North River Resources (Pty) Ltd incorporating
Namib Lead & Zinc Mining (Pty) Ltd

PROPOSED RECOMMISSIONING OF LEAD & ZINC MINE ON EPL 2902

VOLUME 1:
ENVIRONMENTAL IMPACT ASSESSMENT &
ENVIRONMENTAL MANAGEMENT PLAN
INCLUDING CLOSURE AND REHABILITATION
13 December 2013

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Disclaimer

This Environmental Impact Assessment was written for the lead and zinc mine project proposed by North River Resources (Pty) Ltd incorporating Namib Lead & Zinc (Pty) Ltd.

It was compiled by Colin Christian & Associates CC as environmental consultant to North River Resources (Pty) Ltd. Colin Christian & Associates CC and North River Resources (Pty) Ltd take no responsibility for the information contained herein if used for any other purpose or by any other party.
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<td>Gross Domestic Product</td>
</tr>
<tr>
<td>I&amp;APs</td>
<td>Interested and Affected Parties</td>
</tr>
<tr>
<td>IUCN</td>
<td>International Union for the Conservation of Nature</td>
</tr>
<tr>
<td>JORC</td>
<td>Joint Ore Reserves Committee – JORC is the Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves (‘the JORC Code’) is a professional code of practice that sets minimum standards for Public Reporting of minerals Exploration Results, Mineral Resources and Ore Reserves. <a href="http://www.jorc.org">http://www.jorc.org</a></td>
</tr>
<tr>
<td>MAWF</td>
<td>Ministry of Agriculture, Water &amp; Forestry</td>
</tr>
<tr>
<td>MET</td>
<td>Ministry of Environment &amp; Tourism</td>
</tr>
<tr>
<td>ML</td>
<td>Mining Licence (area included in NRR’s application for a mining licence)</td>
</tr>
<tr>
<td>MME</td>
<td>Ministry of Mines &amp; Energy</td>
</tr>
<tr>
<td>MOHSS</td>
<td>Ministry of Health &amp; Social Services</td>
</tr>
<tr>
<td>MSDS</td>
<td>Material Safety Data Sheets</td>
</tr>
<tr>
<td>MTI</td>
<td>Ministry of Trade &amp; Industry</td>
</tr>
<tr>
<td>NAG</td>
<td>Net Acid Generation</td>
</tr>
<tr>
<td>NIMT</td>
<td>Namibian Institute of Mining and Technology (at Arandis)</td>
</tr>
<tr>
<td>NLZM</td>
<td>Namib Lead and Zinc Mine</td>
</tr>
<tr>
<td>NRR</td>
<td>North River Resources (Pty) Ltd. (Project Proponent)</td>
</tr>
<tr>
<td>OHS</td>
<td>Occupational Health and Safety</td>
</tr>
<tr>
<td>OPEX</td>
<td>Operating Expenditure</td>
</tr>
<tr>
<td>PAYE</td>
<td>Pay as you earn (taxes)</td>
</tr>
<tr>
<td>PID</td>
<td>Public Information Document</td>
</tr>
<tr>
<td>QDS</td>
<td>Quarter degree square (latitude &amp; longitude)</td>
</tr>
<tr>
<td>RH</td>
<td>Relative Humidity</td>
</tr>
<tr>
<td>ROM</td>
<td>Run of Mine</td>
</tr>
<tr>
<td>SA NAAQS</td>
<td>South African Air Quality Standards</td>
</tr>
<tr>
<td>SLR</td>
<td>SLR Consulting (Responsible for the groundwater and surface water assessments)</td>
</tr>
<tr>
<td>SPLP</td>
<td>Synthetic Precipitation Leaching Procedure</td>
</tr>
<tr>
<td>TDS</td>
<td>Total dissolved solids</td>
</tr>
<tr>
<td>USD</td>
<td>United States Dollars</td>
</tr>
<tr>
<td>WHO AQG</td>
<td>World Health Organisation- Air Quality Guidelines</td>
</tr>
</tbody>
</table>
INTRODUCTION

The Project Proponent & Holder of EPL 2902

North River Resources (Pty) Ltd (NRR), incorporating Namib Lead and Zinc Mining (Pty) Ltd is the project proponent and holder of Exclusive Prospecting Licence (EPL 2902).

Project Location

The EPL and old mine site are within the Dorob National Park. They lie west of the Rossing Mountain, about 23km east of Swakopmund and 8km off the B2 tar road to the north of it.

The Consultants

Colin Christian & Associates cc was appointed by NRR to conduct the Environmental Impact Assessment (EIA) and Management Plan (EMP). Several other specialist consultants have made a valuable contribution in the fields of flora, fauna, surface- and ground-water, air quality, archaeology and legal and policy matters.

The terms of reference (or “plan of study”) were submitted to MET in July 2011. The TOR covered an EIA and EMP for mining but did not cover the exploration stage. NRR more recently acquired EPL 5075 to the south and east of EPL 2902 but this was not included in the TOR for this EIA as it is in the early exploration stage.

HISTORICAL BACKGROUND

The underground mine was in operation from 1968 to 1992. Shafts extended to about 210m below the surface at the deepest part. A tailings dump exists on the surface, which NRR intends to reprocess.

North River Resources took over the project from Kalahari Minerals in 2009 and began exploration drilling.

PROJECT PROPOSAL

North River Resources proposes to re-open the old mine to produce lead and zinc concentrates for export, with lesser amounts of other metals such as silver. The old underground mine will be extended vertically and horizontally, and will need additional shafts from the surface.
The ore bodies comprise a number of vertical shoots hosted in Karibib formation marbles. Exploration drilling has focussed mainly on targets adjacent to and below the old mine workings. Drilling has been conducted both from surface and from underground. To further prove the ore resource and define/map additional ore bodies, more drilling from underground positions is necessary. To achieve this further development of the mine is first required.

**Stage 1** of the mine development will therefore be advanced exploration, rather than production. No processing is included in Stage 1. Much of the drilling will be underground. Therefore access drives need to be developed to facilitate drilling from underground positions.

Several new exploration targets have also been identified within EPL 2902, which are close to but unconnected to the old mine. Drilling of these targets from the surface is proposed in 2014.

