundra griffinae;*
- Sun spider 1 ~ *Blossia sp;*
- Sun spider 2 ~ *Lawrencega sp;*
- Blister beetle ~ *Iselma deserticola;*
- Ant spider ~ *Heredida griffinae*; and
- Flower beetle ~ *Metaphilehedonus swakopmundensis.*

In future, complementary and simultaneous survey effort should be focused on the sampling areas external to the impact site (20km buffer around the Dome) as well as within it, as it is believed that it is unlikely that these species only occur within the Rössing Dome area, given the extent of similar habitat type around the mine that is largely unstudied. As such the loss of species, although possible, is very unlikely.



LEGEND

- HILLS
- PLAINS
- KHAN RIVER
- OPEN PIT AND ROCK DUMPS
- TAILINGS STORAGE FACILITY
- TOWN

Figure 27: Biotopes around Rössing Uranium

aurecon

Not to scale

MITIGATION

The following general mitigation measures are proposed, most of which will assist to better understand this impact in future:

- The impact on the rocky hillsides habitat should be avoided or minimised i.e. the footprint of the ripios disposal area is to be designed to be the minimum possible.
- Prioritise biodiversity surveys within the rocky hillside habitat, with the objective of collecting the eighteen invertebrate species within the critical priority category.
- Place particular focus on discovery of the four critical priority spiders only found to date within the rocky hillside habitat within the mine.
- Targeted surveys and sampling of areas to be planned and carried out when the best conditions arise, taking advantage of any climatic periods suitable for invertebrate surveys.
- With additional funding available, a list of priority species should be re-analysed and updated on the basis of new work on existing material collected from species which comprise most of the high priority list.
- Institute long term sampling and monitoring programme to be carried out by Rössing Uranium staff and external specialists for the impact site and for areas outside the MLA, within the rocky hillside habitat, open plains and water courses. Prioritise invertebrate sampling, but design monitoring programme to include all species indicated on the Conservation Concern Priority List.
- During expansion operations, use any opportunities for species sampling and collections from these habitats to inform and add to the existing database on high priority species.
- Where possible, translocate and protect individuals of two plant species of concern (*Adenia pechuelii* and *Lithops ruschiorum*).
- Include the two high priority reptile species (*Pedioplanis husabensis* and *Meroles* sp) in future biodiversity surveys within and external to the impact site.
- Circulate biodiversity information with other mining companies, in order to address the impacts of uranium mining on impacted species with larger ranges.
- Use data from future biodiversity surveys to inform the monitoring programme.
- Encourage continued analysis of existing invertebrate material and museum collections from previous biodiversity surveys at Rössing Uranium in order to further update and refine the list of species on conservation concern.

The SEA (SAIEA, 2010) encourages such research to broaden the knowledge base and further recommends that mines such as Rössing Uranium become conservation partners. It also cautions that mining should not be allowed where it is likely that species will become extinct. Rössing Uranium will further investigate potential biodiversity offset opportunities in line with the Rio Tinto Biodiversity Strategy to ensure it is able to meet the overall net positive impact requirement stipulated by Rio Tinto.

The table below provides a summary of the significance ranking.

Possible species loss in the Dome area		
	No mitigation	**Mitigation**
Extent	Local	Local
Magnitude	High(-)	High(-)
Duration	Long Term	Long Term
SIGNIFICANCE	**HIGH(-)**	**HIGH(-)**
Probability	Probable	Probable
Confidence	Unsure	Unsure
Reversibility	Reversible	Reversible

7.3.2.2 REDUCTION IN THE PRODUCTIVITY OF PLANTS AND ABUNDANCE OF SMALL ORGANISMS AND INVERTEBRATES

IMPACT STATEMENT

The increased dust accumulation around the mining operations may reduce the productivity of plants, and reduce the abundance and diversity of soil crust organisms and small invertebrates. The air quality study (refer to Annexure N1), however, predicted no significant increase in dust fallout as a result of the expansion project.

DISCUSSION

Dust emanating from blasting and earth-moving operations will blanket rocks on the soil surface and may seal the cracks and crevices around the base of stones when washed down by fog events. The subsequent impact on soil crust organisms is not known, but may reduce the shelter and refuge places of invertebrates such as spiders and solifugids.

This impact has the potential to lower productivity of the ecosystem by reducing plant growth, reducing the cycling of nutrients through soil crust organisms, and reducing the ability of animals such as spiders and solifugids to survive in the area.

Although the accumulation of dust is certain, its role in influencing invertebrate abundance and diversity is unsure and not well understood. In addition, natural background dust also impacts on the soil crusts and small invertebrates and cannot be mitigated.

MITIGATION

A number of recommendations were proposed to avoid and minimise the impact, or at least result in the better understanding thereof in future:

- Carry out pilot surveys to guide development of long term monitoring programme on impacts of dust and disturbance on biodiversity outside of expansion impact sites, including roads.
- Identify and select indicator species for long term monitoring of the impact of dust (using a 5km buffer from operational areas, pits, crushers, dumps and roads).
- Monitor spider and solifugids to gain understanding of the reasons for the low densities of these species.

Such continued research is in line with the SEA recommendations, specifically the requirement to conduct independent monitoring and research of environmental indicators (SAIEA, 2010). The SEA states that the ecological integrity and diversity of fauna and flora of the Central Namib should not be compromised by the Uranium Rush and recommends that every uranium mine and associated industry adopt the four important principles of mitigation in all activities. These are firstly to try to avoid negative impacts, secondly to mitigate where impacts are unavoidable, and thirdly to rehabilitate where damage is incurred. Most importantly, where possible, these industries should strive for a net positive impact where possible, by for example offset areas. Rio Tinto prescribes an overall net positive impact requirement and this would apply to the Rössing Uranium expansion project.

The table below provides a summary of the significance ranking.

Reduction in the productivity of plants, and reduction in the abundance of soil crust organisms and small invertebrates		
	No mitigation	**Mitigation**
Extent	Local	Local
Magnitude	High(-)	High(-)
Duration	Long Term	Long Term
SIGNIFICANCE	**HIGH(-)**	**HIGH(-)**
Probability	Probable	Probable
Confidence	Unsure	Unsure
Reversibility	Probable	Probable

7.3.3 IMPACT OF BLASTING OPERATIONS ON NEIGHBOURING PROPERTIES

In order to address concerns regarding the effects of current blasting operations at the mine and potential additional blasting operations as a result of the proposed expansion, a ground vibration and air blast (high air pressure shockwave due to blasting operations) study was done.

Concerns such as the physical impact of ground vibration or tremors, air blast, fly rock and fumes were evaluated in the study. The effect of the blasting operations on neighbouring private property, such as those in the town of Arandis, the Arandis Airport and structures on farms were assessed.

Two specific blast monitoring exercises were conducted to allow for comparison in the analysis of results:

- Monitoring of a major pit blast on 21 October 2008 (refer to Figure 28); and
- Continuous blast monitoring for a period of 27 days on a neighbouring farm (Namibplaas, over 12km from the Rössing Uranium pit in a south easterly direction).

Concerns have been raised by the public of Arandis and commercial farmers to the east of Rössing Mine that blasting cause structural damage to houses and infrastructure. In order to substantiate concerns raised by the community and farmers, blast monitors were put out at one commercial farm and a blasting experiment was conducted in October 2008.

Figure 28: Blast operation experiment 21 October 2008 (major pit blast)

7.3.3.1 IMPACT OF GROUND VIBRATION, AIR BLAST AND FLY ROCK

IMPACT STATEMENT

Public concerns are that the ground vibrations and tremors, air blast and fly rock caused by blasting operations during the mine expansion programme will have a physical impact on neighbouring private property in the town of Arandis and Arandis airport.

DISCUSSION

The ground vibration or tremors and air blast levels from blasting operations at the mine are not expected to cause any physical damage to the surrounding buildings, structures, and installations, as measured and expected ground vibration and air blast levels are within the allowed norms as per the Rio Tinto and United States Bureau of Mining Standards. The study predicts that people may be able to faintly feel and hear the blast vibrations.

Although the intensity of blasts at the mine will not change as a result of the expansion project, the frequency of the blasts will increase as the mining rate increases, from one blast per week to two to three balsts per week. Although very low ground vibration levels may be noticed, there is no concern that structures or buildings could be damaged as a result of mine blasts.

Some concerns have also been raised regarding earthquake hazards and whether mine-induced blasting seismicity could damage groundwater aquifers and/or borehole infrastructure in the area of the mine. Although not specifically related to this SEIA, a separate study on this topic has been done for Rössing Uranium by Xamine Consulting Services of Western Australia (Xamine, 2009) and the following main findings came to light:

- Namibia is in the process of producing its own earthquake hazard map and is relying on international monitoring information in the interim. This indicates a 20% probability that an earthquake with an intensity of "rather strong" may be exceeded in 50 years. At these low levels no structural damage should occur and no special construction standards need to be implemented, except to especially sensitive or potentially hazardous structures.
- Public complaints related to blasting operations are related to both ground vibration and airblast. Complaints are more likely from people who were indoors at the time of the blast. Dedicated research into potential blast vibration to damage groundwater aquifers and infrastructure conducted in the United States proved that aquifers and infrastructure such as pipelines and boreholes are rarely damaged from even nearby blast vibration (International Society of Explosives Engineers, 2000a and 2000b).

MITIGATION

It is recommended that the current blast operations be changed in order to optimise the actual blast process and results. It is proposed that the quantity of blast holes detonating simultaneously be reduced, blast holes should be stemmed properly with crushed aggregate and it should be ensured that stemming lengths are no less than the minimum required.

Implementation of a monitoring program to collect data will fill the gaps in information on the effects of blast operations. Detailed monitoring will provide more information regarding the vibration levels generated for the specific size of the blast and people's experience thereof.

The table below provides a summary of the significance ranking.

Impact of ground vibration, air blast and fly rock		
	No mitigation	**Mitigation**
Extent	Local	Local
Magnitude	Low(-)	Low(-)
Duration	Long Term	Long Term
SIGNIFICANCE	**LOW(-)**	**LOW(-)**
Probability	Probable	Probable
Confidence	Sure	Sure
Reversibility	Reversible	Reversible

7.3.4 IMPACT OF FUMES

IMPACT STATEMENT

Public concern that fumes caused by blasting operations during the mine expansion programme will result in nuisance to residents of neighbouring private property in the town of Arandis and at Arandis airport resulted in the assessment of this potential impact.

DISCUSSION

Explosives currently used at Rössing Uranium are required to be oxygen balanced (degree to which it can be oxidised), resulting in a range of gases produced with detonation, including some poisonous fumes such as nitrous oxides and carbon monoxide which are particularly undesirable. Factors such as poor quality control during manufacture, incorrect storage and handling, insufficient charge diameter and surrounding soil conditions may affect the release of fumes.

The fumes emanating from blasting operations at the mine are not expected to cause any nuisance to the residents of surrounding neighbouring properties, given the results of this study.

MITIGATION

Typical mitigation measures to minimise fumes (or the impact thereof) are proper stemming of the blasts and the use of correct stemming material, delaying blasts when the wind blows to Arandis and blasting as soon as possible after charging as longer standing time potentially increases production of fumes.

The table below provides a summary of the significance ranking.

Impact of fumes		
	No mitigation	**Mitigation**
Extent	Local	Local
Magnitude	Medium(-)	Low(-)
Duration	Long Term	Long Term
SIGNIFICANCE	**MEDIUM(-)**	**LOW(-)**
Probability	Probable	Probable
Confidence	Sure	Sure
Reversibility	Reversible	Reversible

7.3.5 NOISE IMPACT

A noise impact study was conducted by DDA Environmental Engineers and is attached hereto as Annexure N7.

IMPACT STATEMENT

The mine expansion programme is expected to contribute towards the already present background noise levels on and around the site associated with the mining operations.

DISCUSSION

A noise assessment was conducted to establish the baseline or background environmental noise and to predict the anticipated noise levels from the proposed mine expansion. In the absence of Namibian national noise standards, the noise levels were measured and assessed in accordance with the relevant South African National Standards (SANS) Code of Practice.

The baseline investigation revealed that the background noise conditions comply with the recommended standard for rural districts for both daytime and night-time. The only exceptions were Arandis and those areas adjacent to the B2 road, which have noise levels typical of suburban districts with little road traffic, slightly exceeding the standards, i.e. 50dBA and 40dBA during daytime and night-time respectively.

The ambient and background noise measurements agree well with the adopted SANS 10103:2008 recommended values as the highest acceptable for rural districts, i.e. 45dBA during daytime (06h00 to 22h00) and 35dBA during night-time (22h00 to 06h00).

Noise modeling was used to predict the noise levels around the mining activities and the various facilities and at several places along the mine's site perimeter. From the environmental perspective the worst-case operational year for the proposed expansion is 2013, given that the maximum material volume will be mined then. Figure 29 indicates the main noise sources on the mine.

Noise modeling was utilised for the sound propagation calculations and the prediction of the sound pressure levels around the mining activities and the various facilities. A modeling receptor grid was utilised for the determination of the expected noise contours as a result of the proposed operations. In addition, the noise levels were estimated at several discrete receptors placed along the site perimeter. The noise modeling was performed via the CADNA (Computer Aided Noise Abatement) noise model.

The main conclusions of the study regarding the total noise levels of the existing operations and the proposed expansion were that it is within limits. Night-time noise levels at the south-eastern boundary of the site and the day-time and night-time levels at the north-eastern boundary exceeded the guidelines, primarily due to the proposed additional conveyor belt to the ripios disposal site. Currently the nearest residents to the north-eastern boundary in that direction are more than 10km away. The overall operational noise impact is described below.

It should be noted that under certain atmospheric conditions, such as temperature inversions with light winds, the mining operations may be marginally audible downwind from the mining area at greater distances, i.e. more than 20km away. Sounds may be audible at around 3dB above the existing noise level. This, however, does not constitute a disturbing noise. The generally acceptable noise level increase, in order to constitute a disturbing noise, is 7dB. The rural area recommended guidelines of 45dBA during daytime and 35dBA for night-time are considered appropriate for the noise impact assessment around the Rössing Uranium site.

The main conclusions of the study regarding the noise impacts of the cumulative noise levels due to the existing operations and proposed expansion were:

- The 45dBA contour, representing the day-time rural guideline, was well contained within the Rössing Mine's MLA and Accessory Works Area northern, western and south-western site boundaries.
- The only exceedance of the 45dBA guideline outside the boundary was a small area adjacent to the north-eastern boundary, where it reached 46.2dBA.
- The night-time noise levels also did not exceed the 35dBA guideline outside the site boundary, except for a small area adjacent to the north-eastern boundary, where it reached 45.3dBA. This is illustrated in Figure 30.
- The 35dBA noise contour reached the south-eastern boundary of the site. The proposed expansion modeling generated noise levels at the north-eastern boundary that exceeded the day-time and night-time guideline.

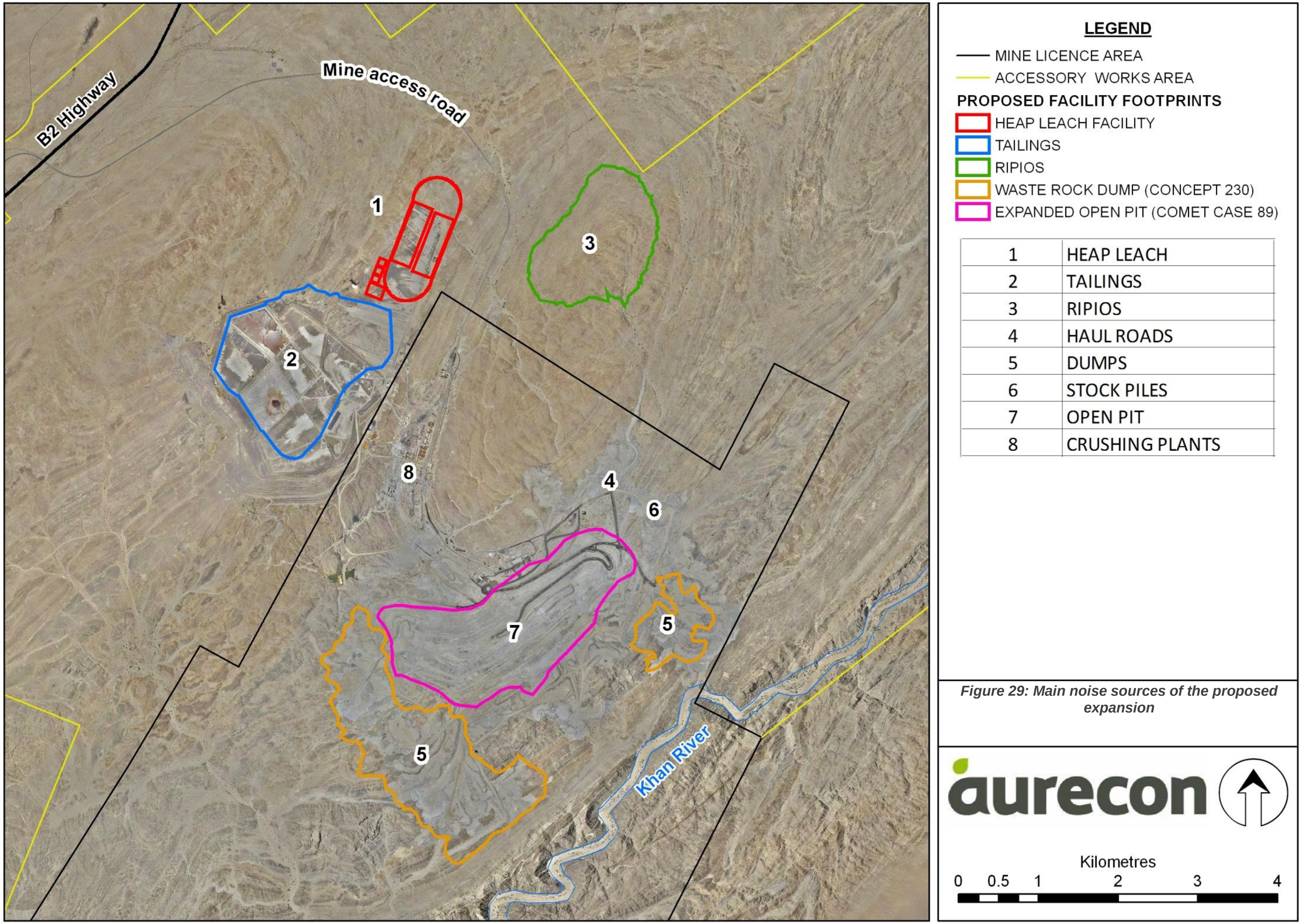


Figure 29: Main noise sources of the proposed expansion

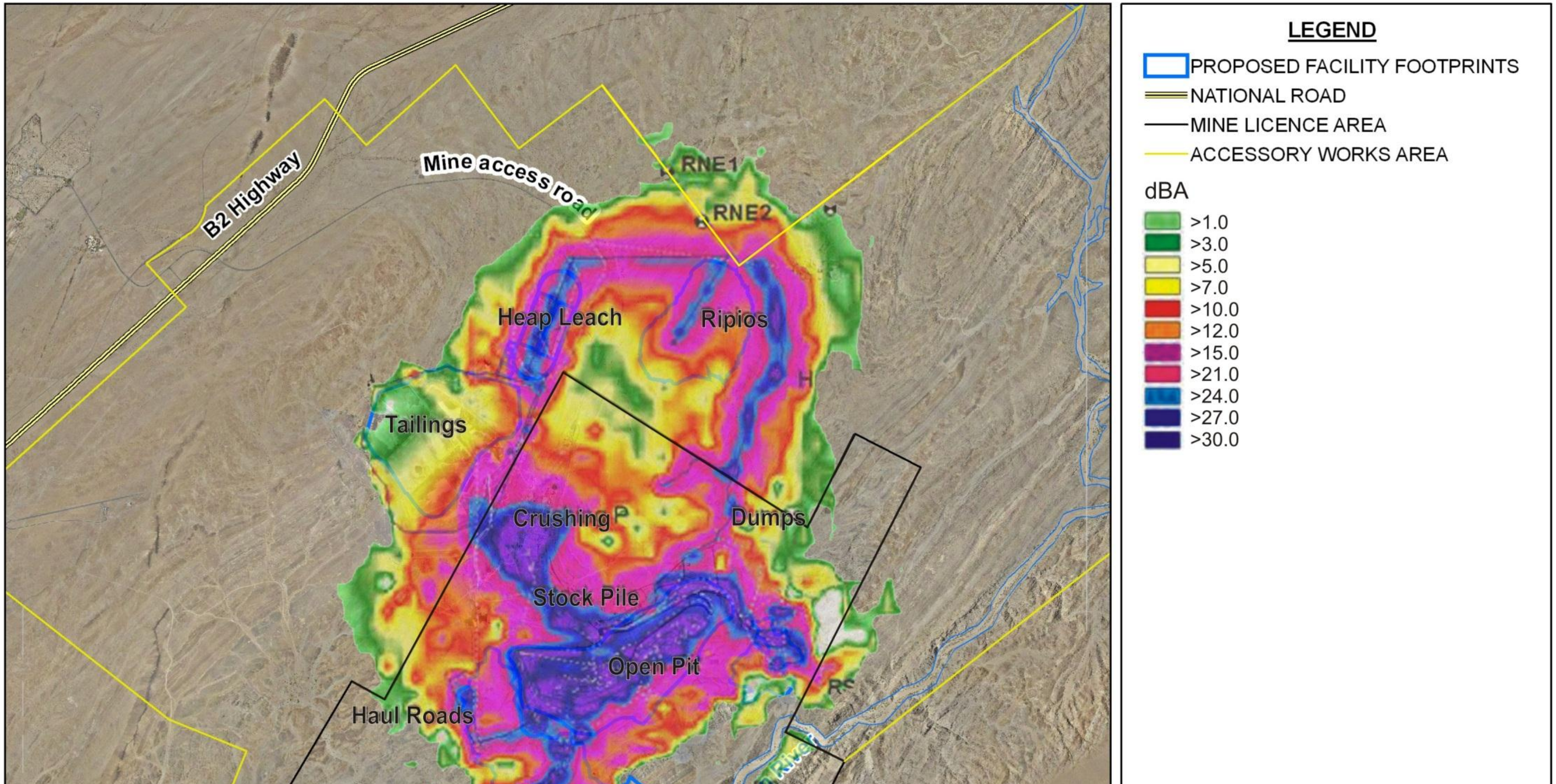


Figure 30: Proposed expansion night-time noise level increase above 35dBA guideline

MITIGATION

Noise control measures as described in the HSE MS summary description (Annexure B) will apply to expansion project components as well.