**Stage 2**: Once the target ore resource has been confirmed, the mine can be further developed and a processing plant constructed, together with other infrastructure. The processing plant will be built adjacent to the old mine and within the previously disturbed area. A target production rate of 250,000 tonnes per annum is envisaged by NRR. This would translate into a minimum life of mining and processing of seven years.

The processing by conventional flotation methods will require the use of chemical reagents, which are hazardous substances.

It is proposed to transport these products in containers by road to the Port of Walvis Bay for export.

Reprocessing of existing tailings will be possible followed by disposal of these old tailings into the existing tailings dam that was developed in the mid 1990’s. Some of the waste rock from new development of the mine drives will be disposed of in existing voids underground to minimise haulage costs and provide stabilised support where needed. Waste rock that cannot be disposed of underground for practical or economic reasons will be hauled to the surface and dumped adjacent to the old mine and existing tailings. Tailings produced by new processing will remain on the surface.

Water will be supplied by a new 110mm pipeline on an existing route, from an offtake on the Swakop – Rössing Mine pipeline. A surplus is available from Areva’s desalination plant. As much water as possible will be recovered by tailings thickening, and then from the tailings dam.

An existing borehole on site can be pumped to provide a supply of non-potable saline water, suitable for drilling activities.

Power will be supplied via an existing line from the national grid. The old poles are still adequate but will need some refurbishment. It is not yet clear whether sufficient power can be supplied by the ErongoRED utility company for the fully developed project. If insufficient power is available, diesel generators will be installed to supply power.

No housing will be provided at the mine, but workers will be transported by bus from Swakopmund. The mine will operate 24 hours per day, seven days per week – three work shifts per day.
Extensive fieldwork was carried out in the EPL by the environmental scientist, botanist, zoologist. A photographic record was made and satellite images (2010) were used to determine the previous condition of the area, which has been cleaned up by NRR since 2010 and is now in better condition than it was when NRR took over the EPL. Derelict old mine buildings and houses have been removed and the mine itself was cleaned up by NRR.

Extensive tracks still exist in the EPL – probably as a result of both exploration and recreational driving in the desert.

Apart from the former housing that was removed, and the tailings that remain, the footprint of the mine and processing plant was small. It appears to have been sparsely vegetated.

In addition to the footprint of the mine and plant, an area of soil contamination was shown to exist in a study by Linus (2010) and confirmed by Airshed (2013). The area of concern lies within 1km around the mine, plus a “plume” of contaminated soil for up to 8km from the old mine and tailings in a west-south-westerly direction.

Apart from small concrete retention dams below the existing tailings, it does not appear that much effort was made by the previous mining company to manage the environmental impacts, such as dust containing metals.

Specialist studies on flora and fauna were carried out for this EIA. It appears that very little vegetation was disturbed by the old mine and plant. The only plant communities of concern are a few Lithops (stone plants) near the site. These should not be affected by the proposed mining but could be damaged if drilling exploration from the surface is extended. The mine site is very sparsely vegetated, but may produce grasses in years with good rains.

A range of wildlife moves through the mine area, and it will be necessary to prevent animals from having access to any contaminated water and prevent them from scavenging. Invertebrates and reptiles may be adversely affected by existing soil contamination by metals.

There is no special habitat for birds and most species tend to be nomadic in the Namib. There are no large trees in the Mining Licence area for nesting by large raptors such as Lappet-faced Vultures.

A number of minor archaeological sites were found by the archaeologist but none of them will be affected by the project.

Detailed studies have been carried out by SLR (2013) on surface water and groundwater. Several monitoring boreholes were drilled and tested quarterly to determine groundwater levels and quality. The existing groundwater is very limited and is of very poor quality, being saline and containing metals. It is not suitable for human or animal consumption, and may be suitable only for drilling purposes. There is very little groundwater, levels vary greatly suggesting that permeability is very low. SLR considers that the ore may be capable of producing acid mine water due to the presence of some sulphates, even though very little water normally enters the mine. SLR considers that the fact that the ore is hosted in marble should help to buffer any acid formation and limit the impact on any metals in solution in the mine. However, they have recommended further studies to determine the level of risk of acid mine water and the degree of buffering that will be achieved naturally by the marbles.
SLR delineated surface water catchments. Although the affected catchments are near the Swakop river (about 8km) SLR found that the drainage is westwards towards the coast (about 25km away) and not into the Swakop River valley. The mine is high in the affected small catchments which will generate little runoff. However SLR recommended that all surface water from the mine site should be caught in retention dams to prevent it leaving the site. The water can then be used in the process, or treated and released subject to compliance with MAWF regulations and permitting requirements.

The tailings will be one of the greatest long term issues as a potential source of dust containing metals, visual impacts, and potentially contaminated surface water runoff. Cladding the tailings with waste rock (marble) is recommended as a means to help mitigate these impacts.

There are no people living in or close to the EPL or ML areas. The nearest residents are along the Swakop river to the south of the EPL.

LEGAL & POLICY FRAMEWORK

A report on the laws and policies with which the project must comply was prepared by a legal specialist and is contained in an appendix to the EIA report. This includes requirements for permits.

PUBLIC PARTICIPATION PROGRAMME

A public information document (PID) was prepared in May 2013 to provide information about the project to authorities and interested members of the public.

In May 2013, letters were sent to the relevant authorities - ministries, parastatals, and town councils – together with the PID – to inform them about the project and provide them with opportunities to express any issues and concerns.

In the same month, an advertisement was placed in three national newspapers (two publications) inviting people to attend a public meeting and to register as interested and affected parties. The first public meeting was held on 21 May 2013 in Swakopmund to present the project proposals and hear and record any issues and concerns. Written submissions were also invited.

Following completion of the Draft EIA Report, a second public meeting was held in order to explain the results of the EIA study and provide an opportunity for comment on the Draft EIA. This was again advertised in three national newspapers (two publications) and people were invited to the public meeting, to register as I&APs. All those who had registered were directly invited, by email or fax, to attend the public meeting. A website address was announced where the draft EIA report could be accessed.

As the key I&AP, a special effort was made to involve the Directorate of Parks in Windhoek, and the Chief & Deputy Wardens of the Erongo Parks. The PID was supplied in May 2013 and copies of the report were provided to them in November 2013, with a special written request for their comment. However, no comments were received by 12 December 2013.
Copies and adverts, minutes, letters, and a register of I&APs are contained in appendices.

**ASSESSMENT CRITERIA**

Each identified impact was assessed in terms of the nature and extent of the impact, the duration, intensity / severity, and the probability of occurrence. Mitigation measures were proposed where practicable, as well as recommendations for monitoring and for further investigation during engineering design of the mine.

Each assessment was given a *significance* rating. This means significance for decisions to approve the project. Those with LOW (-) significance would not affect a decision to approve the project but may still require mitigation. Impacts with MEDIUM (-) significance should affect a decision to approve the project unless they are effectively mitigated. Impacts with HIGH (-) significance would indicate that the impact should affect the decision despite any mitigation or where effective mitigation is not possible – i.e. an environmental fatal flaw.

In this case there are no HIGHLY significant negative impacts because all can be mitigated. This requires a high level of commitment from Lodestone.

On the other hand HIGH (+) significance would indicate a strong benefit of the project.

**SUMMARY OF ASSESSMENTS & MITIGATION**

<table>
<thead>
<tr>
<th>Environmental Impact or Issue</th>
<th>Significance rating before &amp; after mitigation</th>
<th>Possible Mitigation</th>
<th>Further Investigation and/or Monitoring Recommended</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impacts on soil</td>
<td>Medium (-) Low with mitigation</td>
<td>Control of dust at source. Control of stormwater runoff.</td>
<td>Design of site. Annual soil sampling.</td>
</tr>
<tr>
<td>Impacts on air quality: dust (PM$_{10}$ &amp; dust outfall including metals)</td>
<td>Medium (-) Low with mitigation</td>
<td>Refer Table 8.3, p.88. Water sprays, regular clean up, chemical suppressants, speed limits, tipping speeds, rock cladding of tailings, responsible person. Achieve dust deposition rates below 1200 mg/m$^2$/day downwind at source.</td>
<td>Design of plant must include dust suppression aspects. Monitoring dust outfall, &amp; analyse metals content. Monitoring PM$_{10}$ concentrations in air – for health reasons.</td>
</tr>
<tr>
<td>Impacts on natural vegetation, including Lithops nearby</td>
<td>Low (-) Can be avoided</td>
<td>Staff awareness, <em>Alien Prosopis</em> must be eradicated.</td>
<td>Mapping if more exploration. Monitoring to confirm no damage.</td>
</tr>
<tr>
<td>Impacts on invertebrates</td>
<td>Medium (-) Probably reducible</td>
<td>Control footprint of development, metals in soil and limit driving to roads. Control contamination of soil and surface water. Staff awareness.</td>
<td>See soil, air quality, and surface water quality</td>
</tr>
<tr>
<td>Environmental Impact or Issue</td>
<td>Significance rating before &amp; after mitigation</td>
<td>Possible Mitigation</td>
<td>Further Investigation and/or Monitoring Recommended</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-----------------------------------------------</td>
<td>---------------------</td>
<td>---------------------------------------------------</td>
</tr>
<tr>
<td>Impacts on reptiles</td>
<td>Medium (-) Probably reducible</td>
<td>Control contamination of soil and surface water. Driver awareness – avoid reptiles. Speed limit 20km/hr.</td>
<td>See soil, air quality, and surface water quality. Monitor &amp; report road kills for awareness training</td>
</tr>
<tr>
<td>Impacts on birds</td>
<td>Medium (-) Low with mitigation</td>
<td>Bird deflectors on power lines. Control contamination of soil and surface water. Driver awareness, at night</td>
<td>Monitor power line for bird kills</td>
</tr>
<tr>
<td>Impacts on mammals</td>
<td>Medium (-) Low with mitigation</td>
<td>Prohibit poaching in staff contracts. Prevent scavenging. Prevent drinking contaminated water – fencing. Speed limits 20km/hr.</td>
<td>Monitor and record any problems with wildlife for ongoing training and improvement</td>
</tr>
<tr>
<td>Impacts on groundwater levels / resource</td>
<td>Low (-)</td>
<td>None thought to be necessary</td>
<td>Monitor levels</td>
</tr>
<tr>
<td>Impacts on groundwater quality (from acid rock drainage)</td>
<td>Medium (-) Low if mitigated</td>
<td>ARD study to determine acid-generating potential and buffering effect of marbles.</td>
<td>Groundwater monitoring - ongoing</td>
</tr>
<tr>
<td>Impacts on volumes of surface runoff</td>
<td>Low (-)</td>
<td>Not required</td>
<td>Not required</td>
</tr>
<tr>
<td>Impacts on surface water quality</td>
<td>Medium (-) Low if mitigated</td>
<td>Design and construct impoundments for dirty water. Prevent pooling of rainwater. Regular cleanup</td>
<td>Accurate survey and revised stormwater retention plan. Size retention dams for 1:50year rainfall event. Design and operate water re-use system</td>
</tr>
<tr>
<td>Impacts of solid and liquid waste</td>
<td>Medium (-) Low if fully compliant</td>
<td>No disposal on site - use licensed disposal facilities, legal compliance, recycling.</td>
<td>Specialist contractor to handle hazardous waste</td>
</tr>
<tr>
<td>Electricity demand</td>
<td>Low (-) but may be further reduced</td>
<td>Design of installations, solar water heating, energy efficient machines and appliances</td>
<td>Design stage</td>
</tr>
<tr>
<td>Impacts of power line (excluding birds)</td>
<td>Low (-) but may be further reduced</td>
<td>Use single track (combine with pipeline track). Final removal.</td>
<td>Contracts with contractors.</td>
</tr>
<tr>
<td>Environmental Impact or Issue</td>
<td>Significance rating before &amp; after mitigation</td>
<td>Possible Mitigation</td>
<td>Further Investigation and/or Monitoring Recommended</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>----------------------------------------------</td>
<td>---------------------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td>Visual impacts &amp; lighting</td>
<td>Medium (-) Low with mitigation</td>
<td>Trim and cover tailings with layer of waste rock (marble)</td>
<td>Determine volume of waste rock required and plan for it.</td>
</tr>
<tr>
<td>Impacts of water demand</td>
<td>Medium (-)</td>
<td>Thickening of tailings. Maximise recovery of water from tailings</td>
<td>Determine ways to reduce consumption</td>
</tr>
<tr>
<td>Impacts of water supply pipeline</td>
<td>Low (-) but may be further reduced</td>
<td>Single access track. Combine with power line track. Final removal.</td>
<td>Contracts with contractors</td>
</tr>
<tr>
<td>Road Traffic &amp; Namport</td>
<td>Low (-)</td>
<td>Daylight hours and off-peak times</td>
<td>Determine low traffic times</td>
</tr>
<tr>
<td>Mine Closure &amp; Rehabilitation, incl. tracks</td>
<td>Medium (+) Must be a condition of approval</td>
<td>Rehabilitation is mitigation. NRR to provide a fund to cover the costs of rehabilitation.</td>
<td>Design and plan for rehabilitation from the start, including annual contributions to a separate rehabilitation fund.</td>
</tr>
<tr>
<td>Benefits of Direct Employment</td>
<td>High (+) Medium term</td>
<td>Enhancement of benefits by training, and housing allowances (encourage home ownership)</td>
<td>Seek to optimise benefits to staff</td>
</tr>
<tr>
<td>Other Economic Benefits to Namibia</td>
<td>High (+) Medium term</td>
<td>As above, plus bursaries for technical training</td>
<td>Seek to leave benefits – enhanced human resources – after mine closure</td>
</tr>
<tr>
<td>Impacts related to Tourism in Dorob Park</td>
<td>Medium (-) Reducible to Low</td>
<td>Management of tracks and rehabilitation of mine site and tailings</td>
<td>Planning for closure. Monitoring of tracks and compliance with EIA/EMP</td>
</tr>
<tr>
<td>HIV/AIDS</td>
<td>Not assessed</td>
<td>Staff education</td>
<td>Seek good trainers</td>
</tr>
<tr>
<td>Emergency &amp; hospital services</td>
<td>Not assessed</td>
<td>Develop emergency response procedures</td>
<td></td>
</tr>
<tr>
<td>Occupation Health &amp; Safety</td>
<td>Not assessed in EIAs</td>
<td>Employ a specialist in OHS. Protective clothing. Education &amp; training.</td>
<td>Run clinical health monitoring programme.</td>
</tr>
</tbody>
</table>