Specific mitigation measures include the following:

- Buffer zone[27] establishment: A buffer zone of approximately 1.5km from the boundary should be established (outside the mine's north-eastern boundary) in order to ensure compliance with the 35dBA rural guideline. Alternatively, consideration should be given to the restriction of the night-time operations at that location or the construction of an earth berm. The alignment of the conveyor belt to the ripios should be kept as far as possible from the north-eastern boundary. It should be noted that this buffer zone can be established on either the inside or outside of the site boundary.
- Maintenance of equipment and operational procedures: Proper design and maintenance of silencers on diesel-powered equipment, systematic maintenance of all forms of equipment, and training of personnel to adhere to operational procedures that reduce the occurrence and magnitude of individual noisy events.
- Placement of material stockpiles as noise buffers: Where possible, material stockpiles should be placed so as to protect site boundaries from noise of individual operations. If a stockpile is constructed, it should be at a position and of such a height as to effectively act as a barrier to site noise at any sensitive area, if the line of sight calculations show this to be practicable. In particular, the erection of suitable earth berms around the permanent machinery can significantly reduce the noise by up to 15dB.
- Equipment noise audits: Standardised noise measurements should be carried out on individual equipment at the delivery to site to construct a reference data base, and regular checks carried out to ensure that equipment is not deteriorating and to detect increases which could lead to an increase in the noise impact over time and increased complaints.
- Environmental noise monitoring: Environmental noise monitoring should be carried out regularly to detect deviations from predicted noise levels and enable corrective measures to be taken where warranted. A noise monitoring programme, based on the noise modeling and the baseline noise measurements was supplied as a separate document (Dracoulides and Hassall, 2010).

The table below provides a summary of the significance ranking.

Noise impacts		
	No mitigation	**Mitigation**
Extent	Local	Local
Magnitude	Low(-)	Very low(-)
Duration	Long term	Long term
SIGNIFICANCE	**LOW(-)**	**VERY LOW(-)**
Probability	Probable	Probable
Confidence	Sure	Sure
Reversibility	Reversible	Reversible

[27] An area with particular characteristics that reduces the impact of the harmful effects of noise.

7.3.6 IMPACT ON OCCUPATIONAL HEALTH AND SAFETY

IMPACT STATEMENT

The proposed mine expansion is expected to result in a potential increase in occupational health risk to mine workers.

DISCUSSION

A risk assessment has been carried out by Rössing Uranium to establish whether new equipment, processing plant and chemicals, as well as operational and maintenance tasks related to the proposed heap leach facility, would pose unknown risks to workers.

A total of fifty-two elements of the heap leaching operation in the areas of crushing, agglomeration, heap stacking system, leach pads, waste storage area, reagent make up, preparation, storage and dosing system and continuous ion exchange plant were evaluated in the process.

Total cumulative radiation exposure to heap leach workers due to a combination of exposure by radon, external radiation and dust was projected to range between 1mSv and 4mSv per year and is well within the occupational standard of 20mSv per year.

In general the significance of an identified health risk cannot be reduced (see high significance rating in Figure 31). However, the likelihood of occurrence can be reduced from "possible" to "unlikely" (on average) by the introduction of controls, demonstrating the effectivity of such controls.

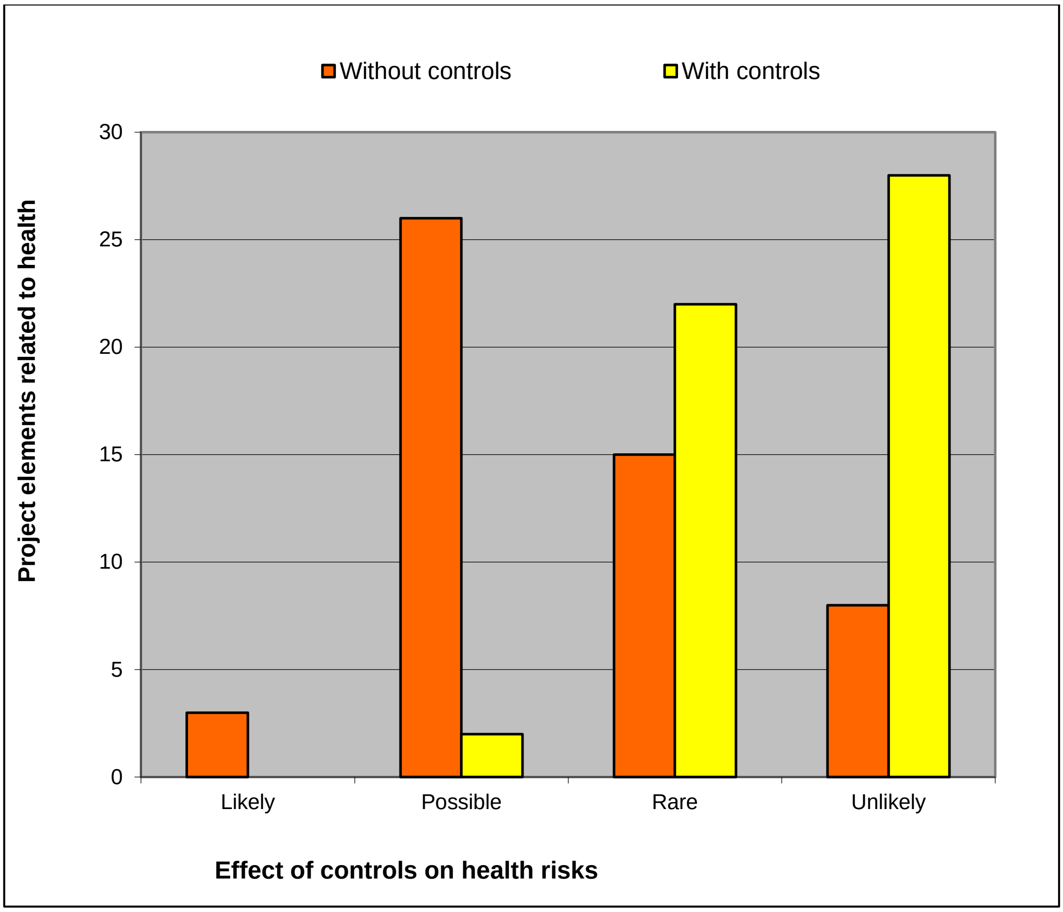


Figure 31: Likelihood of occurrence of health and safety incidents

Mitigation

All mining operations at Rössing Uranium are conducted within the ambit of a very strict HSE management system to manage occupational risks as best as possible and reduce the probability of health and safety impacts. Refer to Annexure B for a summary of the current system.

Risks identified due to the introduction of new equipment need to be addressed by means of engineering controls and these need to be incorporated into the design of the new equipment. Identified risks related to maintenance and operational tasks need to be addressed by strictly following working procedures already in place at Rössing Uranium.

To eliminate any remaining possibility of health impacts, monitoring systems and procedures need to be implemented. The design of engineering controls needs to be requested from the providers of the new equipment (for example dust extraction systems in areas of potential dust generation).

Existing standard operating procedures and safety measures need to be implemented at the heap leach plant and any other new infrastructure. Although the significance remains high negative, the probability drops from "possible" to "unlikely", indicating the effectiveness of the existing control measures.

The table below provides a summary of the significance ranking.

Occupational health and safety impacts		
	No mitigation	**Mitigation**
Extent	Local	Local
Magnitude	High(-)	High(-)
Duration	Long Term	Long Term
SIGNIFICANCE	**HIGH(-)**	**HIGH(-)**
Probability	Possible	Unlikely
Confidence	Sure	Sure
Reversibility	Reversible	Reversible

7.3.7 IMPACT OF PUBLIC RADIATION DOSE

The South African Nuclear Energy Corporation conducted a specialist assessment to establish the impact of potential increased exposure to radiation from mining operations on public health. A copy of the report is attached as Annexure N8.

Impact Statement

The expanded mining and processing operations and related activities may result in increased exposure to radiation emitted.

Discussion

Rössing Uranium's mining activities involve the mining of Naturally Occurring Radioactive Material (NORM). A radiological dose impact assessment was therefore conducted to assess the impact of dust and radon released from the mining activities and from the mine facilities. It also relates the radiological impact of the expanded operations with the impact of the current operations at the mine and the current background radiation levels.

Sources of Radioactivity

The sources of radioactivity assessed include radon and dust sources. Radon sources are caused by exhalation of radon gas from material containing enhanced levels of Ra-226 of which the future tailings dam is expected to be the most significant source.

Dust sources on the mine include the following:

- Fugitive dust emissions from wind erosion from:
  - Tailings,
  - Precipitates (solids deposited out of solution),
  - Open pit,
  - Stockpiles,
  - Waste rock,
  - Coarse ore stockpile,
  - Coarse ore stockpile plume,
  - Fine ore stockpile plume,
  - Conveyor plume,
  - Manganese mill area road,
  - Fine ore crusher, and
  - Ripios;

- Fugitive dust emissions from:
  - Drilling,
  - Blasting,
  - Crushing and screening, and
  - materials handling operations such as loading and tipping;

- Fugitive dust emissions from vehicles:
  - Unpaved roads,
  - Paved roads,
  - Fugitive dust emissions from dozers and graders,
  - Fugitive dust emissions from fine crushing and screening plant, and
  - Emissions from stacks.

The assessment was limited to the study of atmospheric emissions pathways and the sources considered included the following:

- Current SJ open pit (existing and extension): It is expected that the pit walls will emanate radon. Ore handling activities such as loading and hauling and rock dumping will create dust.
- Waste rock disposal facilities (existing and extended): Radon and fugitive radioactive dust may be released from the waste rock disposal facilities.
- New heap leach facility and ripios site.
- The crushing of ore for heap leaching rock will generate radioactive dust. Ore handling activities such as conveying, stacking, and reclaiming could create dust if dry. The heap is also expected to release radon.
- Tailings disposal facilities (existing and extended).
- The extensions to the current tailings disposal facilities are expected to result in an increase in radon emanation and fugitive dust.
- A general increase in production.
- An increase in production will result in a proportional increase in fugitive radioactive dust generation at the plant due to ore handling, crushing, and roasting of the final product.

DOSE LIMITS AND STANDARDS

In the absence of nuclear regulations in Namibia[28], international standards were followed to determine dose and potential dose limits, dose constraints as well as radon action levels and other appropriate criteria. The basic safety indicator for public impact assessments is an individual dose limit, while for planning purposes a dose constraint is used.

The individual dose limit places an upper limit to the dose from all controllable sources to which an individual may be exposed. These include the pathways from all the radioactive material or radiation to which an individual may be exposed. The recommended public dose limit is 1mSv/a and was used as a criterion for this assessment. The SEA (SAIEA, 2010) recommended that increases in radionuclides in air and water originating from uranium mines should not cause the 1mSv/a accepted public dose to be exceeded. It should be noted that the natural background exhalation of radon in the Erongo dominates at distances relatively close to specific sources, i.e. the background radon at Arandis for instance dominates radon emanated from Rössing Uranium considerably.

For radon, an annual dose of around 3mSv/a to 6mSv/a represents an action level requiring some action to be taken when the level is exceeded. For this assessment the public impact of radon has been evaluated against the public dose limit. Total dose due to dust and radon combined is also assessed.

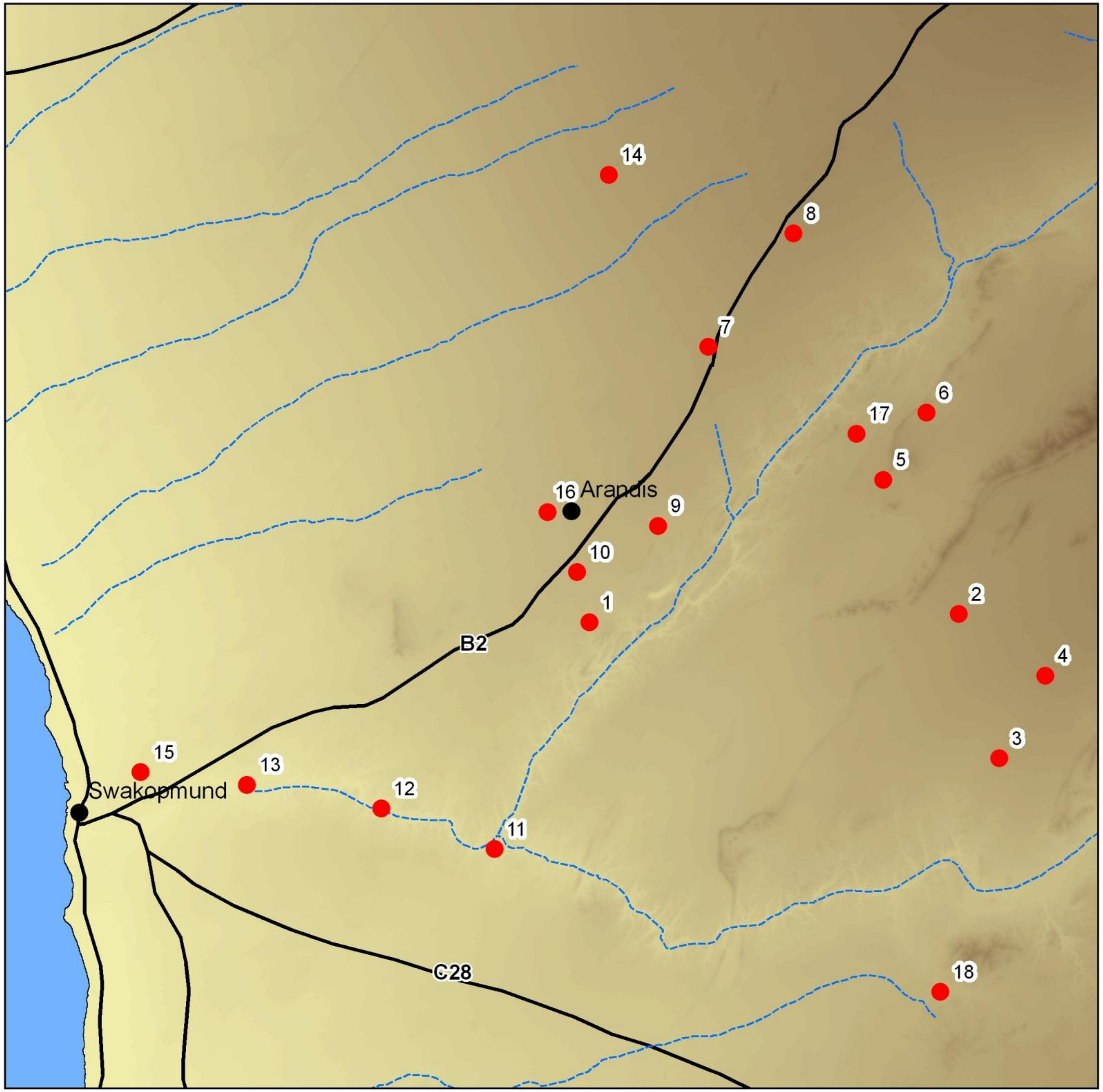
CRITICAL GROUPS AND EXPOSURE SCENARIOS

The radiological impact assessment consists of the identification of public groups potentially exposed (receptor groups), and the determination of the expected radiation doses to these groups. This is done by conversion of dust and radon concentrations modelled through dispersion modeling. Receptor groups potentially affected by the inhalation of dust and radon from the sources mentioned were assessed according to the atmospheric pathway and include the following:

- Residents of Arandis;
- Arandis airport;
- Residents living and working at the old Khan mine site;
- Workers at “E Camp” at the Rössing Uranium Mine;
- Residents of the Swakop River smallholdings and farms;
- Residents of Swakopmund; and
- Workers at neighbouring mines.

The specific locations assessed to cover all these groups are illustrated in Figure 32.

[28]Draft regulations for the protection against ionizing radiation and for the safety of radiation sources and regulations for the safe and secure management of radioactive waste have been drafted to assist with the implementation of the Atomic Energy and Radiation Protection Act (Act No 5 of 2005) and are expected to be gazetted in the near future. These are in line with international best practice and guidelines, such as the International Commission on Radiation Protection (ICRP) and International Atomic Energy Agency (IAEA) guidelines.



LEGEND

- TOWNS
- ROADS
- RIVER / DRAINAGE LINES
- LOCATIONS ASSESSED

1	KHAN MINE
2	FARM BLOEMHOF
3	FARM MODDERFONTEIN
4	FARM GELUK
5	FARM VALENCIA
6	PORTION 1 OF FARM NAMIBPLAAS
7	FARM TREKKOPJE
8	FARM VERGENOEG
9	E-CAMP
10	ARANDIS AIRPORT
11 - 13	SWAKOP RIVER FARMS
14	URAMIN MINE
15	SWAKOPMUND
16	ARANDIS
17	VALENCIA MINE
18	LANGER HEINRICH MINE

Figure 32: Locations assessed in public dose study

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Kilometres

0 4.5 9 18 27 36

RADIOLOGICAL CRITERIA

The major radiological criterion is the international dose limit for members of the public, which should not be exceeded. The SEIA Significance Risk is hence ranked as "High" for doses above the dose limit and requires immediate attention. To ensure a safe margin, a more restricted dose constraint is also introduced at Rössing Uranium at a value of 30% of the dose limit mentioned above. The SEIA Significance Risk is ranked as "Medium" when doses exceed this constraint for consideration over longer-term planning. For doses below the constraint the SEIA Significance risk is ranked "Low". A dose below 1% of the dose limit is internationally regarded as trivial and of no concern. In this case the SEIA Significance risk is ranked as "Very Low". Figure 33 illustrates dose limits and constraints.

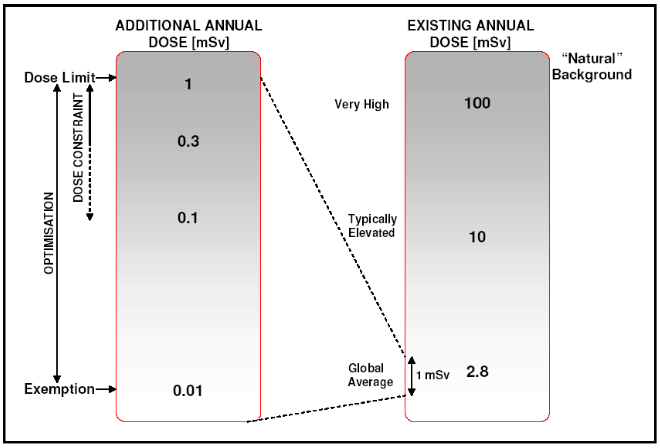

Figure 33: Schematic representation of dose limits and constraints[29]

Some uncertainties regarding the radioactivity content of the new materials to be used in future with the expansion project exist. Conservative calculations performed to account for such uncertainties indicate the highest dose from inhalation of dust at the site boundary will be below 30% of the internationally accepted dose limit, while that for a resident at Arandis it will be below 3% of the international dose limit.