**CONCLUSION**

An Environmental Impact Assessment has been compiled for North River Resources’ proposal to re-open the old underground lead and zinc mine and develop a new processing plant and tailings dam on site.

Consultations with Interested and Affected Parties (I&APs) and the relevant Authorities have been carried out and their concerns have been assessed in the EIA. All public issues and concerns that were raised have been recorded in this report. An opportunity for public comment on the draft EIA report was provided via a final public meeting and an opportunity for
written submissions, only one of which was received. Further consultation has been requested from the Directorate of Parks following their reading of the EIA/EMP.

Various specialist studies have been conducted on environmental aspects of concern – flora, fauna, soils, air quality and dust, archaeology, surface water and groundwater. No fatal flaws were identified, but environmental management is needed in relation to most of these environmental aspects.

The mine and tailings sites are already disturbed by previous mining and processing, and numerous tracks exist over the EPL area.

On the basis of the target area for mining that has been established to date, the mine is not expected to result in any new degradation of the area. This is because the footprint of the mine (above ground), plus the plant and the tailings lie within the previously disturbed area. Within kilometres of the old mine, soils show elevated levels of certain metals (including lead and zinc) particularly downwind of the old tailings - especially due to easterly winds.

Impacts on fauna should be manageable (e.g. preventing drinking of contaminated water and scavenging). The impacts of existing contaminated soil on invertebrates and carnivorous vertebrates are not established. However, in line with the precautionary principle in the Environmental Management Act, every effort must be made to minimise dust fallout from all sources and therefore avoid aggravating the levels of metal concentrations in soils. In the case of the tailings, protection against wind and water erosion needs to be ensured long beyond mine closure to prevent ongoing contamination of soil and water.

It is possible to avoid impacts on sensitive flora, which lie outside the footprint of the development. However, great care needs to be exercised if more extensive drilling exploration is carried out – to avoid impacts on the nearby Lithops populations.

Regarding water quality, although the marbles are expected to provide significant buffering ability, recommendations have been made for further study on the potential for acid rock drainage and to confirm the buffering capacity of the carbonates. This is necessary before mining commences.

The tailings represent the greatest long term concern, as a potential source of dust containing metals, contaminated stormwater runoff, and adverse visual impacts. Long term solutions are most likely to involve trimming and covering the tailings with a layer of marble waste rock.

Measures to prevent contaminated stormwater from the leaving the site need to be designed to be effective after mine closure when water will no longer be pumped out of retention dams.

Recommendations for management and mitigation have been made throughout Sections 8 & 9, as well as in the specialist reports. Please refer to the Environmental Management Plan (EMP) in Sections 11 – 14 below. Some of the practical details will need to be further developed with the mine design engineers.

Regular compliance monitoring will be needed to ensure that the mine complies with the recommendations in the EIA/EMP. Regular monitoring is also needed in regard to dust fallout, metals concentrations in soils, the quality of surface water and groundwater, and the status of the vegetation near the mine.

Despite a history of disturbance, the area is nevertheless sensitive due to it's location in the Dorob National Park. However, given the context of previous disturbance, small footprint and mining underground, it is considered that the economic benefits will outweigh the limited adverse impacts on the natural environment. To ensure this, a high standard of environmental
management and rehabilitation is needed. It is recommended that NRR should set up a fund for rehabilitation, in a separate account that can be used in the event of bankruptcy or default. NRR should put aside a predetermined amount each year into this fund for the express purpose of rehabilitation. The annual amount should be based on the size of operation, expected rehabilitation costs from the feasibility study, and some $/tonne rate. The mine site, tailings, and the redundant tracks within the EPL need to be rehabilitated. The amount of the fund and the annual contribution to it still need to be determined.

The project does not appear to present any adverse socio-economic impacts, provided that health and safety issues for mine personnel are well managed, and the handling, transport and disposal of hazardous waste is in compliance with the law.

The socio-economic benefits of the projects can be enhanced. NRR should also endeavour to support initiatives to benefit human resources in Namibia, in the interests of leaving sustainable benefits after the end of the short life of the Namib Lead and Zinc Mine.

In the opinion of the Environmental Scientist, an Environmental Clearance can be issued – subject to compliance with the recommendations for environmental management in this EIA and an EMP.

************
1 INTRODUCTION

1.1 Project Proponent & Holder of EPL 2902

North River Resources (Pty) Ltd (NRR), incorporating Namib Lead and Zinc Mining (Pty) Ltd is the project proponent and holder of Exclusive Prospecting Licence (EPL 2902), which was renewed on 28 May 2012. The EPL expires on 17 April 2014, which means that a mining licence application must be submitted by that date or a renewal application lodged.

<table>
<thead>
<tr>
<th>Directors</th>
<th>Address</th>
<th>Resident</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mr Martin French</td>
<td>Executive Director</td>
<td>London, UK</td>
</tr>
<tr>
<td></td>
<td>56 Haymarket, London, UK</td>
<td></td>
</tr>
<tr>
<td>Mr Mark Thompson</td>
<td>Non-Executive Director</td>
<td>London, UK</td>
</tr>
<tr>
<td>Zuyuan He</td>
<td>Chairman</td>
<td>China</td>
</tr>
<tr>
<td>Zhiping Yu</td>
<td>Non-Executive Director</td>
<td>China</td>
</tr>
<tr>
<td>Qi Yu</td>
<td>Non-Executive Director</td>
<td>London</td>
</tr>
<tr>
<td>Brett Richards</td>
<td>Non-Executive Director</td>
<td>London</td>
</tr>
</tbody>
</table>

Funding for the project is being supplied from foreign and domestic investors.

1.2 Project Proposal in Brief

North River Resources proposes to re-open an old lead and zinc mine which closed in 1992 to mine these metals for export. The old underground mine will be extended vertically and horizontally, and will need additional shafts from the surface.

The ore bodies comprise a number of vertical shoots hosted in Karibib formation marbles, which are considerably folded. Exploration drilling has focussed mainly on targets adjacent to and below the old mine workings. Drilling has been conducted both from surface and from underground. To further prove the ore resource and define/map additional ore bodies, more drilling from underground positions is necessary. To achieve this further development of the mine is first required.

Stage 1 of the mine development will therefore be for advanced exploration, rather than production. No processing is included in Stage 1. Much of the drilling will be underground. Therefore access drives need to be developed to facilitate drilling from underground positions.

Several new exploration targets have also been identified within EPL 2902, which are close to but unconnected to the old mine. Drilling of these targets from the surface is proposed in 2013 and early 2014.

Stage 2: Once the target ore resource has been proven, the mine can be further developed and a processing plant constructed, together with other infrastructure. A new processing plant will be set up adjacent to the old mine to produce two products: a zinc concentrate, and a lead concentrate. Some by products may be contained within these concentrates.
The scale of mining operations will be small and the mining methods simple. A target production rate of 250,000 tonnes per annum is envisaged by NRR. This would translate into a minimum life of mining and processing of seven years.

It is proposed to transport these products in containers by road to the Port of Walvis Bay for export.

Reprocessing of existing tailings will be possible followed by disposal of these old tailings into the existing tailings dam that was developed in the mid 1990’s. Some of the waste rock from new development of the mine drives will be disposed of in existing voids underground to minimise haulage costs and provide stabilised support where needed. Waste rock that cannot be disposed of underground for practical or economic reasons will be hauled to the surface and dumped adjacent to the old mine and existing tailings. Tailings produced by new processing will remain on the surface.

Water will be supplied by a new 110mm pipeline on an existing route, from an offtake on the Swakop – Rössing Mine pipeline. A surplus is available from Areva’s desalination plant.

An existing borehole on site can be pumped to provide a supply of non-potable saline water, suitable for drilling activities.

Power will be supplied via an existing line from the national grid. The old poles are still adequate but will need some refurbishment. It is not yet clear whether sufficient power can be supplied by the ErongoRED utility company for the fully developed project. If insufficient power is available, diesel generators will be installed to supply power.

No housing will be provided at the mine, but workers will be transported by bus from Swakopmund.

### 1.3 Project Location

EPL 2902 is situated in the Dorob National Park, just to the west of the Rössing Mountain. It lies between Swakopmund (23km) and Arandis (34km). A gravel road of 8km leads northwards off the B2 national road to the mine.

The main railway line between Walvis Bay and the hinterland follows the tar road to the north of it and runs close to the mine, and is crossed by the mine access road.

**Figure 1.1** shows the location of EPL 2902 on a topographic basemap. The EPL covers an area of **4,523.40 ha**.

<table>
<thead>
<tr>
<th>Table 1.2 Co-ordinates of EPL 2902</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Point</strong></td>
</tr>
<tr>
<td>-----------</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
</tbody>
</table>
Figure 1.1 also shows the Rössing pipeline that will supply water, and a 22kV power line that will be the source of electrical power.

**Figure 1.2** shows the extent of EPL 2902 (red rectangle) on an orthophoto map. It also shows the boundaries of the proposed Mining Licence area (545 ha) and the mining targets. The red dots are drill collars – indicating the mining target areas - referred to by NRR as “N20, North, Junction and South”. The green and pink dots show other phases of drilling to be carried out – only three holes have been drilled to date and further drilling would be needed to confirm these as ore resources.

<table>
<thead>
<tr>
<th>Point</th>
<th>Latitude</th>
<th>Longitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>S 22.51199407</td>
<td>E 14.74832610</td>
</tr>
<tr>
<td>2</td>
<td>S 22.51186320</td>
<td>E 14.77399535</td>
</tr>
<tr>
<td>3</td>
<td>S 22.53027762</td>
<td>E 14.77392304</td>
</tr>
<tr>
<td>4</td>
<td>S 22.53087304</td>
<td>E 14.74824955</td>
</tr>
</tbody>
</table>

The marble formation, which is associated with the mineralization, is clearly visible as a pale band running north-south and then south-west to north-east.

Two major watercourses drain westwards across the EPL, one to the north and one to the south of the mining area.

**Figure 1.3** shows the mine area in more detail – new plant, tailings and underground reference points “N20, North, Junction and South”. The old tailings dump will be reprocessed. The new tailings dump will be on the site of one that was established just before the old mine closed.