International criteria guidance on radon exposure is presently under review. Present guidance indicates that radon exposure should be evaluated against separate criteria. Assessed radon doses for Rössing Uranium mine are, however, also below the constraint presented above.

The SEIA Significance Risks for dust and radon are hence regarded as "Low" not requiring immediate attention. The same finding applies to the planned future expansion as the assessment does not present any significant increase in the radiological risks due to dust and radon inhalation as a result of the proposed expansion project.

MITIGATION

Mitigation options may still reduce these doses further but are not required. Existing management practices in place at Rössing Uranium should be adhered to. These are described in the HSE MS summary description contained herein as Annexure B.

General mitigation measures recommended in the SEA (SAIEA, 2010) include that the transport of radioactive material should be in accordance with the procedures reflected in Namibia's regulations that the

[29] Source: International Council for Radiation Protection.

closure of uranium mines should be done according Namibia's regulations and that research and quantification of the cumulative public dose should continue. Rössing Uranium supports these measures and has such in place and can make the result of the public dose specialist study available to contribute to increased knowledge in the subject.

The table below provides a summary of the significance ranking.

Impact of dust and radon inhalation		
	No mitigation	**Mitigation**
Extent	Regional	Regional
Magnitude	Very Low(-)	Very Low(-)
Duration	Long Term	Long Term
SIGNIFICANCE	**LOW(-)**	**LOW(-)**
Probability	Unlikely	Unlikely
Confidence	Certain	Certain
Reversibility	Irreversible	Irreversible

7.3.8 THE IMPACT OF THE DISPOSAL OF GENERAL SOLID WASTE

7.3.8.1 GENERAL

A guideline was developed to manage the general operation and maintenance procedures of the Rössing Uranium general solid waste landfill within the mine precinct and to ensure that sufficient capacity exists for the extended LOM. The operation and procedural manual describes the current site conditions, site facilities, and site preparatory works, keeping of records, landfill monitoring, and health and safety matters.

The disposal of general household wastes such as wood, plastic, paper, metal, textile, sand/stone, and dust at the landfill facility may pose a number of socio-economic and biophysical impacts on the area. A comprehensive discussion, evaluation, and recommendation of appropriate mitigations measures are contained in the specialist report prepared by Pasco Waste & Environmental Consulting attached hereto as Annexure N4. Due to the relative insignificance of most of these potential impacts, this assessment has focused on the most pertinent impacts only, although more are contained in the specialist study report.

PROPOSED MANAGEMENT AND MONITORING PLAN

The specialist report lists a number of generic recommendations regarding the management actions to be undertaken during the operational phase of the landfill. The aim is to mitigate potential negative impacts arising from the construction and operational phases and, where possible, optimise the benefits. A management and monitoring plan will formalise the recommendations into specific actions and suggested targets and guidelines for their implementation.

The following general good management practices relating to the construction and operation of the landfill were proposed and will be implemented by Rössing Uranium:

- A security fence with a lockable gate should be erected around the operating area of the site, and general mine security staff to be aware of the need to secure the site.
- Waste material should be separated at source, thereby facilitating the effective management of lightweight materials at the landfill site.
- Implement management actions to mitigate the visual impact of windblown materials carried from the proposed waste disposal site, including daily cover of the waste, the use of moveable litter screens and regular clean ups in and around the site.

- Implement management actions to mitigate odours generated by waste materials, such as daily cover. Implement management actions to reduce occupational health and safety risks at the waste disposal site, including the protection and use of the required personal protective equipment and improvements to the current emergency response plan. Refer to the HSE MS summary description in Appendix B for more information on current measures in place.
- Manage and control vectors of disease through compaction and application of daily cover.

The SEA presented measures to ensure that there is sufficient capacity at existing licenced landfills, that waste collection and disposal is done safely and responsibly, that waste re-use and recycling is optimised, and that recycling agencies have sufficient capacity to handle an increased waste stream (SAIEA, 2010). Most of these measures were aimed at the local authorities, but Rössing Uranium supports such measures and have similar in place. Arandis was proposed as a suitable location for a recycling centre.

A selection of the impacts identified in the specialist study, with specific mitigation measures recommended, are summarised below.

7.3.8.2 POLLUTION OF GROUND AND SURFACE WATER

IMPACT STATEMENT

Uncontrolled leachate from the landfill may pollute ground and surface water resources.

DISCUSSION

As the landfill and waste to be received is anticipated to be very dry with no or limited moisture and due to the dry climatic water balance (difference between precipitation and evaporation) in the region, no significant leachate is expected at the landfill facilities.

A certain amount of rainwater is normally absorbed into the waste mass and excess liquid percolates through the waste forming leachate. This liquid is brown or black in colour and is a source of pollution with a high chemical and biochemical oxygen demand.

No significant groundwater is present on site and all engineering works are above the groundwater table.

MITIGATION

Mitigation measures include:

- Before discharging to a watercourse, all leachate generated should be treated to an acceptable standard.
- The existing cut-off drain around the site will be maintained and expanded with the site to protect the site against uncontrolled storm water ingress.
- Surface water monitoring points should be established in the valley north and north-east of the landfill and regular monitoring done. These points should be marked and numbered and displayed on a site drawing for future reference.

The table below provides a summary of the significance ranking.

Pollution of ground and surface water		
	No mitigation	**Mitigation**
Extent	Local	Local
Magnitude	Very Low	Very Low
Duration	Long Term	Long Term
SIGNIFICANCE	**VERY LOW(-)**	**VERY LOW(-)**
Probability	Definite	Definite
Confidence	Certain	Certain
Reversibility	Reversible	Reversible

7.3.8.3 SILTATION OF STREAMS DUE TO EXPOSED SURFACES

IMPACT STATEMENT

Erosion of soil from exposed areas may result in siltation of streams.

DISCUSSION

Although the region is generally regarded as a low rainfall area, exposed and uncovered soil areas may be prone to erosion in the unlikely case of heavy rains and flooding.

MITIGATION

All proposed future drainage structures such as manholes, inlet/outlet structures and channels should be inspected to ensure their functionality at all times. If required in future, appropriate erosion controls should also be implemented.

All existing vegetation should be retained as far as possible to assist with soil stabilisation.

The existing cut-off drain around the site will be maintained and expanded with the site to reduce the risk of slope erosion. Although unlikely to become a significant issue on this site in particular, these measures are in line with the international best practice for this category of site.

The table below provides a summary of the significance ranking.

Siltation of streams due to exposed surfaces		
	No mitigation	**Mitigation**
Extent	Local	Local
Magnitude	Very Low	Very Low
Duration	Long Term	Long Term
SIGNIFICANCE	**VERY LOW(-)**	**VERY LOW(-)**
Probability	Probable	Probable
Confidence	Certain	Certain
Reversibility	Reversible	Reversible

7.3.9 IMPACT OF OPERATION OF A HAZARDOUS SOLID WASTE LANDFILL SITE

7.3.10 GENERAL

In future, Rössing Uranium might want to consider the establishment of a hazardous waste landfill site within the MLA as part of the expansion project, to improve waste handling and disposal and as such it was included in this SEIA.

A comprehensive discussion, evaluation and recommendation of appropriate mitigations measures are contained in the specialist report prepared by Pasco Waste & Environmental Consulting attached hereto as Annexure N6.

The South African guidelines for hazardous waste disposal were followed to determine the operational and monitoring requirements for this category landfill.

A landfill is classified according to the potential environmental and health risks by consideration of factors like waste type (waste stream), size of the landfill operation and potential for significant leachate generation based on the climatic water balance.

The landfill will be classified as category H:H, capable of accepting the most hazardous category wastes. An analysis of the expected waste stream found that some of the wastes destined for disposal at the landfill fall into Hazard Groups 1 and 2 (Extreme and High Hazard), requiring an H:H landfill, while other wastes would fall into Hazard Groups 3 and 4 (Moderate and Low Hazard), requiring an H:h landfill. Due to the small difference in design standards between an H:H and H:h landfill, it is recommended that the landfill should be developed according to H:H standards. This will also be in line with the "precautionary principle".

This study was restricted to hazardous waste which, because of certain properties, poses a threat to human health or the environment, such as:

- Risk of explosion or fire;
- Acute or chronic toxicity, damage to ecosystems or natural resources, accumulation in biological food chains and persistence in the environment;
- Chemical instability, reactions or corrosion; and
- Causing cancer, mutations, or birth defects.

Types of wastes generated at Rössing Uranium which fall in this category include pipe sections, rubber liners, scrap metals, pumps, empty drums, shot blasting grit, batteries, fluorescent tubes, used oil, grease, reagent bags and solid laboratory waste. Although recycling is in place for some of these, distance to recycling centres impacts on feasibility of recycling. The current hazardous waste generation rate was extrapolated and increased allowing for the expansion project, and allowing for compaction and daily cover volume resulted in an estimated required airspace volume of 15,000m^3 for the next 20 years.

Rössing Uranium's procedures forbid the disposal of such waste on its existing domestic waste disposal site and the current practice is to dispose of such at the TSF (in prepared trenches and then covered) or at the licenced facility at Walvis Bay. Radioactive waste does not fall into this category and may not be disposed of on a hazardous waste landfill and will have to be disposed of in the mine tailings storage facility as per the current practice for such wastes.

Potential landfill sites were identified (refer to Figure 34) within the already disturbed mining area and preliminary findings indicate suitable sites exist. The study also describes a conceptual design for the hazardous waste facility. This design will meet the disposal need and incorporate the necessary precautionary measures to mitigate possible social and environmental impacts.

Although it is considered highly unlikely that leachate would be generated at the waste disposal facility, leachate management systems and regular monitoring will be mandatory because of the H:H landfill classification.

The operation of the hazardous waste landfill site may pose a threat to human health and safety of workers or the biophysical environment because of the chemical and physical properties of the waste. Odours from the landfill may also create a nuisance. The following generic mitigation measures should be initiated during the operational stage to minimise negative impacts:

- Access control to the waste disposal site, in the form of a security fence, locked gate and 24-hour security (only if not within an already secured area), will be required to prevent unauthorised access.
- Waste material should be separated at source to facilitate the effective management of smaller volumes of materials at site.
- A monitoring programme should be introduced to regularly monitor the implementation of the management actions.

The most significant impacts identified in the specialist study and specific mitigation measures are discussed below.

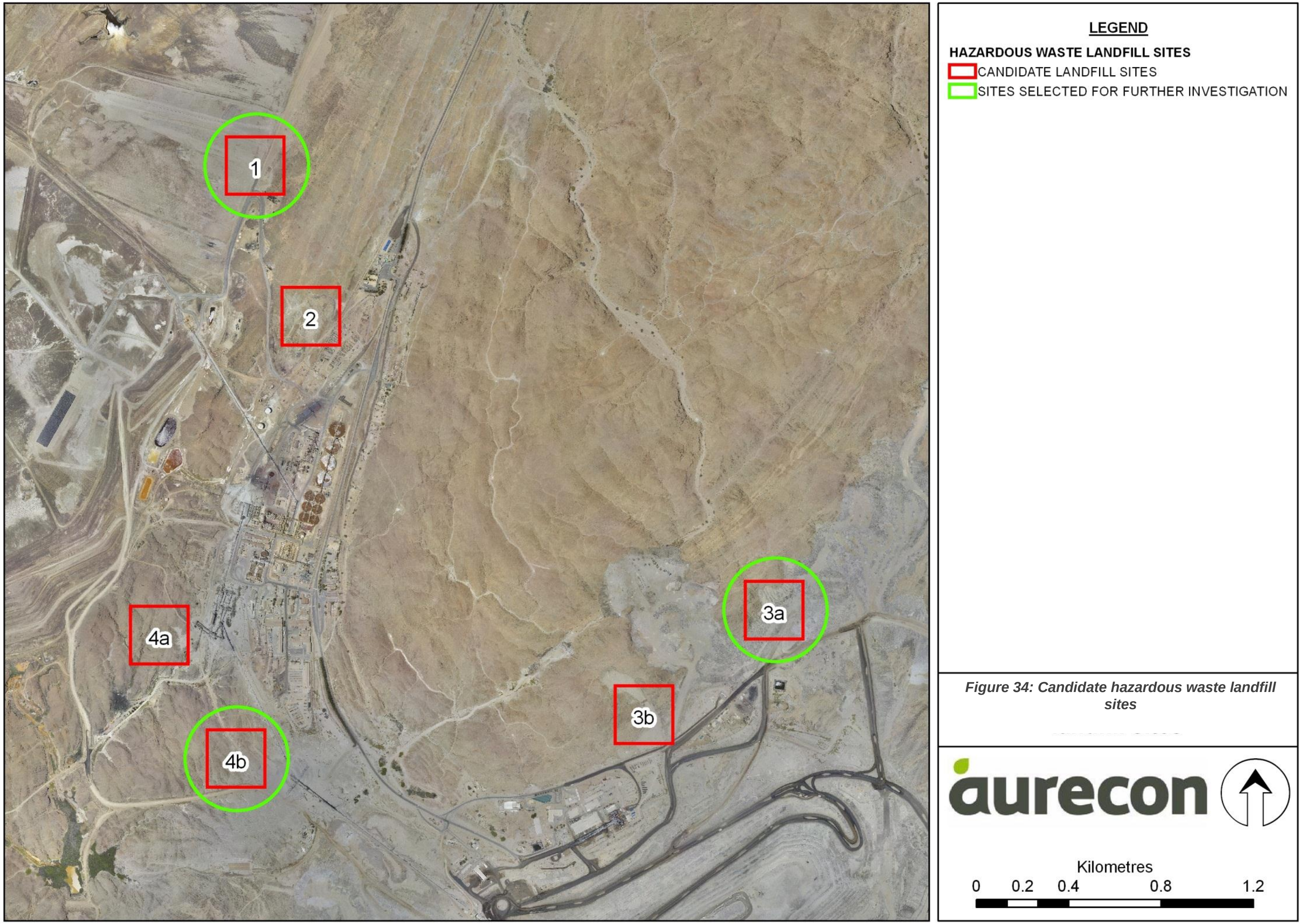

Figure 34: Candidate hazardous waste landfill sites

7.3.10.1 POLLUTION OF GROUNDWATER

IMPACT STATEMENT

Due to climatic and geohydrological conditions, the percolation of water through the waste resulting in the formation of leachate is very unlikely, but remains a possibility.

DISCUSSION

The potential for significant leachate generation depends on the water balance associated with a waste disposal site. This is dictated by ambient climatic conditions or by other site specific factors such as the moisture content of the incoming waste and/or ingress of either ground water or surface water run-off from high ground into the waste body.

The annual rainfall of the region is significantly less than the evaporation rate (27mm and 4,400mm respectively), therefore evaporation greatly exceeds precipitation. With the exception of certain potentially hazardous liquid wastes, no significant volumes of high moisture content wastes would be disposed of at the facility. As a result, no generation of leachate as a result of rain water percolating through the waste body and no significant leachate generation as a result of liquid waste disposal is expected.

Due to the proposed site classification as an H:H facility, leachate management will, however, be mandatory. This leachate management system will include a double geocomposite liner, leachate drainage and leakage detection systems and a leachate storage facility.

MITIGATION

With appropriate drainage design there should be no leachate generation resulting from surface run-off, and as the site would be located much higher than the groundwater level in the area, there should be no groundwater infiltration.

The table below provides a summary of the significance ranking.

Pollution of groundwater resources		
	No mitigation	**Mitigation**
Extent	Regional	Local
Magnitude	Very Low	Very Low
Duration	Long Term	Long Term
SIGNIFICANCE	**LOW(-)**	**VERY LOW(-)**
Probability	Unlikely	Unlikely
Confidence	Certain	Certain
Reversibility	Reversible	Reversible

7.3.10.2 ODOURS FROM THE LANDFILL

IMPACT STATEMENT

Odours generated by the landfill site may create a nuisance locally.

DISCUSSION

It is expected that wind-blown emissions or odours would emanate from the site.

MITIGATION

Implement management actions to mitigate odours generated by waste materials such as daily cover and not disposing of waste under wet conditions.

Covering waste with hydrated lime may also assist in reducing odour nuisance, should it be required.

The table below provides a summary of the significance ranking.

Odours from landfill		
	No mitigation	**Mitigation**
Extent	Local	Local
Magnitude	High	Low
Duration	Long Term	Long Term
SIGNIFICANCE	**HIGH(-)**	**LOW(-)**
Probability	Definite	Probable
Confidence	Certain	Certain
Reversibility	Reversible	Reversible

7.3.10.3 DANGER TO THE HEALTH AND SAFETY OF WORKERS

Impact Statement

The operation of the proposed hazardous waste landfill site may pose health and safety risks to workers.

Discussion

All operations shall be carried out in strict conformance to the Occupational Health and Safety Act. In terms of this Act, the employer is responsible for the health and safety of the people under his or her jurisdiction. Whenever workers or waste reclaimers are exposed to waste on a regular basis, a health risk may exist. The risk is greater at a hazardous waste landfill than at a general waste landfill. The employer or designated person responsible for the occupational health and safety of workers should therefore use his or her discretion in applying the Act and monitoring the health of workers. In case of hazardous waste landfill sites, this will involve medical examinations.

Mitigation

Rössing Uranium has a long history of a safety culture and the HSE MS summary description (refer to Annexure B) contains details on the systems and procedures in place. The same strict measures will apply at the proposed hazardous waste site in future. Specific mitigation measures prescribed in the specialist study are provided below.

Workers should be properly trained and access control to the site should be enforced. A safety officer should be appointed to ensure that safe procedures are being adopted. A safety plan should also be compiled and displayed for all staff to comply with. The safety plan should cover topics such as:

- no smoking on the site;
- awareness of vehicle movements particularly on or near the working face;
- protective clothing requirements;
- keeping the site clean and neat;
- dust suppression;
- ensuring that vehicles at the working area have a firm riding surface;
- ensuring the stability of permanent and temporary embankments, if applicable;
- first aid and accident procedures;
- any other applicable working regulations; and
- dangers of landfill gas and leachate.

Workers should be provided with protective clothing, such as overalls, heavy duty safety boots, gloves, goggles and dust masks.

Various training schemes are available to site operating and supervisory staff. Operator training may take place on site, while supervisory training may take place at training institutes. Along with suitable training of personnel, it is also imperative to introduce emergency procedures. A decision flow chart defining broad emergency strategies should be readily available to all personnel. This flow chart should incorporate a set of trigger and completion parameters, i.e. a set of parameters that will trigger and end an emergency procedure respectively. Possible example emergency scenarios should be displayed along with the flow chart and a list of actions and information common to all emergencies should be provided. The list should contain information such as:

- names of contact persons in case of an emergency;
- emergency contacts (fire, police and ambulance); and
- flow of information (who should be notified and when).

The table below provides a summary of the significance ranking.

Health & safety of workers		
	No mitigation	**Mitigation**
Extent	Local	Local
Magnitude	High	Low
Duration	Long Term	Long Term
SIGNIFICANCE	**HIGH(-)**	**LOW(-)**
Probability	Probable	Probable
Confidence	Certain	Certain
Reversibility	Irreversible	Irreversible

7.3.11 IMPACTS ON TRAFFIC

In response to both internal and external concerns related to road safety and increased risks related to the mine expansion, a detailed traffic impact assessment and a road safety audit were done on the local roads and transport networks in the mine's operational area. Factors such as the expected future growth in background road traffic and the transportation of staff and materials associated with the proposed mine expansion were considered. The traffic impact assessment was conducted by Burmeister and Partners and is attached as Annexure N10. It has to be noted that some of the mitigations indicated herein would fall outside the jurisdiction of Rössing Uranium, but that Rössing Uranium would encourage such measures by the relevant authorities, through the Chamber of Mines or the SEMP implementation agency where applicable.

7.3.11.1 IMPACT ON THE ROAD NETWORK

IMPACT STATEMENT

It is expected that traffic volumes on the B2 road between Walvis Bay and Swakopmund and Swakopmund and Rössing Mine will increase by approximately 30% following the proposed expansion at the mine. This may have an impact on road traffic management and road safety.

DISCUSSION

The B2 road between Walvis Bay and Swakopmund (coastal road) and Swakopmund and Rössing Mine is well known for its high traffic volumes, especially heavy vehicles, and road users have raised concerns regarding their safety.

It is predicted that the expansion of the mine will increase traffic volumes by approximately 30% and background growth (estimated at approximately 40%) will further increase traffic on the road. This prediction is based on actual historic counts, which were extrapolated to define the background traffic and analysed using a traffic engineering simulation program.

The expected increase in the number of employees provided the basis for the calculations to determine an increase in Rössing mine commuter traffic volumes, with proposed production rates used as a basis to determine likely heavy vehicle traffic increases for supplies.