Before NRR took over, the site was in poor condition with many derelict old houses and waste heaps, which have since been removed to a stockpile adjacent to the old mine entrance. The landing strip and access road from the south-west, and the water pipeline from the south running along the western side of the tailings are also shown.

A dark plume of dust deposition from the mine area and tailings stretches for over 1km to the southwest from the old mine and tailings (also in Figure 1.2).

The new mine and infrastructure will be developed within the area already disturbed by previous mining activities. The extent of underground workings will span about 700m in length on an axis running north-west from the plant. Along that axis are a number of shafts opening to the surface.

**Figure 1.4** is a drawing of the preliminary mine layout with the old and new tailings. The red outline encloses an area of 19 ha. This drawing not include all of the underground mine stretching 700m to the north-west from the plant.
Figure 1.5 (by NRR) provides a plan view of the underground mine. The old worked out voids are at “South” and “Junction” and the proposed new mining targets are labelled “North” and “N20”. The position of the old tailings on the surface is shown for reference.

Figure 1.6 (by NRR) provides a vertical “cross-section” through the old mine and proposed new mining area. The new targets are the ore shoots shown in various colours. Possible new development of drives and shafts are shown conceptually. The thin coloured lines show potential future drilling to explore the ore shoots at depth.

Figure 1.7 shows the mine layout in relation to sensitive vegetation communities – the Lithops ruschiorum habitats (purple patches), which will be referred to in Section 4, below. It also shows the locations of monitoring boreholes (blue dots) that were drilled as part of the hydrogeological explorations.

1.4 Need and desirability of the project

Mining makes a valuable contribution to Namibia’s economy, contributing 8% of GDP and providing more than 50% of the country’s foreign exchange earnings (http://www.indexmundi.com/namibia/economy_profile.html). Since Namibia has to import a lot of its food and manufactured goods, such foreign exchange earnings are extremely important.

The biggest consumer of lead worldwide is the manufacture of batteries (International Lead and Zinc Study Group website). The demand for lead is strong in rapidly developing countries with large populations such as China and India.

The contribution to the demand for lead is made up by the following uses:

<table>
<thead>
<tr>
<th>Use</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Batteries</td>
<td>80%</td>
</tr>
<tr>
<td>Cable sheathing</td>
<td>1%</td>
</tr>
<tr>
<td>Rolled and extruded products</td>
<td>6%</td>
</tr>
<tr>
<td>Shot / ammunition</td>
<td>3%</td>
</tr>
<tr>
<td>Alloys</td>
<td>2%</td>
</tr>
<tr>
<td>Pigments and other Compounds</td>
<td>5%</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>3%</td>
</tr>
</tbody>
</table>
Figure 1.1: Location Map: EPL 2902, and existing water pipeline and power lines.
Figure 1.2: Orthophoto Map: EPL 2902 & Proposed Mining Licence Area. Red dots indicate underground mining targets.
Figure 1.3: Orthophoto Map: Old Mine Precinct & New Mine Layout & Tailings. “N20, North, Junction and South” refer to areas of the underground mine.
Figure 1.4: New Mine Layout Drawing, Processing Plant with old and new Tailings
Figure 1.5: Plan View of Underground Mine: Old (South & Junction) and Proposed New Mine (North and N20)
Figure 1.6: Cross Section of Underground Mine: Old, & Possible New Development and Shafts at depth. The thin coloured lines represent future drilling.
Figure 1.7: Lithops Plant Populations (approximate positions) & Groundwater Monitoring Boreholes in relation to Mine Layout
1.5 Environmental Consultants

North River Resources appointed Colin Christian & Associates CC (CCA) to undertake the Environmental Impact Assessment (EIA) and Management Plan (EMP). The study team comprises:

- Mr. Colin Christian Pr.Sci.Nat. – Environmental Scientist & Project Leader for the EIA & EMP (Colin Christian & Associates), Mr Christian’s CV is contained in Appendix A.
- Dr. Antje Burke – Landscape ecologist / botanist (EnviroScience),
- Dr. John Irish – Vertebrate & invertebrate fauna (Biodata),
- Mr. Peter Watson – Legal Specialist (Envirolex Namibia),
- Ms. Katharina Dierkes – GIS Mapping (Maproom),
- Dr. John Kinahan – Archaeologist (Quaternary Research Services),
- Ms. Maureen Fidler – Public Participation Assistant,
- Ms. Hanlie Liebenberg-Enslin – Air quality (Airshed),
- Mr. Arnold Bittner – Groundwater & Surface water (SLR Consulting).

1.6 Terms of Reference for the EIA & EMP

The terms of reference were developed by CCA in consultation with the client and were contained in the “Plan of Study” / Scope of Work that was submitted to MET on 05 July 2011 (refer Appendix B). Subsequently the need for additional specialist studies became apparent and consultants were commissioned to assess the impacts on air quality, groundwater and surface water.

The other specialist studies included legal and policy requirements, archaeology, flora, fauna – invertebrates, mammals, reptiles, amphibians and birds.

The appointment of CCA excluded the exploration activities, which were already in progress when CCA was first approached by NRR, and clean up at the old mine had already commenced. However, CCA provided guidance to NRR, informally, regarding areas that are relatively sensitive habitats, the need to restrict vehicle access to existing tracks, and Dr Kinahan provided a guideline document on exploration in areas with archaeological material.

1.7 Approach to the EIA & EMP

The content and approach to the EIA is guided by the provisions of the Environmental Management Act (2007) and the Regulations that came into being in February 2012.

This EIA has involved fieldwork by the Environmental Scientist and specialists (flora, fauna, archaeology, air quality, and geohydrological aspects), public participation, consultations with authorities, specialist studies, assessment of impacts. A previous study on the extent of soil contamination (Linus, 2010) was verified by independent soil sampling and analysis and then used in the specialist air quality study by Airshed (2013).

The methodologies used by specialists in their respective fields are explained in their reports which are contained in appendices.
Section 2 provides a brief historical background - since the project involves re-opening an existing mine.

Section 3 provides details of the project proposal.

Section 4 is a description of the affected environments. In doing so it draws on a number of specialist reports and the authors own field observations. It includes a sub-section on the pre-existing conditions of the affected environment.

Section 5 is a summary of a specialist report on the Legal and Policy requirements with which the project must comply.

Section 6 provides a summary of the public participation programme, including consultations with authorities. It describes the activities and opportunities for public input, and a summary of the issues and concerns raised by all interested and affected parties.

In Section 7, the criteria are explained that were used in assessing the predicted impacts and determining their significance for decisions about the project.

Section 8 is an assessment of the impacts on the bio-physical environment. For those impacts that are potentially significant, mitigation measures are recommended wherever practically possible, as well as recommendations for monitoring compliance with those recommendations.

Section 9 is an assessment of the impacts on the socio-economic environment.

Section 10 provides a summary of all the assessments in tabular format, including their significance rating for decisions about the project. It also provides a qualitative assessment in terms of the criteria used in the field of Environmental Economics.

Section 11 is a conceptual environmental management plan, which will need to be further detailed during the design stage of the project, and which should be used to guide the environmental management of the project from the design stage, through construction, operations, closure and rehabilitation.
2 HISTORICAL BACKGROUND

A brief history of the Namib Lead & Zinc mine is provided by LMS (Oct, 2012) and is summarized in sections 2.1 to 2.4.

2.1 Previous Mining & Exploration

The mine was in operation from 1968 to 1992. Underground levels were developed and a vertical South Shaft was the main access point. This shaft extends to about 150m below surface. Two declines also spiral down into the mine, known as Junction Ramp and North Ramp. These are drivable in small vehicles carrying personnel, but not large haul trucks. The deepest part of the old mine is 210m below surface.

Substantial tailings are still found on the surface close to the mine entrance. However, no waste rock dumps exist on the surface. It is therefore assumed by NRR that the waste rock was all processed and disposed of as tailings, or backfilled into stope voids.

During the early years of mine operation, lead concentrate was the primary product, with much of the zinc remaining in the tailings. Historical documents show zinc being produced from 1974, but the plant was upgraded in 1984 to produce more zinc concentrate.

The mine was abandoned in 1992 and the mining licence lapsed. No rehabilitation or closure operations were carried out. The site was left in very poor condition with rubbish, chemicals, mining equipment and unfenced shafts being left open. Numerous derelict houses were also left close to the site, as shown in Figure 1.3. Much of the surface mining infrastructure had been removed.

The pre-existing condition of the mine site and EPL area is described in Section 4 (especially 4.11). Also in that section NRR’s efforts at cleaning up the site are described.

From 1992 the underground workings flood to 6.5 level and no attempts to re-enter the mine were made until 2011.

Various exploration activities were carried out between 1993 and 2008 by various companies. In 1996 an attempt was made to reprocess the surface tailings by African Exploration. However the company was under capitalised and the project failed.


In 2011 NRR pumped water out of the lowest level in order to undertake exploration activities.

Since the purchase of the Namib project, NRR has undertaken considerable work on the Namib Project and now believes the project is viable.

2.2 Exploration and Clean up by NRR

North River Resources took over the exploration from Kalahari in 2009. In 2010 NRR began refurbishment and cleaning of the underground mine, which was structurally sound but in poor
condition, with considerable debris. The mine was made safe, and dewatering was completed in March 2012.

On the surface, redundant surface infrastructure, including derelict houses, were removed to a single stockpile adjacent to the old mine. The photosheets following Section 2.4 show the mine site during the final stages of clean up in early May 2012. NRR has retained a few buildings for their use, namely three brick structures and a large shed frame.

The mine site, both underground and surface, is ready for construction to begin.

**Underground Exploration**

A detailed survey and mapping of mining voids was carried out and sampling was done. NRR considered that the most obvious exploration target was at depth and therefore that much of the future drilling should be carried out at depth.

In 2011 twenty one diamond drill holes (totaling 1,315 metres) were drilled from underground positions targeting the continuation of many previously mined ore shoots some 80m below the previous base of mining at 200m below surface. The grade was found to improve with depth in some areas.

A JORC compliant resource was announced on 10 October 2012. CSA Global (UK) Ltd estimated a resource of 668,000 tonnes at grades of 6.6% Zinc (Zn), 2.5% Lead (Pb), 46 g/t Silver (Ag) and 33 g/t Indium (In). Details are shown in Table 2.1 below. This resource is mainly located in the north ore shoots between the surface and 150 metres.

**Table 2.1  JORC Compliant Mineral Resource Estimate Cut-off Grade 1% Pb& Zn**

<table>
<thead>
<tr>
<th>JORC Classification</th>
<th>Tonnes</th>
<th>Lead (Pb) (%)</th>
<th>Zinc (Zn) (%)</th>
<th>Silver (Ag) (ppm)</th>
<th>Indium (In) (ppm)</th>
<th>Pb (t)</th>
<th>Zn (t)</th>
<th>Ag (kg)</th>
<th>In (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indicated</td>
<td>80,000</td>
<td>1.8</td>
<td>7.1</td>
<td>41</td>
<td>51</td>
<td>1,440</td>
<td>5,680</td>
<td>3,280</td>
<td>4,080</td>
</tr>
<tr>
<td>Inferred</td>
<td>588,000</td>
<td>2.6</td>
<td>6.5</td>
<td>47</td>
<td>31</td>
<td>15,288</td>
<td>38,220</td>
<td>27,636</td>
<td>18,228</td>
</tr>
</tbody>
</table>

Source: CSA Global Resource Report

NRR expects that a total indicated resource figure of 1M tonnes can be achieved from the planned drilling (referred to as Stage 1). This is comprised of the current JORC ore reserves in the north, the 100 vertical metres directly down dip of them, and the area directly below the base of historical mining in the Junction and South areas. The drilling will extend to about 300m below ground surface in places (refer to Figure 1.6, p.10)

**Surface Exploration**

An airborne VTEM survey was flown in June 2012 covering all relevant parts of the EPL. Thirty two (32) areas of interest were identified and several have been prioritized as targets for drilling during 2013 to 2014. These include several that are unconnected with the old mine – some are as much as 3.8km from the old mine. All the drill hole locations, existing and planned, are shown in Figure 1.2, above. Some additional mineralised zones were found but further drilling will be needed to confirm whether these are mineable resources.
New EPL 5075

A new EPL has been granted to NRR (EPL 5075) to the east and south of EPL 2902, extending as far as the Swakop River. To date this new area has not been included in CCA’s terms of reference and is excluded from this EIA.