A road safety audit was further conducted and found that the expansion of the mine's operations will not contribute to an increase in the safety risk associated with travelling on the routes should the commuting staff make use of a safe and sufficient bus transport system, as per the existing arrangement.

The audit also identified a number of major road safety deficiencies related to road markings and traffic signs (faded or incorrectly used) and safety features (such as clearing the line of sight and incorrect provision of guard rails).

It was concluded that the national road network still has sufficient design carrying capacity and that increased traffic due to increased operations at the mine would not impact the general road network severely, resulting in the significance ratings below. Certain intersections may however be negatively impacted as a result of the increase in traffic volumes and these were identified with suggestions for improvement. The SEA (SAIEA, 2010) on the other hand concluded that the Erongo road network is already struggling with traffic volumes and that some major upgrades will be required by 2013 to accommodate the anticipated volumes of traffic during the construction of some uranium rush mines and associated industrial developments.

MITIGATION

Key recommendations to mitigate the predicted impacts are:

- The Rössing Uranium/Arandis intersection with the B2 can be improved to better accommodate an increase in traffic by changing the layout (e.g. by construction of a new road from the south to improve the intersection with the B2 by prohibiting all right-turning movements and limiting users to left-turn movements only, as illustrated in Figure 35).
- Other intersections and accesses on to the B2 need to be upgraded to optimal functionality, especially the B2 T-junction with the C34 (dune road).
- By upgrading the C34 to a bitumen standard, heavy vehicle traffic may be channelled away from the town of Swakopmund. The SEA also prioritised this proposal as critical (SAIEA, 2010).
- The findings and recommendations of the road safety audit should be presented to the relevant authorities and their commitment to an implementation plan obtained.

In addition to these measures, the SEA recommended that the B2 between Swakopmund and Arandis be upgraded to a 4-lane highway as soon as possible (SAIEA, 2010). The table below provides a summary of the significance ranking.

Impact on the road network		
	No mitigation	**Mitigation**
Extent	Regional	Regional
Magnitude	Medium	Low
Duration	Long Term	Long Term
SIGNIFICANCE	**HIGH(-)**	**MEDIUM(-)**
Probability	Probable	Probable
Confidence	Certain	Certain
Reversibility	Irreversible	Irreversible

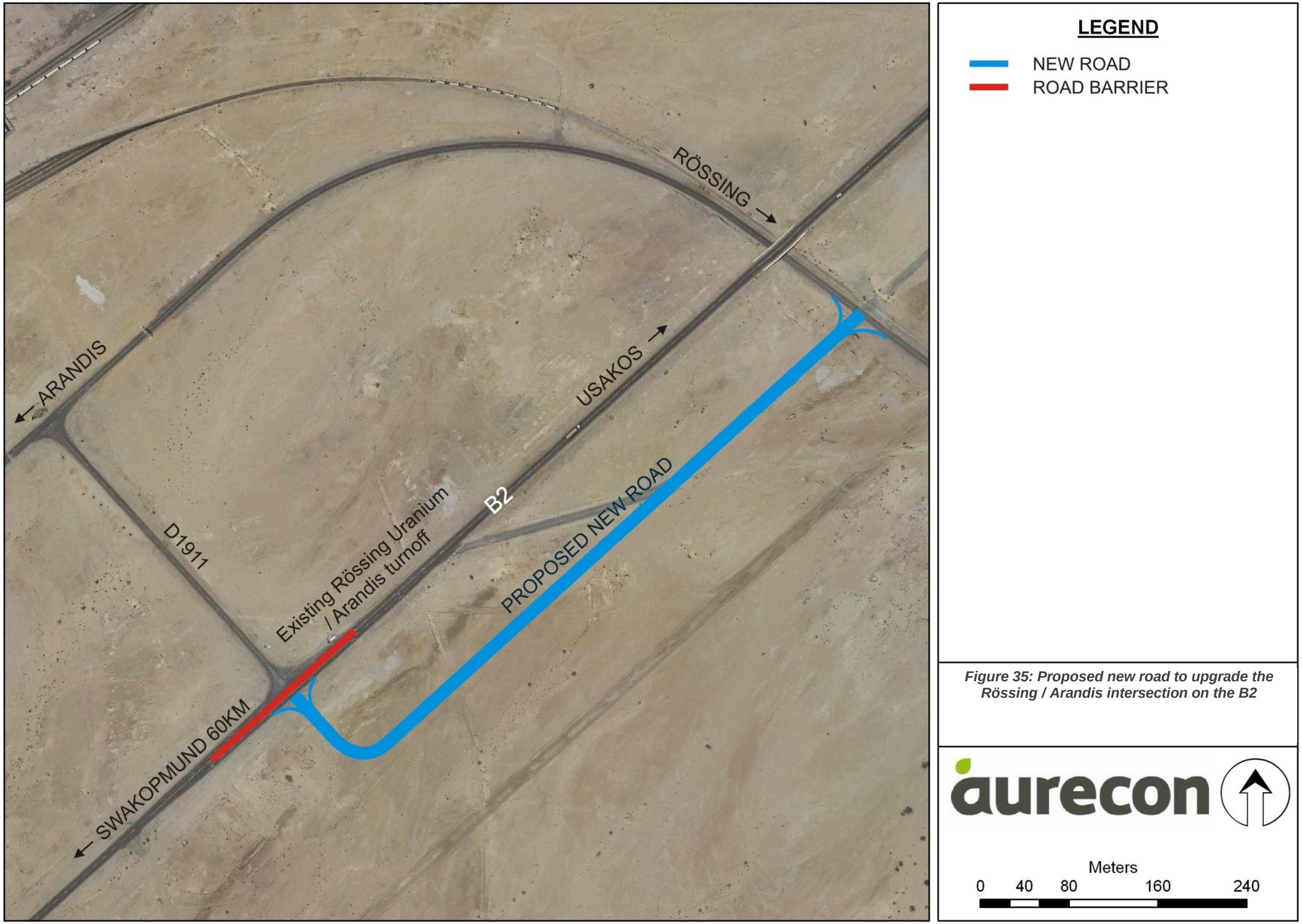

Figure 35: Proposed new road to upgrade the Rössing / Arandis intersection on the B2

7.3.12 EMERGENCY RESPONSE AND EVACUATION

IMPACT STATEMENT

Given the projected staff increase, the study also evaluated the current emergency response transport measures in place and investigated the need to improve thereon to reduce response times.

DISCUSSION

The mine's current emergency response and evacuation support systems were assessed and found to be sufficient. Although remotely located the response time to stabilise severely injured persons is acceptable due to the on-site facilities. Medical facilities in Swakopmund can deal with most severe injuries. Response times for air evacuation are constrained by aircraft availability.

MITIGATION

The existing HSE Management System includes a Disaster Management and Recovery procedure to limit the risk of occurrences of disastrous events and allows for medical emergencies and responses. The availability of an aircraft for charter emergency flights at Arandis could be investigated to reduce response times for air evacuation. In addition, Arandis airport should be kept in a good working condition and the Rössing Uranium procedures should include a requirement to monitor the airport and confirm that it has a valid licence.

A suitable area within the MLA should be identified and demarcated as a helicopter landing pad to provide an additional evacuation option.

The table below provides a summary of the significance ranking.

Emergency evacuation		
	No mitigation	**Mitigation**
Extent	Local	Local
Magnitude	Medium	Low
Duration	Long Term	Long Term
SIGNIFICANCE	**MEDIUM(-)**	**LOW(-)**
Probability	Unlikely	Unlikely
Confidence	Unsure	Unsure
Reversibility	Irreversible	Irreversible

7.3.13 VISUAL IMPACT

Visual Resource Management Africa was commissioned to undertake a Visual Impact Assessment (VIA) to assess the expected landscape modifications created by the proposed mine expansion activities. A copy of the report is attached as Annexure N11.

IMPACT STATEMENT

It is expected that the various mine expansion activities will have an impact on the visual, aesthetic and scenic environment of the area and the surroundings.

DISCUSSION

The study assessed the proposed landscape changes to analyse potential visual impact of the proposed expansion project on the current landscape, sense of place and scenic value of the area. The study provides information on the visual implications of the current and proposed mining operations on the surrounding sense of place, as well as mitigation strategies to reduce the impact of the proposed landscape changes.

The factors considered include the following:

- The cumulative impacts of existing and future mines in the Erongo region;
- Expansion of the existing open pit;
- The operation of a new heap leach facility;
- Creation of additional waste rock dumps;
- Creation of a new ripios disposal facility;
- Additional plant and plant structures;
- Increased tailings storage facility;
- Lights at night; and
- Increased blasting activities.

Visual contrast is measured in order to analyse the proposed landscape modification and is expressed as:

- None ~ Element of contrast not visible or perceived.
- Weak ~ Element of contrast can be seen but does not attract attention.
- Moderate~ Element of contrast begins to attract attention and begins to dominate the characteristic landscape.
- Strong~ Element of contrast demands attention, will not be overlooked, and is dominant in landscape.

In addition to visual contrast, the visual absorption capacity is also considered when determining the impact significance. This refers to the capacity of the receiving environment to absorb the visual intrusion and typically relates to colour, shape, form and texture.

The relative value of visual resources of an area is classified as follows:

- Classes I and II being the most valued;
- Class III representing a moderate value; and
- Class IV being of least value.

Detailed three dimensional modeling of the structures and the geometries of all the proposed landscape modifications was undertaken in order to gain a better understanding of their visual impact. To effectively visualise the proposed landscape modifications, a photo-montage exercise was undertaken for all new proposed landscape modifications as seen from the Key Observation Points (KOPs). KOPs refer to locations surrounding the mine from where the degree of contrast that the proposed landscape modifications will make to the existing landscape can be assessed. KOPs can be a single point of view or a linear view along a road, trail or river corridor.

The identified KOPs include the following and are illustrated in Figure 36:

- Arandis ~ Residential;
- B2 Eastbound ~ National Road;
- B2 Westbound ~ National Road;
- Khan River Valley ~ Nature/Wilderness recreation;
- Namib Naukluft Park ~ Wilderness/Conservation;
- Panner Gorge ~ Wilderness and recreation; and
- Welwitschia Plains ~ Wilderness/Conservation/Agriculture.

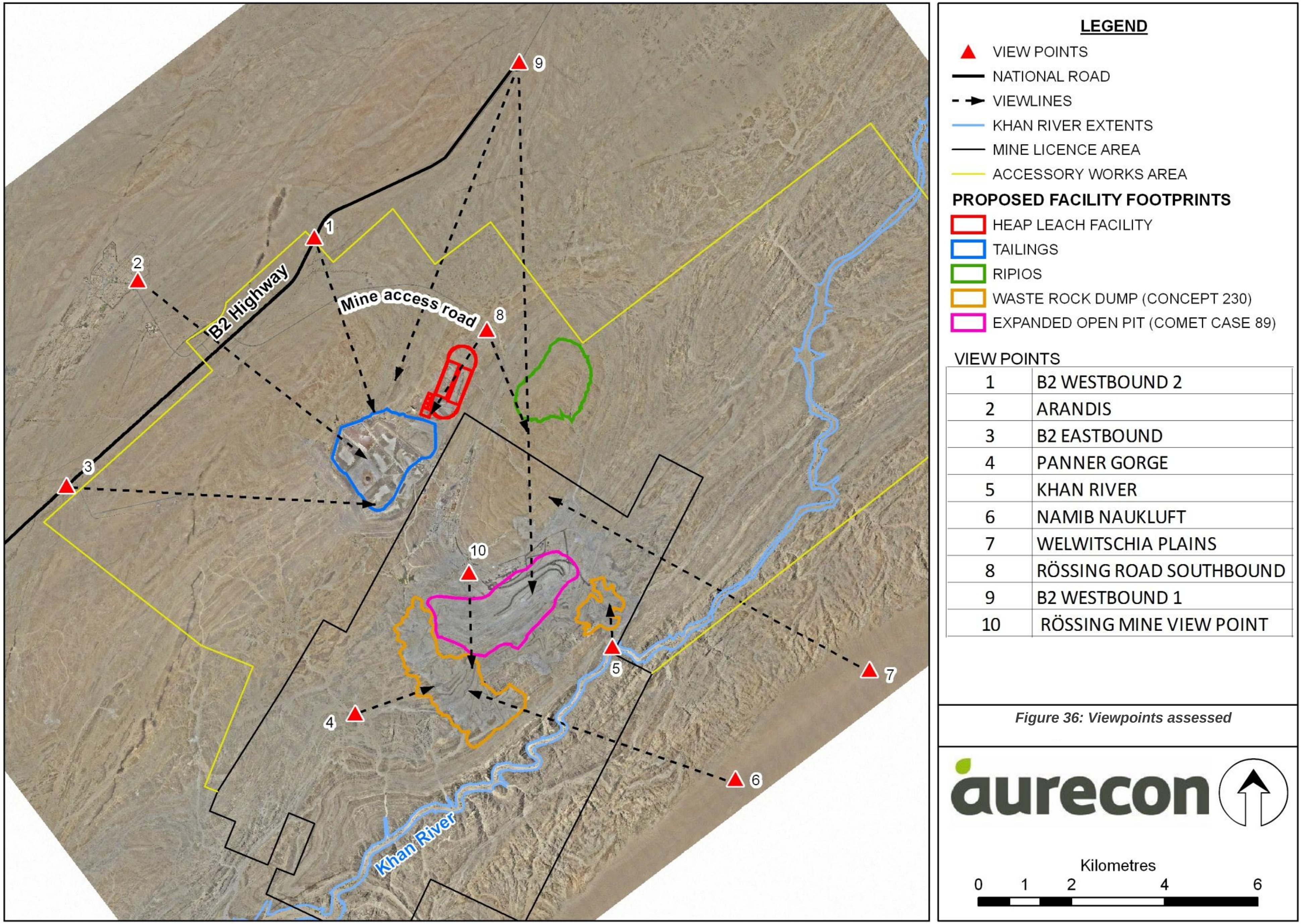

Figure 36: Viewpoints assessed

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7.3.14 DESCRIPTION OF IMPACTS FOR INDIVIDUAL KOPS

The assessment considered all of the factors listed above and the following conclusions were reached for the various KOPs:

ARANDIS

It is expected that the tailings storage facility will dominate the landscape over time due to its size and scale and proximity. The sense of place already contains views of the existing TSF and the level of change to the landscape characteristic will be moderate without domination.

B2 EASTBOUND AND B2 WESTBOUND

The construction of the proposed expansion project facilities is similar to that existing on site. The distance reduces the visibility and detail. The oxidised brown colour of the tailings storage facility is very similar to the surrounding landscapes, as is the strong horizontal line created by the shape.

KHAN RIVER VALLEY

The Khan River is an important tourist view corridor and should not be subjected to landscape modifications. The existing vista does include close views of the existing waste rock dumps.

NAMIB NAUKLUFT PARK

The Namib Naukluft Park is an important wilderness reserve where the lack of manmade activities is vital to benchmark the Namibian "place of open spaces" sense of place and heritage. The area is classified as being highly valued. Due to the distance (approximately 5km) from the park to the waste rock dumps and the ripios landscape modifications, the broken lines and variable benches of the visually preferred design would reduce the degree of contrast to suitable weak levels. Much of the proposed activities would be screened by the waste rock dump. With distance, the rough texture and grey colour of the ripios and the waste rock dump would help to reduce the degree of contrast to acceptable moderate levels.

PANNER GORGE

Panner Gorge has high levels of landscape character associated with the river and surrounding mountain features. It is also important due to the long term planned tourism at the Khan heritage area located in this area which includes a significant archaeological chert quarry. The post operational life of the mine would still need to offer tourism activities in the Panner Gorge area in conjunction with the Khan heritage area. During the operation phase the activities associated with disposal at the waste rock dump would exceed the moderate levels of contrast required for the area. However, at closure stage and beyond, moderate levels of contrast will be generated as the broken lines of design of the waste rock dump would be similar to the surrounding landscape and with careful design and shaping of the final protruding "peak" features, contrast would be limited.

WELWITSCHIA PLAINS

The Welwitshia Plains is highlighted as a visually sensitive hotspot area which needs to be avoided, protected, and actively conserved. A new visual footprint would be created by the development of the ripios disposal area on the Dome which is in clear view of the Welwitschia Plains. The ripios would not dominate the view as it fits below the skyline and is located in an area which has high visual absorption capacity levels due to the rugged terrain. With the distance the grey colour of the ripios would further assist to reduce the degree of contrast.

CONCLUSIONS

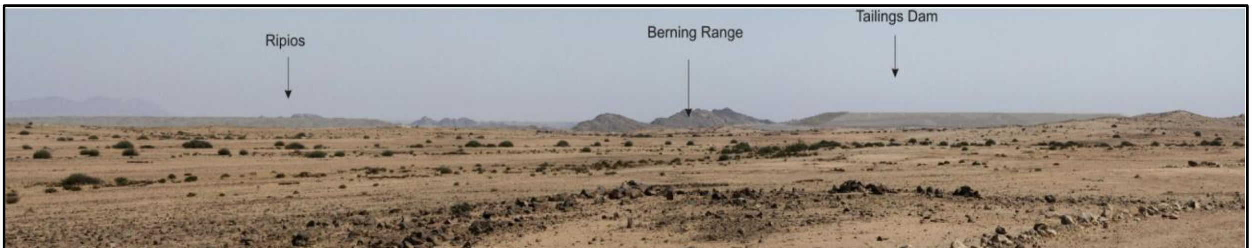
The sense of place of the MLA has already been significantly impacted due to the long period the mine has been operating. As a result of the reduced visual envelope, the landscape character of the surrounding areas such as the Khan River and Welwitchia Plains remain intact and modifications associated with the further expansion of the mine have a lower significance rating.

The only mining expansion activity that could potentially generate higher levels of visual intrusion are the tailings facility which is located on the existing tailings facility and the ripios which is located on the Dome. Due to the increased height of the tailings to 680mamsl this would result in higher levels of contrast created by massing and scale. The geometry is organic which allows a more effective blending with the forms, lines and textures of the existing landscape.

The ripios is also a large landscape modification (approximately 1.8km^2 in area), but is effectively located in a natural depression and surrounded by rugged terrain. This increases the visual absorption capacity levels and visual intrusion as seen from the Welwitschia Plains and NNP would be limited. Views from the north, such as from the B2 are limited and reflect strong horizontal lines which mimic the existing landscape. It is concluded that the existing zone of visual influence would be marginally increased, mainly to the north towards Arandis. Refer to Figure 37 for the selected plates from the visual impact assessment.

View of the proposed tailings dam from the B2 eastbound.

View of the proposed tailings dam from the Arandis bridge



The creation of a more natural line is proposed to mitigate the visual impact of the proposed Tailings Storage Facility

Figure 37: Plates from the visual impact assessment

The combined visual impact of other mines has the potential to generate high cumulative visual impacts and significantly detract from the high levels of landscape character that define and sustain eco-tourism in the region.

The SEA (SAIEA, 2010) reached a similar conclusion and defined the continued visual attractiveness of the Central Namib as a specific desired outcome. It prescribed that an EIA, inclusive of a visual impact assessment and an EMP, such as this study done for Rössing Uranium, be commissioned by all developers. It further provided indicators such as sampling of tourists to gauge their visual experience of the Central Namib.

MITIGATION

A number of mitigations are proposed to effectively reduce the overall visual impact:

Waste rock dumps

- To be designed within the defined visual preference height specifications, as per the specialist study recommendations.
- Elevated and prominent angular shapes of the waste rock dump need to be rounded so as to reduce the level of contrast generated by the corners and straight lines created by the benching, to ensure that these prominent features appear more natural in relation to the surrounding landscape.

Coarse Ore Stockpile

- Removal of the remaining ore stockpile and structures associated with the stockpile at mine closure and shaping the site to a natural land form.

Plant and Structures

- Structures should be as low as possible.
- Natural desert colours (medium grey-brown) should be used, especially for larger surfaces such as roofs and storage tanks.
- All components of the infrastructure should be removed at mine closure and the site should be landscaped to natural forms.
- Bright colours such as red, green, white, and blue should be avoided, except for required safety markings.
- Surface pipelines are to be painted grey, unless required to be colour coded for safety reasons.
- Glass surfaces should be shielded to avoid glare and reflections.

Heap Leach Facility

- Dust control measures to be implemented during construction.
- Large permanent machinery needs to be painted a grey-brown desert colour.
- All machinery, structures, and remaining ore to be removed at closure.
- The area needs to be covered with a layer of waste rock to reduce wind erosion and the visual effects of dust at closure.

Blast Plume

- Blasting should take place in the afternoon when the atmospheric haze is more intense, on preset days so that tourist ventures can plan to use the surrounding areas when no blasting is taking place.
- It is recommended that blasting times are co-ordinated with other mines to ensure that the cumulative impacts of blasting are reduced as far as possible.

Ripios

- Machinery and structures to be painted in grey-brown desert colours.
- Dust control measures should be implemented during the construction phase.
- Strict dust control measures should be implemented to ensure that dust generated after stacking process is limited.
- The outer edges need to be smoothed off so as to create a more rounded shape.
- All machinery and equipment should be removed from the site at closure.

Tailings Storage Facility

- A wet dust suppression process should be implemented.
- During operation the outer edges of the TSF need to be rounded off.
- The creation of a more natural line is proposed to mitigate the visual impact of the proposed TSF.

LIGHTS AT NIGHT

- All lighting is to be kept to a minimum within the requirements of safety and efficiency.
- Where such lighting is deemed necessary, it should be restricted to low-level lighting.
- No external up-lighting of any parts of the structures, including the stacks, should be allowed.
- External lighting should use down-lighters shielded in such a way as to minimise light spillage and pollution.
- To reduce the light impact of the ripios stacker, lighting reduction design and technologies should be assessed. The aim should be to reduce the source light generated by the stacker operating at night from any prominent location.
- Security and perimeter lighting should also be shielded so that no light falls outside the area needing to be lit.
- Overly tall light poles are to be avoided. No naked light sources are to be directly visible from a distance (except for the aircraft warning lights) and only reflected light should be visible from outside the site.

The table below provides a summary of the significance ranking.

Visual impact of the expansion		
	No mitigation	**Mitigation**
Extent	Regional	Regional
Magnitude	Medium	Low
Duration	Long Term	Long Term
SIGNIFICANCE	**HIGH(-)**	**MEDIUM(-)**
Probability	Probable	Probable
Confidence	Unsure	Unsure
Reversibility	Irreversible	Irreversible

7.3.15 IMPACT ON GEOHYDROLOGY (GROUNDWATER)

As a result of various delays in the technical work related to the proposed expansion project components, and the prefeasibility study for the heap leach project in particular, groundwater modeling could not have been completed at the time of completion of the other SEIA specialist studies. This has now been completed and the updated groundwater model by Aquaterra (Aquaterra, 2011 – see Annexure N13) is presented below. This latest information was not communicated to the public during the series of public participation meetings scheduled in August 2010. Where required, the impact significance related to each of the facilities was reconsidered.

Given the cumulative nature of the potential impacts on geohydrology as a result of the proposed expansion project components, a single groundwater model was prepared to include all these facilities. Aquaterra completed an update to the groundwater model in 2010, and a further update in 2011 and the following section was extracted from these reports.

The development of the Rössing Groundwater Model has been incremental since the original model was developed in 2001. The model was designed to assist in the assessment of operational strategies for the TSF and the prediction of impacts of long term closure strategies. Since this time, the model boundaries have been extended, with the final extension including the entire Dome Gorge catchment and the Khan River downstream to its confluence with the Swakop River to ensure that the impact assessment includes these areas of concern.

As part of the current work, the Rössing Uranium groundwater model developed in 2009 was updated to include:

- The latest geological information available from Rössing Uranium staff that suggests that the Karabib marble, located on the northern side of existing TSF, is more permeable than previously thought.

- The latest elevation data for the mine area.
- Recharge to groundwater from the existing waste rock dumps.
- Calibration data over the period 1990 to 2007, including TSF deposition and seepage at the toe of the dam, groundwater pumping from boreholes within the TSF and surrounding recovery systems, dewatering of the open pit and groundwater monitoring data.

The calibrated model was then used to predict the likely flow paths of seepage from the proposed extension of the existing TSF and the ripios development in the Dome Gorge area during operation and closure. The modeling assumes that the open pit is dewatered consistent with mine development and remains a local groundwater sink after mining is complete.

The general groundwater flow direction within the catchment is from northwest to southeast. The model boundaries extend southwest as far as the confluence with the Swakop River and include the following:

- The entire extent of Khan Mine, Panner, Pinnacle and Dome Gorges;
- The open pit;
- The Khan and underlying Khan River aquifer; and
- An area immediately south of the Khan River.

The calibrated groundwater flow model has been used to assess:

- Potential flow paths from the expanded TSF, including heap leach pads developed on the existing TSF, Ripios in the Dome Gorge area and waste rock dumps, using particle tracking over the operating period and after closure of the facilities.
- Options for capturing potential flow paths from the existing and proposed tailings facilities that are predicted to reach the Khan River.
- Long term flow paths resulting from the interactions of decommissioned tailings facilities and the open pit.

The prediction assumed that the existing TSF will be operational between 2009 and 2024 and include heap leach facilities and that there will be a new ripios facility in the Dome Gorge area. These facilities will be decommissioned in 2024. To predict the impact of the operational TSF and long term closure impacts, the model was run from 2009 to 2024, and then for a period of up to 1,000 years.

The Aquaterra reports detail both particle tracking modeling and sulfate contaminant transport modeling for various time periods for the base case and the expansion case. The reason for assessing sulfate contaminant transport is that the particle tracking alone only indicates potential flow paths, but fails to quantify the transportation of specific contaminants along such a flow path. The selection of sulfate as an "indicator" contaminant is to ensure that the worst case scenario is evaluated, given that sulfates are not naturally attenuated. It is, however, acknowledged that sulfate ions in the seepage are likely to combine with dissolved calcium ions to form gypsum (calcium sulfate), but the concentration of sulfate will remain sufficiently high to use this as an indicator.

The model indicates that the majority of the seepage from the TSF and heap leach pad moves down Pinnacle Gorge and is captured by the cone of depression formed by dewatering of the pit, ultimately ending up in the pit. Some seepage moves down Panner Gorge and ends up in the Khan River, at between 50 and 100 years. In addition, limited seepage that emanates from the rock dumps south of the pit moves down Dome Gorge and is predicted to enter the Khan River after 500 to 1,000 years. All the seepage from the ripios dump on the Dome moves down Dome Gorge and ends up in the pit. This indicates the potential flow paths. As for specific contaminant transport modelling, the increase in sulfate concentration at the bottom of Pinnacle Gorge (at its furthest extent after 100 years) is only 1mg/ℓ. Seepage from the rock dumps adjacent to the bottom end of the Dome Gorge does enter the Khan River through the Dome Gorge fracture system, at a sulfate concentration of 90mg/ℓ. The current sulfate levels at borehole 1.6 (in the Khan River alluvium, just downstream of Panner Gorge) have varied between 600mg/ℓ to 800mg/ℓ since 1986. The limited seepage from the rock dumps at 90mg/ℓ is unlikely to significantly increase the sulfate levels in the Khan River any further.

The highest concentrations of sulfate, spread over the greatest area, occur 20 years after the start of the prediction. Thereafter, the extent of the sulfate plume remains relatively static. The overall plume extent does continue to increase after 20 years, but only at very low concentrations, while the central high concentration areas actually recede after 20 years. The worst quality "finger" of sulfate movement occurs along the Pinnacle Gorge, towards the open pit.

Figure 38 indicates the sulfate contaminant transport modelling after 100 years. Note that the figure appears pixelated, as it was taken directly from the groundwater model results, which is calculated in grid blocks.

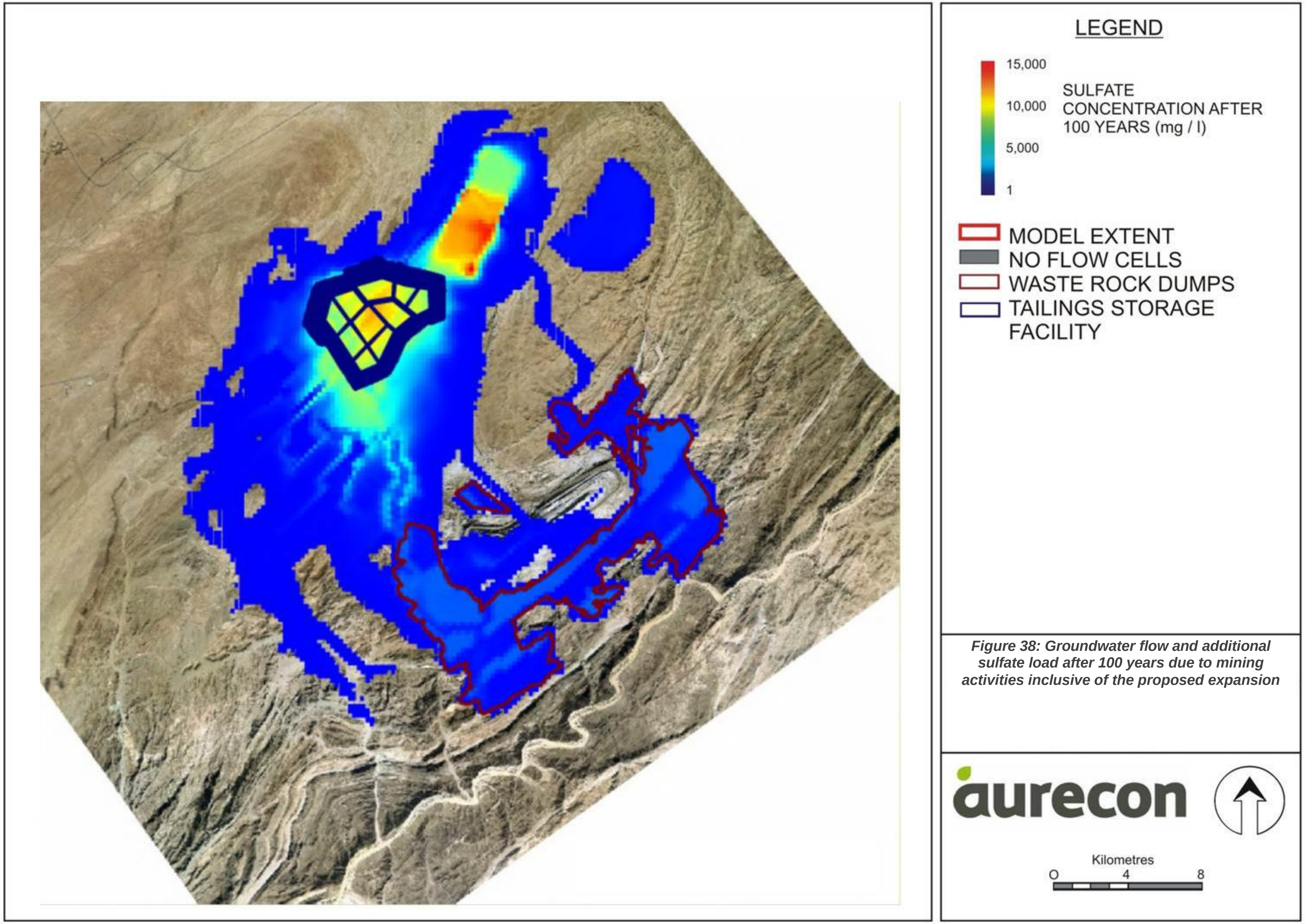


Figure 38: Groundwater flow and additional sulfate load after 100 years due to mining activities inclusive of the proposed expansion

Prior to the updated groundwater model by Aquaterra, a study was conducted by SRK Consulting to assess the impacts that the various components of the Rössing Uranium expansion project are expected to have on the water environment in the vicinity of the proposed facilities. This report is attached hereto as Annexure N12.

Rössing Uranium has been monitoring water quality and effectiveness of the various control measures for years and has an extensive record thereof. The re-use of water is a specific priority of the water management strategy. Refer to the HSE MS summary description in Annexure B for details on the existing system. With the introduction of new processing methodologies it needs to be established what potential for groundwater contamination exists and whether the existing control systems need to be upgraded to prevent heap leach, ripios, rock dumps and tailings facilities from potentially contaminating the Khan River or groundwater.

The components of the expansion activities expected to have an impact on the surface- and groundwater resources are discussed below.

7.3.15.1 IMPACT OF WASTE ROCK DUMPS ON GROUNDWATER

IMPACT STATEMENT

It is expected that minor leachate volumes could be generated by the rock dumps after rainstorms and this may impact on groundwater.

DISCUSSION

The groundwater environment overlain by the current rock dump is separated from the Khan River receiving environment by the mine's active seepage control systems. These will remain operational for about 30 years beyond closure. However, passive systems have to be installed to control potential leachate generated by rainwater infiltration in the longer term.

The waste rock types from the expanded SJ Pit has been subjected to kinetic leaching and geochemical analysis to determine their propensity to generate acid, mobilise metals and release salts that could migrate to the Khan River over time. Seepage controls are in place and will be maintained. Results from the leach tests indicate that soluble uranium will be present in the seepage water from the waste rock dumps at closure of the mine.

The actual long term impact of the waste rock dumps on the entire Khan River is expected to be even less significant than the earlier predictions, probably because of the dilution factor when groundwater flow in the river increases during periods of rain.

It is expected that the waste rock dumps will continue to contribute small loads of nitrate, sulfate and uranium to the Khan River aquifer during the operational phase. Column leach testing indicates that nitrates are fairly quickly washed out of the dumps, but sulfate and uranium releases will persist beyond closure. It is expected that the extended waste rock dumps will continue to leach small loads of potential contaminants such as uranium, sulfate and nitrate in particular into the Khan River catchment.

MITIGATION

Leachate leaving the rock dumps will be controlled by the existing groundwater cut-off trenches. Leachate chemistry has been characterised and quantified to confirm adequate management. Figure 38 indicates the groundwater flow and sulfate load after 100 years due to mining activities, inclusive of the proposed expansion, with the existing controls in place. No sulfate (selected because it is a conservative contaminant to assess due to the ease with which it will disperse) is expected to reach the Khan River. It should be noted that Figure 38 provides a cumulative picture, and does not focus on the impacts from the waste rock dumps in isolation.

Seepage from the base of the waste rock dump is likely to continue in the long term and should be managed as follows:

- Leach column testing should continue to refine predictions concerning the quality of seepage from the bases of the dumps;
- Lysimeter systems (to measure percolation volumes) should be constructed at the base of specified waste rock dumps to provide direct evidence of flow rates and seepage composition (based on detailed chemical analysis); and
- A program of performance trials on candidate passive chemical barriers should be started to determine their effectiveness and reliability in capturing and immobilising uranium and other contaminants in seepage flows to the Khan River.

Evaporation paddocks where the runoff from the waste rock should directly impact the Khan River will assist to intercept sediment and control erosion. The final pit geometry should allow for the runoff from the top of the dump to flow towards the pit.

The table below provides a summary of the significance ranking.

Groundwater pollution from waste rock dumps		
	No mitigation	**Mitigation**
Extent	Local	Local
Magnitude	Medium	Medium
Duration	Long Term	Long Term
SIGNIFICANCE	**MEDIUM(-)**	**MEDIUM(-)**
Probability	Probable	Probable
Confidence	Certain	Certain
Reversibility	Irreversible	Irreversible

7.3.15.2 IMPACT OF DOME GORGE RIPIOS STORAGE FACILITY ON GROUNDWATER

IMPACT STATEMENT

The main impacts on the groundwater that could be associated with storage of ripios on the Dome Gorge is groundwater mounding and increased recharge under the ripios storage facility.

DISCUSSION

It is predicted that mounding will increase the piezometric head under the Dome Gorge ripios storage facility by about 40m and will accelerate transport of solutes away from the ripios storage facility. Recharge is expected to stop after 20 years after closure which will cause the dissipation of the mound.

It is anticipated that the cone of depression from the open pit on the south of the Dome is expected to intercept most solutes entering the groundwater from the ripios storage facility.

The following issues have been considered in the assessment of the ripios disposal facility:

- Runoff from the ripios dump will flow along the gorges where the ripios has been placed. If the runoff exceeds 2m/s erosion of the side slopes can be expected and sediment will be included in the water. This water/sediment will be collected by the existing cut-off trenches.
- Groundwater seepage and occasional supernatant water flowing over the ripios will enter the seepage collection facilities, but should the normal collection capacities be exceeded, the water will create a groundwater mound which will drive the solute transport. The water is redirected into the pit via fractures.

- The runoff and seepage water from the ripios are likely to transport contaminants such as sulfates, uranium, iron, manganese and nitrate. **Error! Reference source not found.** illustrates the additional sulfate load after 100 years.
- The Rössing Marble and amphibole schist has an important influence on seepage movement as it functions as a preferential flowpath for seepage as shown by the particle tracking.
- Although up to 10m^3/day of seepage from the ripios dump could occur, the model predicts that the particles would not reach the Khan River within 500 years after closure.

MITIGATION

Surface and alluvial water can be controlled by dams and cut off trenches. Potential deeper fracture flow will be diverted by aquifers cross-cutting Dome Gorge and draining water into the deep open pit from where it will evaporate.

Paddocks will be constructed around the base of the ripios dump to contain the sediment-laden runoff from the dump. The paddocks should be extended as the ripios grows and regular maintenance should be undertaken to collect silt and ensure sufficient freeboard is maintained. It is suggested that the paddock be constructed 25m away from the edge of the ripios with a wall of around 1,000mm.

For the ripios storage facility the following water management measures are envisaged:

- Upstream cut-off drains;
- Seepage control facilities to be constructed below the ripios facility in the low gorges;
- The transport model developed by Aquaterra will be used to assist in formulating appropriate additional management measures; and
- Additional boreholes are required to monitor the effectiveness of the management measures.

The table below provides a summary of the significance ranking.

Groundwater pollution from ripios disposal facility		
	No mitigation	**Mitigation**
Extent	Regional	Local
Magnitude	Medium	Low
Duration	Long Term	Long Term
SIGNIFICANCE	**HIGH(-)**	**LOW(-)**
Probability	Probable	Probable
Confidence	Certain	Certain
Reversibility	Irreversible	Irreversible

7.3.15.3 IMPACT OF HEAP LEACH PAD ON GROUNDWATER

IMPACT STATEMENT

The operation of the heap leach pad on top of the current tailings facility is expected to contribute towards continued groundwater mounding.

DISCUSSION

The heap leach facility will be developed over the north-eastern sector of the current tailings storage facility. The main groundwater impact from the development of the tailings and heap leach pad is continued groundwater mounding that will increase the piezometric head under the heap leach pad by between 5m to 10m.

Mitigation

To mitigate the impacts on both surface and groundwater, the new heap leach facility will be plastic lined and situated on the current tailings dam. Potential small liner leaks, although unlikely would be neutralised by the underlying tailings sands. The tailings facility itself is adequately controlled by cut off trenches and dewatering wells.

Certain measures for water management around the heap leach pad will be provided and include the pregnant leachate solution pond, internal drains and an impermeable base of the pad from which almost zero seepage is expected.

Embankment walls should be constructed to an elevation such that the 1:2,000 year flood high water level will be lower than the embankment. This will reduce rainwater entering the heap leach pad.

In addition to the comprehensive monitoring system already in place around the existing TSF, the following water management measures are envisaged at the heap leach plant:

- Workshops and acid tanks to be contained in a bunded area sized for 110% of the potential spillage; and
- Appropriately spaced additional boreholes should be installed around the plant to monitor for potential seepage.

The table below provides a summary of the significance ranking.

Ground water pollution from the heap leach facility		
	No mitigation	**Mitigation**
Extent	Local	Local
Magnitude	Very Low	Very Low
Duration	Short Term	Short Term
SIGNIFICANCE	**VERY LOW(-)**	**VERY LOW(-)**
Probability	Probable	Probable
Confidence	Certain	Certain
Reversibility	Irreversible	Irreversible

7.3.15.4 IMPACT OF TAILINGS STORAGE FACILITY ON GROUNDWATER

Impact Statement

The continued disposal of tailings on the current tailings facility is expected to contribute towards continued groundwater mounding.

Discussion

The following issues have to be considered in assessing this impact:

- Groundwater seepage from the extended tailings may be slightly acidic (pH 5), similar to that from the existing tailings.
- The tailings are placed on top of the existing tailings facility and this will result in a higher head to drive the groundwater plume. This may result in additional water that needs to be captured in the seepage facilities and could impact the stability of the outside face of the higher TSF.
- The tank leach tailings will cover the existing tailings resulting in a delayed recovery of the water for reuse.
- Ponding of water will occur upgradient of the heap leach embankments as the heap leach pad is situated in a depression. This water may flow onto the pad (for rainfall events in excess of 128mm during return events less frequent than 1:2,000). This water could end up in the stormwater dam. For smaller rainfall events the water will both evaporate and seep into the underlying tailings after the rainfall event.

- Spillage from the stormwater dam below the pregnant leachate solution pond will occur for rainfall events greater than 100mm (100mm in 24 hours relates to about a 1:1,000 year event). If this occurs then the contaminated solution will flow to the north of the plant into an existing canal. This water will eventually back up behind the Dome Gorge Ripios facility and the water could be collected in the seepage control trenches. If the water is not collected in these collection facilities then the water will seep into the alluvial aquifers and will be intercepted in the open pit.

MITIGATION

For the post closure scenario the establishment of long term passive groundwater filters (passive reactive barriers) need to be investigated to control minor residual groundwater flow. Continuous pumping 30 years after closure will not yield sufficient water to allow pumping anymore. This general mitigation measure will apply to the entire system on the mine.

The existing and proposed additional control measures and monitoring requirements are in line with the SEA (SAIEA, 2010) that recommended that mines should adopt best practice methods for seepage control and detection around potential pollution sources, construct suitably sized and separate stormwater collection drains for 'clean' and 'dirty' stormwater and conduct regular monitoring and reporting.

The table below provides a summary of the significance ranking.

Ground water pollution from tailings storage facility		
	No mitigation	**Mitigation**
Extent	Local	Local
Magnitude	High	High
Duration	Long Term	Long Term
SIGNIFICANCE	**HIGH(-)**	**HIGH(-)**
Probability	Probable	Probable
Confidence	Certain	Certain
Reversibility	Irreversible	Irreversible

7.3.16 RESOURCE USE

The various components of the Rössing Uranium expansion project are expected to increase the water and power demand.

7.3.16.1 IMPACT ON WATER SUPPLY

IMPACT STATEMENT

The various components of the Rössing Uranium expansion project are expected to result in an increase in the demand for available water, especially given the proposed water intensive heap leach facility.

DISCUSSION

Escalation in mining activities in the region has led to an increase in water demand. Due to the lowering in groundwater levels of the major aquifers and the likelihood that the current abstraction permit issued by Water Affairs to NamWater may not be renewed, a sustainable alternative source to groundwater for existing and expanded operations had to be considered.

Rössing Uranium's current source of water is the Omaruru Delta (Omdel) aquifer. Recent figures on groundwater levels of the Omdel aquifer indicate a deterioration to the extent that renewal of the abstraction permit at existing rates is unlikely. The capacity of the Kuiseb scheme is being expanded but the potential rate of expansion may not match the decrease in the Omdel scheme.

The use of desalinated water is currently being explored and initially may be supplied by the existing Erongo Desalination Corporation. This desalination plant is located approximately 40km north of Swakopmund and would be able to supply water into the existing NamWater distribution network. The development of a second desalination plant is also being considered as a potential future source and would be a joint effort between the mining companies and NamWater.

The SEA concluded that for a medium growth scenario, there is sufficient water from the existing NamWater groundwater sources to supply domestic users until 2020. However, there is not enough for the operational needs of existing mines, and therefore also not any new or expanded developments. The Khan and Swakop aquifers can also not satisfy the operational needs of the mines, but may be able to provide for short-term constructional needs within safe limits. The only feasible option for adequate water supply is desalination. The high cost of this water should not be passed on to the domestic consumer while groundwater is sufficient to meet their needs and the mining and related industries should reduce water usage as far as possible to minimise cost of purchasing desalinated water. The potential cumulative impact in terms of water supply is over abstraction of water from aquifers, which will affect dependant vegetation (and knock-on effects on animals dependant on this vegetation for survival) and functioning of ecosystems, as well as water abstraction yields for farming (SAIEA, 2010).

MITIGATION

Through a group under the auspices of the Uranium Stewardship Committee, Rössing is cooperating with the other operating mines and the exploration groups that are in different stages of development of their projects to facilitate and expedite the development of increased desalination capacity by NamWater to replace the groundwater resource currently used to supply the mines.

Although assurances have been received from the Ministry of Agriculture, Water and Forestry that supply to existing consumers will not be reduced, it is foreseen that this required additional desalination capacity may take some years to develop. As stated above, an interim arrangement is being negotiated to access surplus water from the existing Erongo Desalination Corporation plant.

The mine's existing annual water demand varies from 3.5 to 4 million m³ and is expected to increase to 6 million m³ per annum including the additional demand created by the heap leach facility.

The SEA (SAIEA, 2010) stated that there should be an adequate and reliable supply of water at reasonable cost for all consumers and to achieve such, all mines should use desalinated water for mine operations, but should first strive to reduce water consumption as far as possible by re-use and recycling. Rössing Uranium's actions to secure a supply of desalinated water are in line with this recommendation.

The table below provides a summary of the significance ranking.

Water supply		
	No mitigation	**Mitigation**
Extent	Regional	Regional
Magnitude	High	Low
Duration	Long Term	Long Term
SIGNIFICANCE	**HIGH(-)**	**MEDIUM(-)**
Probability	Definite	Definite
Confidence	Certain	Certain
Reversibility	Reversible	Reversible

7.3.16.2 IMPACT ON ELECTRICITY SUPPLY

IMPACT STATEMENT

The various components of the Rössing Uranium expansion project will result in an increase in the demand for electricity.

DISCUSSION

Electricity is supplied by NamPower from the national grid via a link to the 220kV line between Omburu and Walmund substations. This line supplies power to Walvis Bay, Arandis, Swakopmund, as well as Rössing Uranium. A ring feed also exists in order to allow a dual feed to the region inclusive of Rössing Uranium.

Namibia has only three power generation sources, namely the Van Eck coal-fired power station in Windhoek (capacity 120MW), the Ruacana hydro-electric power station (240MW capacity, but availability only 50%) and the Paratus diesel-powered facility in Walvis Bay (capacity 24MW). As such, the national generation capacity is 384MW, against the approximate national demand of 550MW. The predicted demand of the mines alone is likely to be 231MW under the expected development scenario (SAIEA, 2010).

To meet the increasing demand, NamPower is evaluating a variety of different options, including both base load and emergency options. NamPower plans to supply the long-term base load from either a gas or coal-fired plant with a likely capacity of 400MW at Walvis Bay, plus a hydro-electric plant on the Kunene. In the interim, power will be supplied from inputs via the Capriri Link and a fourth turbine at Ruacana, and in emergencies the diesel-powered Anixas facility could be utilised, ensuring sufficient capacity (SAIEA, 2010).

Rössing Uranium is currently tying into the NamPower grid connecting Omaruru to Swakopmund. Substations on this line are Omburu (Omaruru), Khan and Walmund (Swakopmund) substations. The capacity of the existing grid is currently being upgraded between Omburu and Khan to make provision for the capacity required by Trekkopje mine and desalination facilities. The capacity of the grid between Khan and Walmund is a 215MVA line and is sufficient for the Rössing Uranium needs.

The existing electricity demand of Rössing Uranium is 35MVA for the tank leach operation with an additional demand of 22MVA estimated for the heap leach operation. The heap leach operation is divided into three main electrical distribution areas namely crushing, processing and ripios disposal.

Mitigation

Rössing Uranium is interconnected to the NamPower grid by means of two 220kV:11kV transformers. The increased energy demand required for heap leach requires a provision to be made in the existing main substation for an additional incoming feeder and an additional transformer parallel to the existing transformers. This will provide a total feed-in capacity of 80MVA. Switchgear, protection and high voltage interconnection on NamPower side will also form part of the upgrade. The existing NamPower yard provides space for the additional transformer and equipment to be installed.

Minimum backup generation is required. All other provisions for a "crash stop" in the electricity supply, such as process storage ponds and emergency facilities have been provided for. Since the existing backup generation facility has recently been upgraded, surplus backup generation capacity exists. Provision has been made to link this as limited backup supply power to the heap leach operation.

The table below provides a summary of the significance ranking.

Energy supply		
	No mitigation	**Mitigation**
Extent	Regional	Regional
Magnitude	High	Low
Duration	Long Term	Long Term
SIGNIFICANCE	**HIGH(-)**	**MEDIUM(-)**
Probability	Definite	Definite
Confidence	Certain	Certain
Reversibility	Reversible	Reversible

7.3.16.3 GREEN HOUSE GAS EMISSIONS

IMPACT STATEMENT

The various components of the Rössing Uranium expansion project is expected to result in an increase in the generation of green house gas contributions.

DISCUSSION

The green house gas (GHG) contributions due to the Rössing Mine expansion will double from the current figures. The base case operations, assuming no expansion is illustrated in green in Figure 39. With the proposed activities, the total calculated carbon dioxide (CO_2) emissions will be as illustrated in yellow.

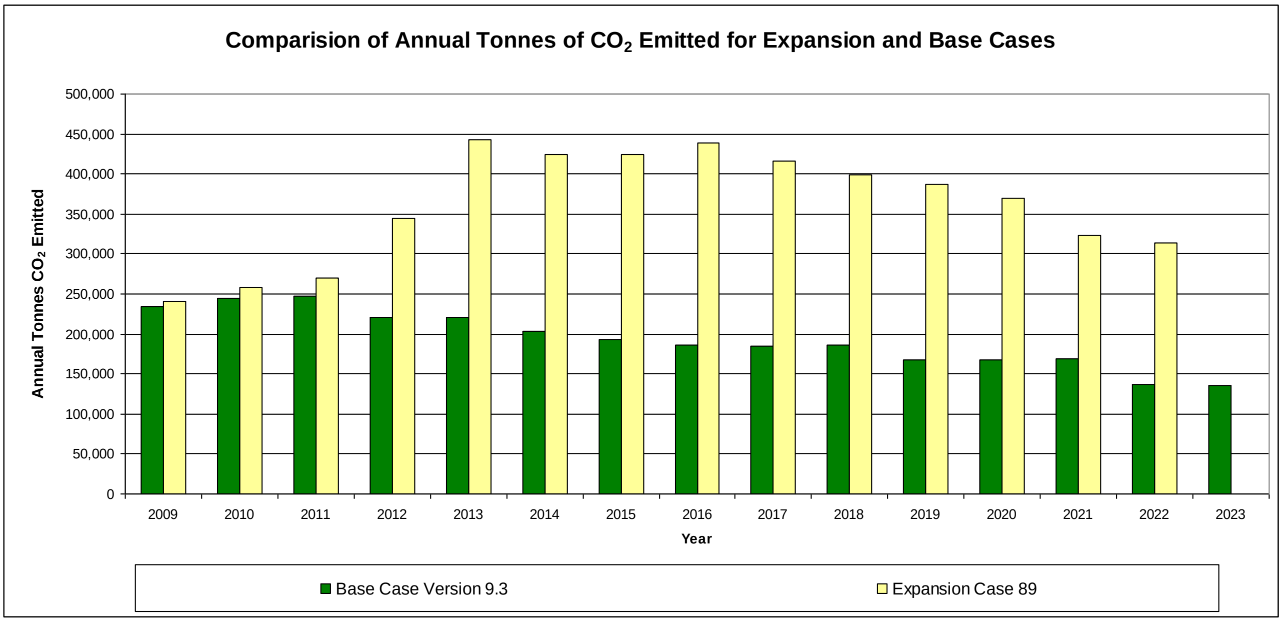


Figure 39: Annual CO_2 emissions due to base case (2010) and expansion (year 2013)

The estimated CO_2 emissions from Rössing Mine for current operations for the year 2010 are approximately 0.258 million metric tons per year. This should be seen in the perspective of the annual Namibian and global emission rate of green house gases, which is approximately 2.83 million metric tons and 30,176.7 million metric tons respectively, expressed as carbon dioxide (CO_2) equivalent. Rössing Mine's emissions therefore contribute approximately 9.1% of Namibia's GHG gas emissions and 0.0009% of global GHG emissions.

MITIGATIONS

Rössing Uranium should continue to improve and implement the HSE policies and procedures relating to the management of GHG emissions and demonstrate a continual improvement as required by their HSE Management System. Refer to Annexure B for a summary of the measures in place to manage this impact.

The table below provides a summary of the significance ranking.

Green house gas emissions		
	No mitigation	**Mitigation**
Extent	National	National
Magnitude	High	Medium
Duration	Long Term	Long Term
SIGNIFICANCE	**HIGH(-)**	**HIGH(-)**
Probability	Definite	Definite
Confidence	Certain	Certain
Reversibility	Reversible	Reversible

7.4 CONSTRUCTION PHASE IMPACTS

7.4.1 GENERIC CONSTRUCTION PHASE IMPACTS

IMPACT STATEMENT

There are impacts on the socio-economic and biophysical environment that would occur during the construction phases of the proposed mine expansions that are not exclusive to the particular project. Such generic impacts are common to all construction sites and can usually be reliably predicted and mitigated.

Typical construction phase impact management actions would include the following:

- Dust, noise and vibration control;
- Secure storage of fuel and hazardous materials;
- Proper maintenance and operation of equipment and machinery;
- Proper collection, storage and disposal of refuse;
- Provision of facilities for construction workers on site (lighting, toilets, water, eating areas etc.);
- Installation of emergency plans (fire, evacuation etc.) and first-aid procedures;
- Control of traffic safety and road conditions;
- Application of access control and security procedures;
- Application of statutory occupational health and safety standards throughout the site;
- Installation of contingency plans for spillage of fuels or hazardous substances;
- Demarcation of exclusion zones to limit biodiversity disturbance, heritage resource impacts and soil erosion; and
- Control of surface runoff and impacts on water resources.

The generic construction-related impact management actions listed above have been incorporated in the Social and Environmental Management Plan (SEMP) compiled as part of this Draft SEIA Report and presented in Annexure O. Together with the continued application of Rössing Uranium's own best practice and performance standards, particularly those relating to occupational health and safety, typical construction-related impacts can be confidently predicted to be well managed. By implication, any contractors tasked with construction activities will be obliged to maintain the same high standards.

DISCUSSION

A composite assessment of the generic construction-related impacts would indicate that their extent would be local. Their magnitude would be low, since a slight alteration should result from any physical construction activity. A short duration is in keeping with the limited period of time during which construction occurs (up to 3 years in this case). The significance of generic construction phase impacts is therefore regarded as negative but very low.

MITIGATION

Additional mitigation measures are not considered, since best practice and appropriate environmental control measures are already being applied and Rössing Uranium is committed to compliance with all the statutory requirements that govern typical construction site impacts.

The table below provides a summary of the significance ranking.

Generic construction phase impacts		
	No mitigation	**Mitigation**
Extent	Local	N/A
Magnitude	Low	N/A
Duration	Short term	N/A
SIGNIFICANCE	**VERY LOW(-)**	**N/A**
Probability	Definite	N/A
Confidence	Certain	N/A
Reversibility	Reversible	N/A

Construction phase impacts related to the specific proposed facilities are regarded as very low, since few of them are site-specific. However, specialist studies have considered construction phase impacts in appropriate cases, namely the cross-cutting issues of employment creation and construction camps detailed below.

7.4.2 IMPACT ON EMPLOYMENT CREATION DURING CONSTRUCTION

A full copy of the report titled Socio-economic Component of the Social and Environmental Assessment Report for the Rössing Uranium Mine Expansion Project: Socio-economic Impact Assessment and Recommendations for a Socio-economic Management Plan compiled by Marie Hoadley is included as Annexure N9 of this SEIA Report. It forms the basis of the findings presented below.

IMPACT STATEMENT

Mining projects are generally labour-intensive during their construction phases, although this fact should be offset against the non-permanent nature of the employment.

The proportion of unskilled workers required during construction is higher than during the operational phase. A positive benefit of in-service skills enhancement is thus available. Although of a limited duration, construction phase employment will also contribute to the multiplier effect in the regional economy. Figure 23 includes the construction phase employment figures.

DISCUSSION

The impact would be felt at all levels, i.e. local, regional and national, since not only would there be an increased cash inflow in neighbouring towns, remittances to labour-sending areas elsewhere in Namibia would also occur. The magnitude of the impact is regarded as medium since there would be a notable alteration in livelihood enhancement. The duration of the impact is regarded as short term, although the effects may be felt for several years. The probability of it occurring is definite and the impact would not occur if economic conditions should change unfavourably.

The significance of employment opportunities during the construction phase is therefore regarded as moderately positive, since the duration of the impact is limited.

MITIGATION

There is the potential to further enhance the positive impact of construction phase employment, if contractors were to be required to undertake in-service job training. The potential of temporary workers finding permanent employment or being better equipped to find employment outside of Rössing Uranium would thus be enhanced. However, the low skills base and short term nature of construction employment would not significantly increase the already positive impact.

The table below provides a summary of the significance ranking.

Impact of employment creation during construction		
	No mitigation	**Mitigation**
Extent	National	National
Magnitude	Medium	Medium
Duration	Short Term	Short Term
SIGNIFICANCE	**MEDIUM(+)**	**MEDIUM(+)**
Probability	Definite	Definite
Confidence	Certain	Sure
Reversibility	Reversible	Reversible

7.4.3 IMPACT OF CONSTRUCTION CAMPS

IMPACT STATEMENT

The social impacts of construction camps result from large numbers of workers who, while separated from their families and not having the normal family-related duties and distractions, tend towards abusive behaviour. Such behaviour often involves alcohol, promiscuity, and violence. With contract workers receiving a relatively high income, tensions may result in relation to lower earning local communities. The social cohesion of local communities may be affected, particularly when there is ignorance of local customs and practices.

DISCUSSION

A construction camp will be required during the construction of the expansion project facilities. The construction period will last approximately 3 years, and during that period an estimated 200 to 250 construction workers will require accommodation in such temporary facilities.

The most feasible town within which to establish a construction camp is Arandis, and requests from other companies for permission to establish a construction camp have been received by the Council. The town is close to the Rössing Uranium mine, it has all the required services, and such a location would not increase traffic on the B2 between Rössing Uranium mine and the coast. Furthermore there is sufficient space on the periphery of the town for a camp. Rössing Uranium has not decided on the final position of such a camp, but has been evaluating several options in this regard.

The extent of the impact will be felt at the local level. Regarding the magnitude of the impact insofar as social conditions and functioning are concerned, Swakopmund, as a sizable, diverse, and resilient community and could assimilate the new arrivals. Arandis, a small, non-cohesive community with few coping mechanisms, would be subjected to greater impact and the assessment table reflects this. One of the alternatives is to establish a camp on private / state farms. This option does not present a possibility for social impacts, as both potential sites are situated in areas remote from community groups and are thus believed to be of low magnitude and the Swakopmund option as of medium magnitude. The duration of the impact would be short term in all cases.

The Social Management Plan makes recommendations about the location of the construction camp, its management, and limitations on the size of the workforce to be housed there.

MITIGATION

As some of the contractors will be local, and much of the unskilled labour required during construction will also be sourced locally and thus have accommodation, the mitigation measures proposed are intended to become operative in the event that a large part of the construction labour force comes from outside the area and will need accommodation.

Mitigation in the form of comprehensive management plans for construction camps and locating such camps away from settled communities can go a long way towards reducing this impact. Comprehensive management plans should be a contractual requirement in any event.

The table below provides a summary of the significance ranking.

Impact of construction camps		
	No mitigation	**Mitigation**
Extent	Regional	Regional
Magnitude	High	Low
Duration	Short Term	Short Term
SIGNIFICANCE	**MEDIUM(-)**	**LOW(-)**
Probability	Probable	Probable
Confidence	Sure	Sure
Reversibility	Reversible	Reversible

All of the construction phase impacts described in this section would be managed through the implementation of a construction phase SEMP. The purpose of the SEMP is to protect sensitive on site and off site features through controlling construction activities that could have a detrimental effect on the environment. The SEMP is contained in Annexure O of this report.

7.5 CUMULATIVE IMPACTS

Cumulative impacts are difficult to deal with on a project SEIA level, since they may occur outside of the geographical area of the particular project being assessed and thus require the collaboration of other institutions, and involve broader social, economic and biophysical considerations outside the scope of the specific project-level assessment. The fact that several other mining companies have been pursuing uranium interests in the Erongo Region emphasized the need for a holistic approach, by means of a strategic or sectoral level assessment. Such a Strategic Environmental Assessment (SEA) of the so-called "Central Namib Uranium Rush" (Uranium Rush) was recently undertaken by the Southern African Institute for Environmental Assessment, commissioned by the Ministry of Mines and Energy of the Government of Namibia. This section provides a summary of the SEA sections applicable to cumulative impacts.

The SEA (SAIEA, 2010) provides a bird's eye view of cumulative environmental impacts in the Erongo region brought about as a result of the Uranium Rush (and other directly linked developments, and potential developments, such as desalination and chemical plants), and advises on how to avoid negative cumulative impacts and to enhance opportunities for positive impacts, within the uranium sector and between mining and other industries. It should be noted that for some aspects of the environment available data was lacking, such as for biodiversity, and that attaining a level of comprehensive data would be an undertaking of many years. To wait for such a time before development could continue would be unreasonable, and the SEA therefore proceeded with information at hand. The SEA found that the cumulative impacts resulting from the Uranium Rush are not limited to the Erongo region, but are wide-ranging, affecting the southern African region as a whole, particularly the Namibian and South African economies.

The second medium-growth mine development scenario, of the four possible scenarios that the SEA developed, has been used as a departure point to describe cumulative impacts that are relevant to this SEIA Phase 2 for Rössing Uranium's expansion project. This scenario is described as being "in-line with expectations", which is an expected total of 5 to 7 mines operating in the Erongo region by the year 2020. The four mines that currently possess mining licences, and one or two additional mines, are included and predicted to be operating by 2013 in this scenario, as well as the acceptance that existing mines will proceed with planned expansion projects and that uranium prices will be optimistic. The uranium mines included are Rössing Uranium (with expansions) Langer Heinrich (Stages I, II and III), Trekkopje, Valencia, Rössing South (Husab Project) and the Etango Project. Furthermore, one additional non-uranium mine was considered as part of this growth scenario. The other industrial developments that were considered that are directly linked to the uranium mining industry are the two desalination plants by Trekkopje and NamWater, a 400MW coal-fired or compressed natural gas power station at Walvis Bay and the Gecko mining and chemicals operations.

A summary of the description of the cumulative impacts in the SEA (SAIEA, 2010) is included herewith as Annexure P.

7.6 CLOSURE PHASE PLANNING AND PROVISION

Closure planning at all Rio Tinto operations is undertaken in accordance with Rio Tinto Closure Standard Guidance. This addresses the characteristic activities required for planning and implementing closure whilst allowing business units the freedom to interpret these to take account of the particular circumstances of their operation and its social and physical setting. The standard contains guidelines on the following aspects:

- Planning for closure:
    - The knowledge base,
    - Closure strategy,
    - Closure Management Plan, and
    - Decommissioning Plan.
- Implementation and operation;
- Performance measurement:
    - Cost estimating,
    - Review, and
    - Monitoring.

The Minerals Policy for Namibia requires a Final Mine Closure Plan to be prepared before a mining licence is granted and the Chamber of Mines of Namibia has recently published its draft framework for mine closure. The latter is based on the Australian Strategic Framework for Mine Closure with the aim of developing relevant and practical closure plans.

Closure planning at Rössing will continue to be driven by the Rio Tinto closure standard, whilst taking account of the guidance from the Chamber of Mines of Namibia. Planning for closure of the Rössing mine began in 1991. Since then there have been several significant milestones, including the Technical Closure Studies (2001-2002) and the Social Closure Strategy (2005), both of which provided important input into the 2005 Closure Management Plan (CMP). This was prepared in accordance with the Rio Tinto Closure Standard issued in 2004. It is currently being updated in accordance with the Rio Tinto 5-year update cycle and will take account of the proposed expansion project.

As part of this process all Rio Tinto operations, including Rössing Uranium, are required to develop, maintain and manage a process for eventual closure, which addresses all relevant aspects and impacts of closure in an integrated and multi-disciplinary way, and provides a fully scoped and accurate cost of closure to the company that is documented and auditable. Thorough and comprehensive definition of the scope of measures to be undertaken at closure is necessary in order to reach a realistic estimation of the costs, and to provide assurance to the directors and shareholders that adequate financial provision for closure has been made. Reporting of closure provisions to the corporate body is an annual event. The adequacy and validity of closure planning at all operations is internally, but independently assessed by the corporate body through the Closure Management Plan Review process.

7.6.1 CLOSURE ASPECTS OF THE EXPANSION PROJECT

Closure implications for the heap leach project have investigated the differences of the base and expansion cases as follows:

- The base case represented by the currently approved LOM plan with tank leach processing until 2023; and
- The expansion case that includes a new 15Mtpa heap leach process facility in addition to the existing tank leach operation and continues until 2026.

Some aspects of the current Rössing Uranium operation, such as the mining method or the tank leach process, remain essentially unchanged by the introduction of the expansion option, although there are important changes for other aspects. Locating the heap leach facility on the existing TSF, and placing the spent heap leach material (ripios) on the Rössing Dome, will require different closure measures compared to the base case. Because of the tailings generated by the tank leach process can no longer be disposed of on the entire footprint of TSF, the TSF will have to be raised to a height of 680mamsl.

7.6.2 EXPANSION OF THE OPEN PIT AND ASSOCIATED WASTE ROCK MANAGEMENT

The current mining rate must increase to satisfy the expansion case (~65Mtpa is expected between 2011 and 2017), and both cases result in additional waste rock production. As a result, the dimensions of the open pit will increase and additional waste material will be deposited on the waste rock dumps located on the southern side of the open pit adjacent to Pinnacle and Dome Gorges. The footprint of these dumps is not expected to enlarge, but they are expected to increase in height. The conclusion from the closure implications summarised below is that the increase in size of the open pit and the additional waste rock generated do not pose any particular difficulties for site closure:

- Radon emanation: The increase in pit size or dump height does not itself justify installation of a radon barrier but the increased emanation will be incorporated into an updated public dose assessment for the whole site. Some mitigation may be required depending on the outcomes from this assessment.
- Surface and groundwater quality: The additional dimensions of the open pit do not result in any changes to its capability to store and evaporate drainage water to prevent surface or groundwater contamination, e.g. through reaching the Khan River. Waste dump design must include installation of a store and release cover and ensure drainage is directed towards the open pit. Passive reactive barriers will have to be installed to control potential leachates in the long term.
- Geotechnical stability: The increased size of the open pit does not entail additional measures to stabilise final rock faces and benches. Dump designs must establish whether the new dump heights require installation of specific drainage measures to ensure and maintain slope stability.
- Biodiversity: Longer-term trials to establish how best to encourage plant colonisation of the upper surface and slopes of the waste dump can be implemented.
- Accessibility: The increase pit size or waste dump height does not required additional measures to prevent public access.
- Aesthetics: The additional height requires the dumps to be designed to minimise visual intrusion from key viewpoints within the Khan River Valley and from the south. Revegetation of the slopes will be encouraged.

7.6.3 HEAP LEACH FACILITY

The closure implications for the heap leach are summarised below and the main conclusion is that the heap leach facilities do not pose any particular difficulties for site closure:

- New comminution circuit: This equipment has the potential for reuse by other mining operations following clean-up and refurbishment. If beneficial re-use or recycling as scrap is not viable, plant will be dismantled and disposed of within the open pit.
- Screening and agglomeration circuits: The extent of contamination and potential for decontamination and beneficial re-use/recycling will be dependent upon the extent of the wet/dry parts of the circuit, and must be established. If beneficial re-use or recycling as scrap is not viable, dismantling and disposal within the open pit will be required.
- Racetrack stackers and conveyors: The racetrack stackers and conveyors have the potential for reuse by other mining operations following clean-up, refurbishment, and dismantling. If beneficial re-use is not viable, the structure and plant will be broken up and disposed of as scrap or within the open pit. Drainage pipes may be removed progressively if the final design permits and the spent area covered with ripios.

- Storage ponds and CIX plant: The contaminated liners may be buried beneath ripios, but tanks, pumps, piping and associated infrastructure will require disposal in the hazardous waste site for low level radioactive waste or within the open pit.
- General plant area: The preferred closure actions are contained within the current 2005 Closure Management Plan.

7.6.4 TAILINGS STORAGE AND USING RIPIOS AS A FINAL COVER

The continued deposition of tailings on the TSF and the establishment of the heap leach pad on the northern TSF results in the following:

- Water will continue to recharge the tailings facility until mine closure and needs to be controlled for 30 years until active pumping become unfeasible;
- Resistance to wind and water erosion and greater geotechnical stability need to be maintained at greater heights;
- Placement of ripios cover to prevent water erosion on the outer faces of the tailings pile may be problematic if the outer slopes are steep;
- A reduction in the water inventory of the tailings mass within the existing TSF that would make seepage and potential contamination easier to manage and control is not foreseen;
- A decline in surface water drainage from the TSF during the operational period is not foreseen; and
- Increased overall radon emanation from the site because of the larger surface area of tailings.

The implications of increasing the height of the TSF to higher levels are as follows:

- Volumes and final height: The additional volumes of tailings produced up to 2023 are estimated at ~180Mm^3 for the 14Mtpa tank leach process, which would result in a final surface height that in the region of 680mamsl.
- Geotechnical stability: This is expected to be sufficient, but requires further confirmatory analysis.
- Wind erosion: Generally the higher profile to the TSF will increase the potential for wind erosion and dust generation. Rock waste or ripios covers need to be placed for stabilisation. Further investigations to determine how to best place the ripios or waste rock cover over the outer margins of each berm is required.
- Water erosion: This will remain a critical aspect to address. The specification of a potential ripios cover and its placement over the outer margins of each berm is critical in order to maximise infiltration/exfiltration and minimise lateral drainage. Further analysis of these aspects, including the margin design, will be required.
- Groundwater seepage: Water inventory within the TSF will remain high until cessation of the processing operations. Updating the geo-hydrological model to incorporate the expected changes in inventory will confirm the long term seepage and groundwater pumping requirements. Longer-term control will be through attenuation or the use of reactive barriers.
- Surface water drainage: Current surface water drainage from the TSF is expected to continue. The present control and management measures are anticipated to be sufficient, and it will be possible to recycle pumped water. Additional geo-hydrological modelling is needed to confirm this in future.
- Radon emanation: The surface area of tailings will increase the overall radon emanation from the site. This in itself may not itself justify installation of a radon barrier but the increased emanation will be incorporated into an updated public dose assessment for the whole site. Some mitigation may be required depending on the outcomes from this assessment.
- Aesthetics: There will be visual intrusion from the TSF because of the final height and the light colour of the ripios or rock cover. Final shaping of outer edges of the TSF needs to be considered.
- Accessibility: The current proposal for a ditch and rock berm as part of the cover design with a peripheral fence and warning signs is satisfactory for the TSF.

The main conclusions for use of Ripios as a cover for the TSF are:

- Further test work is required to confirm that ripios meets the cover design specification required to cover the TSF;
- If ripios does not meet the cover design specification, placement of conventional rock cover on the TSF and the Dome may be necessary; and
- Natural revegetation may initially be restricted because of the residual acidity of the Ripios but this will reduce in time and allow colonisation, which should assist its stability and store and release cover characteristics.

The closure implications for the use of ripios as a cover for the TSF and the ripios disposal facility on the Dome are summarised below:

- Cover design: No changes to the current cover design specifications are needed. The initial predictive modeling indicates that ripios functions as an effective store and release cover with negligible net percolation (<1.0% of average rainfall) and limited infiltration during extreme 24-hour storm events (e.g. 124mm for 17mm diameter ripios from a 1:10,000 year event). This modeling also shows ripios is resistant to water erosion with removal of approximately 40m^3/year over a 1,000 year period using conservative erosion parameters under average rainfall conditions. The inclusion of a major storm event did not affect these rates. Gulley development over the same period indicated that galleys up to 0.9m deep could be created near the crest of the slopes. The long-term resistance of ripios to weathering and the behaviour of salts during the wetting/drying cycles of intermittent rainfall events are of long term concern. The potential for precipitated salts to cement particles together or form pans with limited permeability that will influence infiltration/exfiltration characteristics or the ability of ripios to maintain a free-draining physical structure that resists water erosion need to be investigated. In addition washing of fines into the matrix to prevent infiltration may also lead to ongoing erosion of the upper layers and destruction of the cover function. Further test work to confirm the input parameters for the models and the physical and chemical characteristics of the ripios is needed to confirm its suitability as a final cover.
- Geotechnical stability: The geotechnical stability of the existing tailings mass is sufficient to provide a stable foundation for the deposition of the ripios cover. Initial predictive modeling of the resistance of the ripios to water erosion confirms that the overall stability of the ripios will be good, but further confirmatory analysis of long-term durability, rock integrity and weathering characteristics is required.
- Wind erosion: Some dust generation may be expected during placement of the ripios and from deflation of smaller particles present on the surface material as these dry, but both effects will be temporary.
- Water erosion: No adverse effects are expected over the flat or gently sloping areas of the TSF and the Dome deposition areas because the ripios will act as a store and release cover balancing infiltration and exfiltration with little or no lateral movement of water. Placement of the ripios over the steeper outer slopes of the TSF is critical in order to provide sufficient depth of material to maximise infiltration/exfiltration and minimise lateral drainage. Further analysis of these aspects and also the detailed toe design on the western side of the TSF will be required.
- Groundwater seepage: Water inventory within the ripios storage facility will be reduced as it drains down and because infiltration from the spread ripios is negligible. Updating the geohydrological model to incorporate the expected changes in inventory will confirm long term seepage and groundwater pumping needs. Longer term control will be through attenuation or the use of reactive barriers. The ripios storage facility is not expected to change groundwater seepage from the Dome which will drain southwards and collect within the open pit through lateral geological fractures and no further action is envisaged.
- Surface water drainage: Run-off from the ripios (<10% of rainfall) will not affect the current surface water drainage from the TSF. Any surface water draining from the Dome disposal area will collect within Dome Gorge in the surface water cut-off trench and be recycled during operations or drained to an evaporation area after closure. Seepage that by-passes the cut-off trench will drain to the open pit through lateral geological fractures.
- Radon emanation: The emanation of radon from ripios is similar to that of the tailings material. Consequently the ripios cover will not change radon emanation from the TSF or the levels of emanation from ripios deposited on the Dome.

- Biodiversity: Over the long term the ripios is expected to remain acidic in the range 4.4pH to 7.0pH because of the formation of dilute acid from leaching. This process was confirmed in the 6-month rainwater simulation column test work. As a consequence, the colonisation by native species may be quite slow, until the residual acidity is reduced, although the smaller particle size distribution of the ripios (compared to a waste rock cover) will probably result in a more favourable long-term plant habitat. Long-term re-colonisation and transplantation studies will be needed to show that natural colonisation can be expected in time.
- Aesthetics: There will be visual intrusion from the TSF because of the final height and the light colour of the ripios if used. Visual intrusion from the Dome can also be expected but will be less pronounced.
- Accessibility: The current proposal for a ditch and rock berm that forms part of the cover and toe design is satisfactory and a similar enclosure will be provided on the Dome. Additional warning signs will be erected.

7.6.5 CLOSURE PLAN FOR EXPANSION PROJECT

Closure for the expansion project has been examined in terms of the additional closure measures and cost over and above those proposed for the current operation in the 2005 Closure Management Plan (CMP). The key actions include:

- Open pit and waste dumps: No additional measures will be required at closure. Enlargement of the open pit will increase the length of the pit margin and require installation of additional fencing and the rock berm.
- Tank leach facility: No additional measures will be required at closure.
- Heap leach comminution, conveying and agglomeration circuit:
  - Transfer all crushed ore from plant, stockpiles, surge bins, screens and agglomerator drums to final heap leach;
  - Isolate and disconnect power and water supplies to plant;
  - Clean and decontaminate crushers, crusher housing, bins, stockpile area, screens and screen housing;
  - Clean and decontaminate agglomerator and conveyors;
  - Dismantle crushers, crusher housing, bins, screens, screen housing and agglomerator;
  - Decontaminate surrounding soil and foundations;
  - Clean, decontaminate and dismantle conveyors;
  - Sell these for re-use by other mines or sell as scrap metal; and
  - Where sale is not viable dispose of within open pit.
- Heap leach racetrack, stackers and conveyors:
  - Isolate and disconnect power and water supplies to heap leach stackers, ripios reclaim stackers and conveyors;
  - Clean and decontaminate stackers and conveyors;
  - Dismantle stackers and conveyors;
  - Sell for re-use by other mines or sell as scrap metal;
  - Where sale is not viable dispose of within open pit;
  - Remove drainage pipes and dispose of in hazardous waste area or cover with ripios as part of final cover;
  - Puncture HDPE liner at base of each dump; and
  - Grade (where necessary) and cover base of exposed leach pads and exposed tailings with minimum 1.0m depth ripios from remaining spent leach dumps.
- Heap leach storage ponds and CIX/SX plant:
  - Drain pregnant, intermediate and barren leach ponds, fresh water rinse pond, all tanks, pipes and pumps;
  - Backfill ponds with ripios;
  - Isolate pumps and remove for disposal in hazardous waste site;
  - Isolate and disconnect all other utilities (compressed air and acid tanks);
  - Remove pipes to the plant and dispose of in hazardous waste site;
  - Descale and clean acid tanks and all reagent mixing tanks;

  - Dispose of all liquors by evaporation and add residues to sump in ripios/ TSF;
  - Remove resins from CIX carousels and dispose of in hazardous waste site;
  - Clean and decontaminate CIX pre-filter plant and carousels; and
  - Demolish all tanks and dispose of in open pit.
- Heap leach miscellaneous closure items:
  - Clean up reagent handling equipment at the reagent storage area in Walvis Bay;
  - Clean reagent storage areas at Walvis Bay for disposal to further industrial use; and
  - Clean and remove all remaining structures within the heap leach area and dispose of in open pit.
- Tailings and ripios: During operations ripios will be used to progressively cover the existing tailings within the western arm of the TSF. Consequently, at closure the final spent leach dumps will be used as cover the eastern arm of the existing tailings and the final strip. The following measures will be required:
  - Grading of existing tailings on eastern arm of TSF and place ripios to a minimum depth of 1.0m;
  - Undertake design for western toe to incorporate marble foundation placement, silt trap and rock berm;
  - Place vegetation promoting cover (if required) on final layer of ripios on Dome using truck and dozer;
  - Dismantle conveyors and stackers;
  - Sell for re-use by other mines or as scrap metal; or
  - Where sale is not viable dispose of within open pit.

The closure schedule remains consistent with that contained in the 2005 CMP. A two year period will be required to dismantle the processing plant and cover the tailings facility. A period of 10 years requiring pumping of surface water drainage and a 30 year period for continued active groundwater control are predicted and allowed for in closure planning.

8 CONCLUSIONS AND RECOMMENDATIONS

This chapter concludes the report, describes the recommendations that have emerged from the assessment of identified potential impacts and mitigation measures, and provides a synopsis of the preferred alternative actions that Rössing Uranium is applying for authorisation of.

8.1 CONCLUSIONS

The proposed developments consist of Rössing Uranium implementing the following activities or establishing the following components of their expansion project, as listed below. The general layout of the proposed expansion project components is illustrated on Figure 8. In summary, these activities and facilities include the following:

EXTENSION OF THE CURRENT SJ OPEN PIT

- The horizontal extension of the existing open pit;
- This will be done in phases to actively mine the pit until 2026;
- The main extensions will be to the north west and south west;
- Additional mining equipment will include 19 new 180t haul trucks, 5 rope shovels, a hydraulic shovel, a blast hole diesel drill and 3 blast hole drilling rigs; and
- Blasting intensity to remain the same as per the existing operations, although frequency will increase from one blast per week to two to three blasts per week.

INCREASED WASTE ROCK DUMP CAPACITY

- Mainly vertical extension of existing waste rock dumps;
- Positioned to allow for future potential pit limits and not sterilising potential future mining areas; and
- Additional impact on Khan River minimised through limiting it to the existing footprints where possible.

CRUSHING LINE

- An additional crushing line will be established in parallel to the existing crushing line, similar to the existing, except that ore need not be crushed as fine for the proposed heap leaching.

INCREASED TAILINGS STORAGE FACILITY CAPACITY

- Tailings from the current tank leach process will continue to be disposed of on the existing tailings facility that will be extended vertically from the current 640mamsl to 680mamsl; and
- Similar to the existing, tailings will be disposed of using the conventional paddy deposition method.

AN ACID HEAP LEACH FACILITY

- Proposed new processing technology to be introduced on top of the north-eastern segment of the existing tailings storage facility;
- Crushed ore is placed on the prepared pad by means of mechanical stacker reclaimer system following preparation in the agglomeration drum to introduce the sulphuric acid and other chemicals to optimise the leach process;
- Stacker reclaimer system follows the process around the "race track"-shaped pad of approximately 2km in length; and
- Stacked heap is then drip irrigated with sulphuric acid and leachate is collected in a collection system and then processed to extract the product in the existing plant.

RIPIOS DISPOSAL AREA

- Spent ore from heap leaching will be disposed of in a new area on the Rössing Dome in a half circle shape with the radius of approximately 1km; and
- The ripios will be transported there with a rope conveyor system which can be easily and entirely removed at decommissioning as it is seen as temporary features.

ADDITIONAL PLANT AND OTHER RELATED INFRASTRUCTURE

- Existing tank leach processing facility will remain largely unchanged with provision of additional continuous ion exchange and solvent extraction facilities for the heap leach plant; and
- Additional office facilities and other staff amenities will be provided with each of the listed facilities.

We submit that this Final SEIA Phase 2 Report provides a sufficiently comprehensive assessment of the issues raised during the scoping stage and later in the public participation process by I&APs, stakeholders, National, Regional and Local authorities, Rössing Uranium and the SEIA project team inclusive of specialists. Table 12 provides a summary of the significance of the environmental impacts associated with this proposed project, both without controls and with recommended mitigation applied.

Table 12: Summary table of impact significance

MINE EXPANSION OPERATIONAL PHASE		WITHOUT Controls	WITH Recommendations
Socio-Economic			
	Sustainability of Arandis	High(-)	Medium(+)
	Employment creation	High(+)	High(+)
	Public health and safety	Medium(-)	Low(-)
	Housing on property markets	High(-)	Medium(-)
	Housing at Arandis and Swakopmund	High(-)	Medium(-)
	Local economies	Medium(+)	High(+)
	Inward migration	High(-)	High(-)
	Social services	High(-)	Medium(-)
Air quality			
	Human health due to PM10 emissions	High(-)	Medium(-)
Archaeology			
	Archaeological sites	Very Low(-)	Very Low(-)
Biodiversity			
	Possible species loss in the Dome area	High(-)	High(-)
	Reduction in the productivity of plants and in abundance of soil crust organisms and small invertebrates	High(-)	High(-)
Ground vibration and air blast			
	Ground vibration, air blast and fly rock	Low(-)	Low(-)
	Fumes	Medium(-)	Low(-)
Groundwater contamination			
	Waste rock dumps	Medium(-)	Medium(-)
	Heap leach and plant	Very Low(-)	Very Low(-)
	Ripios disposal facility	High(-)	Low(-)
	Tailings storage facility	High(-)	High(-)
Noise			
	Noise	Low(-)	Very Low(-)
Occupational health and safety			
	Occupational health and safety	High(-)	High(-)
Radiological public dose			
	Dust and radon inhalation	Low(-)	Low(-)
Traffic			
	Road network	High(-)	Medium(-)
	Emergency evacuation	Medium(-)	Low(-)
Visual			
	Visual	High(-)	Medium(-)
General waste			
	Pollution of ground and surface water	Very Low(-)	Very Low(-)
	Siltation of streams due to exposed surfaces	Very Low(-)	Very Low(-)
Hazardous waste			
	Pollution of groundwater	Low(-)	Very Low(-)
	Odours from landfill	High(-)	Low(-)
	Danger to health and safety of workers	High(-)	Low(-)
Water and energy resource use			
	Water supply	High(-)	Medium(-)
	Energy supply	High(-)	Medium(-)
	Greenhouse gas emissions	High(-)	High(-)

8.1.1 LEVEL OF CONFIDENCE IN ASSESSMENT

With reference to the information available at this stage of the project planning cycle, the confidence in the environmental assessment undertaken is regarded as acceptable for decision making, due to the fact that the assessment is based on a maximum (worst case) expansion scenario and the potential impacts are well defined and understood as a result of this being an existing operational mine.

It is acknowledged that the project details may evolve during the detailed design and construction phases. However, these are unlikely to change the overall environmental acceptability of the proposed project. Furthermore, any significant deviation from that assessed in this SEIA should be subject to further assessment and may require an amendment to the conditions of the MET:DEA clearance, after due process has been met.

To further increase the level of confidence in the assessment, the Draft SEIA Report will be subjected to both internal and independent external review prior to public release and submission to the MET:DEA.

8.1.2 OPERATIONAL PHASE IMPACTS ON THE SOCIAL AND BIOPHYSICAL ENVIRONMENT

Table 12 shows the operational impacts of the proposed expansion project components on the social and biophysical environment. The most significant negative impacts, i.e. those of a ***medium or high negative rating, with mitigation*** include the following:

SOCIO-ECONOMIC

- Housing on property markets ~ The requirements for housing the mine's workforce will destabilise property markets in the towns, as a shortage in housing will inflate house prices in anticipation of the mine's need to provide additional housing.
- Housing at Arandis and Swakopmund ~ Rössing Uranium's increasing workforce may impact negatively on the social and community processes in Arandis and Swakopmund.
- Inward migration ~ Inward migration of work seekers to Erongo Region will increase as a result of the perceived job opportunities offered by the proposed expansions to the mine.
- Social services ~ With current capacity, the schools in Swakopmund and Walvis Bay may not be able to accommodate the schooling requirements of an enlarged workforce at Rössing Uranium. Within the mine's communities of impact, there are large numbers of people who do not have the option to send their children to private schools, and as the numbers of such people increase, their reliance on state services places severe strain on the capacity of the service providers.

AIR QUALITY

- Human health due to PM10 emissions ~ Mine emissions from vehicle movement, materials loading and transportation, wind erosion, drilling and blasting activities and emissions from on-site stacks (i.e. at the roasters, scrubbers and baghouse), will have an impact on ambient air quality as these are sources of dust. The main pollutant of concern is dust particles suspended in the air, especially smaller particles called PM10. These particles are inhaled via the respiratory system and may impact on human health. The closest residential area to the mine is Arandis.

BIODIVERSITY

- Possible species loss in the Dome area ~ Although it is unlikely, the establishment of a ripios disposal area measuring approximately 1.8km^2 on the Dome area will potentially result in the loss of endemic animal species.
- Reduction in productivity of plants and abundance of soil crust organisms and small invertebrates ~ The increased dust accumulation around the mining operations may reduce the productivity of plants, and reduce the abundance and diversity of soil crust organisms and small invertebrates. The air quality study, however, predicted no significant increase in dust fallout as a result of the expansion project.

GROUNDWATER CONTAMINATION

- Waste rock dumps ~ It is expected that minor leachate volumes could be generated by the rock dumps after rainstorms and this may impact on groundwater.
- Tailings storage facility ~ The continued disposal of tailings on the current tailings facility is expected to contribute towards continued groundwater mounding.

OCCUPATIONAL HEALTH AND SAFETY

- Occupational health and safety impact ~ The proposed mine expansion is expected to result in a potential increase in occupational health risk to mine workers.

TRAFFIC

- Road network ~ It is expected that traffic volumes on the B2 road between Walvis Bay and Swakopmund and Swakopmund and Rössing Mine will increase by approximately 30% following the proposed expansion at the mine. This may have an impact on road traffic management and road safety.

VISUAL

- Visual ~ It is expected that the various mine expansion activities will have an impact on the visual, aesthetic and scenic environment of the area and the surroundings.

WATER AND ENERGY RESOURCE USE

- Water supply ~ the various components of the Rössing Uranium expansion project are expected to result in an increase in the demand for available water, especially given the proposed water intensive heap leach facility.
- Energy supply ~ the various components of the Rössing Uranium expansion project will result in an increase in the demand for electricity.
- Greenhouse gas emissions ~ the various components of the Rössing Uranium expansion project is expected to result in an increase in the generation of greenhouse gases.

8.1.3 CONSTRUCTION PHASE IMPACTS

The expected impacts of the construction of the proposed expansion project components on the social and biophysical environment is elaborated on in Section 7.4.3. None of these are expected to be of high negative significance with mitigation.

8.1.4 SOCIAL AND ENVIRONMENTAL MANAGEMENT PLAN AND CLOSURE PLAN

A draft of the SEMP that has been developed to guide the design, construction, operational and closure phases of the proposed project is contained in Annexure O of this report. The implementation of the SEMP would minimise possible negative impacts on construction and operation and assign responsibility for environmental controls, i.e. ensure that the recommended mitigation measures are applied and the impact significance ratings are consequently reduced to acceptable levels. More detailed project specifications, for inclusion in the various construction contracts, would be required should the project be approved and the engineering designs of the various components have been finalised. The detailed project specification would also take cognisance of any conditions of the MET:DEA clearance.

It should be noted that the Draft SEMP presented in Annexure O is designed to serve as a clear and detailed indication of Rössing Uranium's intention to address social and environmental controls during the design, construction, operational and closure stages of the expansion project. Its finalisation and ultimate approval is expected to be a condition of the environmental clearance presently being sought from MET:DEA.

8.2 RECOMMENDATIONS

8.2.1 ALTERNATIVES

With reference to the project alternatives examined in the SEIA Phase 2 process and described in this report, we recommend that the preferred alternative as presented herein be approved based on the conclusions reached and the extensive process followed to determine the preferred layout for the proposed project components and facilities.

8.2.2 MITIGATION MEASURES

For numerous of the impacts identified in the process and examined in this SEIA, the key to the most effective mitigation measures available lies in the application of international best practice, either in the engineering design of the particular project component, or through the strict on-site implementation of existing operational controls to ensure that prescribed performance standards or limits are met. In these cases there is no need for specification of additional mitigation measures, since the objective of mitigation has effectively been addressed and any additional mitigation is unlikely to further reduce the significance of the impacts. The advantages in dealing with this category of impacts are that the design engineers and operational staff have given due consideration to the relevant social and environmental issues and have built in the required mitigation measures (hence no need to specify any in addition), and that strict implementation is guaranteed. All specified mitigation has to be considered against the background of existing measures in place at Rössing Uranium.

However, the significance levels of most of the rest of the identified impacts could generally be reduced by implementing the recommended mitigation measures. This section summarises the recommended mitigation measures described in the assessment for the most significant impacts identified and where mitigation will significantly reduce the impact significance (regardless of actual significance), where these are available, and the assumption is made that these will be implemented.

Socio-economic

- Impact on the sustainability of Arandis~
  - The mine's activities should be aligned to ensure the sustainability of the town of Arandis e.g. phasing out mine ownership in Arandis, continuing the assistance for capacity building, support of service providers in the town of Arandis and informing the Arandis community as soon as downscaling and/or closure become possibilities.
- Impact of housing on Arandis and Swakopmund~
  - The shortage of housing and impact on communities in Swakopmund and Arandis may be limited by identifying available temporary accommodation for rent, providing housing in the Progressive Development Area in Swakopmund and considering the provision of mobile homes.
- Impact of inward migration~
  - Attempts should be made to stem inward migration by preventing backyard shack dwelling, informal housing and the attendant health and social problems by promoting home ownership and a formal housing scheme.
- Impact on social services~
  - A shortage of schooling facilities may be addressed by building extra classrooms at schools were the shortage is most critical and by considering the building of a new school.

Air Quality

- Impact on human health due to PM10 emissions ~
  - The main source of fugitive particulate emissions, also predicted to contribute to the highest impacts, is from vehicle entrainment on unpaved road surfaces within and around the open pit. It is recommended that dust control products such as Hydro Tac, Hydro Sperse or similar be investigated to further reduce emissions from this fugitive dust source.
  - It is further recommended that the dust fallout network, established for the two month monitoring campaign, be continued to monitor increases in dust fallout in the surrounding area due to the proposed expansion activities. Continued PM10 monitoring should be undertaken at the sensitive receptor of Arandis to establish emission contributions from Rössing Uranium.

Biodiversity

- Possible species loss in the Dome area ~
  - The impacts on the rocky hillsides habitat should be avoided or minimised.
  - In future, complementary and simultaneous survey effort should be focused on the sampling areas external to the impact site (20km buffer around the Dome) as well as within it.

- Prioritise biodiversity surveys within the rocky hillside habitat, with the objective of collecting and/or rediscovering the eighteen invertebrate species within the critical priority category.
- Place particular focus on discovery of the four critical priority spiders only found to date within the rocky hillside habitat.
- Targeted surveys and sampling of areas to be planned and carried out when the best conditions arise, taking advantage of any climatic periods suitable for invertebrate surveys.
- With additional funding available, a list of priority species should be re-analysed and updated on the basis of new work on existing material collected from species which comprise most of the high priority list.
- Institute long term sampling and monitoring programme to be carried out by Rössing Uranium staff and external specialists for the impact site and for areas outside the MLA, within the rocky hillside habitat, open plains and water courses. Prioritise invertebrate sampling, but design monitoring programme to include all species indicated on the Conservation Concern Priority List.
- During expansion operations, use any opportunities for destructive sampling of habitats and associated studies to inform and add to the existing database on high priority species.
- Where possible, translocate and protect individuals of two plant species of concern (*Adeniapechuelii* and *Lithopsruschiorum*).
- Include the two high priority reptile species (*Pedioplanishusabensis* and *Meroles* sp) in future biodiversity surveys within and external to the impact site.
- Circulate biodiversity information with other mining companies, in order to address the impacts of uranium mining on impacted species with larger ranges.
- Encourage continued analysis of existing invertebrate material and museum collections from previous biodiversity surveys at Rössing Uranium in order to further update and refine the list of species on conservation concern.
- Consider investing in an offset project to realise the overall net positive impact requirement set by Rio Tinto.

- Reduction in the productivity of plants and in abundance of soil crust organisms and small invertebrates~
  - Carry out pilot surveys to guide development of long term monitoring programme on impacts of dust and disturbance on biodiversity outside of expansion impact sites, including roads.
  - Identify and select indicator species for long term monitoring of the impact of dust (using a 5km buffer from operational areas, pits, crushers, dumps and roads).
  - Monitor spider and solifugids to gain understanding of the reasons for the low densities of these species.

GROUNDWATER CONTAMINATION

- Groundwater contamination from the ripios disposal facility~
  - Upstream cut-off drains;
  - Seepage control facilities to be constructed below the ripios facility in the low gorges;
  - The transport model developed by Aquaterra will be used to assist in formulating appropriate additional management measures; and
  - Additional boreholes are required to monitor the effectiveness of the management measures.
- Groundwater contamination from the tailings storage facility ~
  - The establishment of long term passive groundwater filters (passive reactive barriers) need to be investigated to control minor residual groundwater flow.
  - Continuous pumping 30 years after closure will not yield sufficient water to allow pumping anymore.
  - Adopt best practice methods for seepage control and detection around potential pollution sources, construct suitably sized and separate stormwater collection drains for 'clean' and 'dirty' stormwater, and conduct regular monitoring and reporting.

OCCUPATIONAL HEALTH AND SAFETY

- Occupational health and safety impact~
  - Risks identified due to the introduction of new equipment need to be addressed by means of engineering controls and these need to be incorporated into the design of the new equipment.

Identified risks related to maintenance and operational tasks need to be addressed by strictly following working procedures already in place at Rössing Uranium.
  - To eliminate any remaining possibility of health impacts, monitoring systems and procedures need to be implemented.
  - The design of engineering controls needs to be requested from the providers of the new equipment (for example dust extraction systems in areas of potential dust generation).
  - Existing standard operating procedures and safety measures need to be implemented at the heap leach plant.

VISUAL

- Visual impact of waste rock dump
  - To be designed within the defined visual preference height specifications, limiting the level to 635mamsl.
  - Elevated and prominent angular shapes of the waste rock dump need to be rounded so as to reduce the level of contrast generated by the corners and straight lines created by the benching, to ensure that these prominent features appear more natural in relation to the surrounding landscape.
- Visual impact of coarse ore stockpile
  - Removal of the remaining ore stockpile and structures associated with the stockpile at mine closure and shaping the site to a natural land form.
- Visual impact of plant and structures
  - Structures should be as low as possible.
  - Natural desert colours (medium grey-brown) should be used, especially for larger surfaces such as roofs and storage tanks.
  - All components of the infrastructure should be removed at mine closure and the site should be landscaped to natural forms.
  - Bright colours such as red, green, white, and blue should be avoided, except for required safety markings.
  - Surface pipelines are to be painted grey, unless required to be colour coded for safety reasons. Glass surfaces should be shielded to avoid glare and reflections.
- Visual impact of heap leach facility
  - Dust control measures to be implemented during construction.
  - Large permanent machinery needs to be painted a grey-brown desert colour.
  - All machinery, structures, and remaining ore to be removed at closure.
- Visual impact of blast plume
  - Blasting should preferably take place in the afternoon when the atmospheric haze is more intense, on preset days so that tourist ventures can plan to use the surrounding areas when no blasting is taking place.
  - It is recommended that blasting times are co-ordinated with other mines to ensure that the cumulative impacts of blasting are reduced as far as possible.
- Visual impact of ripios disposal
  - Machinery and structures should be painted in grey-brown desert colours.
  - Dust control measures should be implemented during the construction phase.
  - Strict dust control measures should be implemented to ensure that dust generated during the stacking process is limited.
  - The outer edges need to be smoothed off so as to create a more rounded shape.
  - All machinery and equipment should be removed from the site at closure.
- Visual impact of tailings storage facility
  - During operation the outer edges of the TSF need to be rounded off.
  - The creation of a more natural line is proposed to mitigate the visual impact of the proposed TSF.
- Visual impact of lights at night
  - All lighting is to be kept to a minimum within the requirements of safety and efficiency.
  - Where such lighting is deemed necessary, it should be restricted to low-level lighting.
  - No external up-lighting of any parts of the structures, including the stacks, should be allowed.

  - External lighting should use down-lighters shielded in such a way as to minimise light spillage and pollution.
  - To reduce the light impact of the ripios stacker, lighting reduction design and technologies should be assessed. The aim should be to reduce the source light generated by the stacker operating at night from any prominent location.
  - Security and perimeter lighting should also be shielded so that no light falls outside the area needing to be lit.
  - Overly tall light poles are to be avoided. No naked light sources are to be directly visible from a distance (except for the aircraft warning lights) and only reflected light should be visible from outside the site.

HAZARDOUS WASTE DISPOSAL

- Impact of odours from the landfill~
  - Implement management actions to mitigate odours generated by waste materials such as daily cover and not disposing of waste under wet conditions.
  - Covering waste with hydrated lime may also assist in reducing odour nuisance.
- Danger to health and safety of workers~
  - Workers should be properly trained and access control to the site should be enforced. A safety officer should be appointed to ensure that safe procedures are being adopted. A safety plan should also be compiled and displayed for all staff to comply with. The safety plan should cover topics such as:
    - ~ No smoking on the site;
    - ~ Awareness of vehicle movements particularly on or near the working face;
    - ~ Protective clothing requirements;
    - ~ Keeping the site clear of mud and rubbish;
    - ~ Dust suppression;
    - ~ Ensuring that vehicles at the working area have a firm riding surface;
    - ~ Ensuring the stability of permanent and temporary embankments;
    - ~ First aid and accident procedures;
    - ~ Any other applicable working regulations; and
    - ~ Dangers of landfill gas and leachate.
  - Workers should be provided with protective clothing, such as overalls, heavy duty safety boots, gloves, goggles, and dust masks.
  - Various training schemes are available to site operating and supervisory staff. Operator training may take place on site, while supervisory training may take place at training institutes. Along with suitable training of personnel, it is also imperative to introduce emergency procedures. A decision flow chart defining broad emergency strategies should be readily available to all personnel. This flow chart should incorporate a set of trigger and completion parameters, i.e. a set of parameters that will trigger and end an emergency procedure respectively. Possible example emergency scenarios should be displayed along with the flow chart and a list of actions and information common to all emergencies should be provided. The list should contain information such as:
    - ~ Names of contact persons in case of an emergency;
    - ~ Emergency contacts (fire, police and ambulance); and
    - ~ Flow of information (who should be notified and when).

WATER AND ENERGY RESOURCE USE

- Impact of increased water use~
  - Rössing Uranium should continue to improve and implement the HSE policies and procedures relating to the management water and energy and demonstrate a continual improvement as required by their HSE MS.
  - The use of desalinated water is currently being explored and may be supplied firstly from the existing Erongo Desalination Corporation and secondly from the proposed NamWater Desalination plant, both of which could be able to supply water to the existing NamWater distribution network.

- The development of the second desalination plant is currently being considered and would be a joint effort between mining companies and NamWater.

CONSTRUCTION PHASE

- Impact of construction camps~
  - Mitigation measures are proposed in the event that a large part of the construction labour force comes from outside the area and will need accommodation. Mitigation in the form of comprehensive management plans for construction camps and locating such camps away from settled communities can go a long way towards reducing this impact. Comprehensive management plans should be a contractual requirement in any event.

8.3 THE WAY FORWARD

This final SEIA Report will be submitted to MET:DEA for their consideration.

In considering this final SEIA Report, MET:DEA will ascertain whether the process undertaken is acceptable and whether there is adequate information to allow for an informed decision. Should the above be acceptable, they will need to decide on the social and environmental acceptability of the proposed project. MET:DEA's decision will be documented by a clearance of the project that will detail the decision and describe any conditions they might impose. Following the issuing of the MET:DEA clearance, their decision will be communicated by means of a letter to all registered I&APs and stakeholders.

If a clearance is issued for the SEIA Phase 2 process, Rössing Uranium will be able to move from the planning stage of the project into the design and construction stages.

As the environmental practitioners responsible for leading this SEIA process, Aurecon are of the opinion that the project components assessed and being applied for should be positively received by MET:DEA and that an environmental clearance should be issued. This opinion is based on our comprehensive understanding of the environmental impacts likely to result from these activities and facilities, as detailed in this and preceding documentation, and that the alternatives and mitigation measures as described and recommended will reduce the identified environmental impacts to an acceptable level.

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