2.3 Dorob National Park

Previous operation of the mine preceded upgrading of the conservation status of the West Coast Recreation Area to the Dorob National Park. The Park was proclaimed on 01 December 2010 (Government Notice 226). A high level of environmental management and rehabilitation will be expected by MET due to the national park status of the area. One of the issues faced by NRR is that there is historical and ongoing recreational 4x4 vehicle activity in the area, over which NNR has no control. Systems for controlling access to the Park have not yet been fully developed by the Directorate of Parks.

2.4 Photosheets of the Mine Area

The photosheets below show the mine area and its surroundings in May 2012, when NRR had almost completed their clean up of the site and removal of all the old buildings that were shown in the orthophoto (Figure 1.3).

Photo 2.1 is a distant view of the old mine covering much of the proposed mining licence area.

Photo 2.2 is a telescopic, panoramic sequence of the mine area which provides a good overview of the old mine layout and surroundings.

Photo 2.3 is a closer panoramic view from the adjacent dolerite ridge. It shows the tailings, and the mine shafts opening to the surface.

Photos 2.4 – 2.7 show the old and new tailings sites, existing retention dams to capture water from the tailings, and the mine entrance.
Photo 2.1: A view over the mine area towards the south-west from the hills in the northeast of EPL 2902. The photo shows much of the Proposed Mining Licence area with the existing tailings and mine infrastructure, which is shown in more detail in the following photos. Note the relatively flat terrain, interrupted in places by dolerite dykes and low marble “koppies”. The vegetation is extremely sparse, but exceptional rains may bring much more grass cover in good years.
Photo 2.2: A telescopic, panoramic sequence taken from the same position as Photo 2.1 showing: 

- **A** - Swakop River Valley; 
- **B** - New tailings dam; 
- **C** - Old tailings dam; 
- **D** - Old plant site; 
- **E** - water supply reservoir; 
- **E to F** - underground mine with shafts reaching the surface (the mine may be extended towards point G); 
- **G** - Dolerite dyke.
Photo 2.3: A panoramic sequence of the mine precinct taken from the dolerite ridge, looking southwards. H- Rössing mountain; J- rubble from derelict old mine houses that were demolished as part of the clean up operation; K to L - the underground mine is visible only from heaps of overburden and fenced shafts.
Photo 2.4: Old tailings to be re-processed under the new mine proposal.

Photo 2.5: New tailings dam site. The old buildings have been removed.

Photo 2.6: Existing retention dams to catch water from tailings. These may need to be enlarged.

Photo 2.7: Mine entrance, with water reservoir on top.
3 PROJECT PROPOSAL

3.1 Preamble

This section outlines the project proposal for underground exploration and mining, the details of which have been provided by North River Resources, mainly through their Development Plan and Conceptual Engineering Study (LMS, Oct 2012) and subsequent information from NRR (Claridge, pers comm). The assessment of environmental impacts in Sections 8 & 9 is based on this understanding of the proposed project activities.

3.2 Stages of Exploration, Mining & Processing

NRR has proposed to develop the mine in Stages 1 & 2. These two stages will overlap in time to some degree. Stage 3, will be a closure and rehabilitation stage, which has not been dealt with explicitly in the report by LMS (Oct, 2012). To the extent that minor amounts of waste rock and tailings may be disposed of underground during both Stages 1 and 2, Stage 3 will run concurrently. However rehabilitation on the surface will still be required after mine closure.

Figure 1.2 provided a map of the target areas in relation to the surface, while Figure 1.6 shows the relative locations of identified targets and proposed drilling exploration underground – during 2012 and early 2013.

Further details of activities are provided in Sections 3.3 – 3.32.

Table 3.1 shows a preliminary timetable for the three stages.

<table>
<thead>
<tr>
<th>Table 3.1 Preliminary Timetable for Stages 1, 2 &amp; 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commencement</td>
</tr>
<tr>
<td>Stage 1: Exploration</td>
</tr>
<tr>
<td>Stage 2: Mining &amp; Processing</td>
</tr>
<tr>
<td>Stage 3: Closure and Rehabilitation</td>
</tr>
</tbody>
</table>

3.2.1 Stage 1: Underground Mining for Exploration Purposes (no processing)

Stage 1 will comprise the advanced exploration stage with development of the mine to facilitate underground drilling of ore shoots. Exploration to date has indicated that much of the high grade deposits are at depth. It is also known that the ore bodies are relatively narrow, variable and near-vertical forms. These ore bodies are more accurately targeted by drilling from underground than from the surface. This stage seeks to confirm and quantify the ore resource, and also to define the ore shoots for mining operations.

Some drilling of new targets will also be conducted from the surface as shown in Figure 1.2. Some drilling exploration has already been undertaken and further drilling will be conducted in 2013/2014.
In order to prove the ore resource (upgrade it from the current “inferred” and “indicated” status) the existing underground drives need to be extended (“developed”) to gain access to the ore bodies at deeper levels - for exploration and ultimately to facilitate mining.

Also during Stage 1 some backfilling of old voids may be carried out as a means to dispose of waste rock generated while developing the drives – to avoid hauling it to the surface.

Existing shafts may need to be renovated and possibly new shafts developed to provide ventilation. Development of additional shafts to remove ore to the surface may also be considered, but at this stage seems unlikely.

Any ore that is produced during the process of developing drives and shafts will be stockpiled underground or removed to the surface and stockpiled for later processing as part of Stage 2.

3.2.2 Stage 2: Mining, Production & Processing

Stage 2 involves production mining, construction and operation of a processing plant, and further development of the mine drives and shafts. It is proposed that the tailings re-treatment process will commence and operate while the underground mine is being developed. Mining production and processing will continue for a minimum of 7 years at a proposed rate of 250,000 tonnes per annum.

Mining and processing can commence and run concurrently with further drilling of the ore bodies to define them more accurately. Thus there is an overlap between these stages. The economics of mining will improve if a production rate above 250,000 tonnes per annum can be achieved.

During operations, backfilling of waste rock into the worked out voids will be ongoing where technically and economically feasibility.

3.2.3 Stage 3: Closure & Rehabilitation

Most of the tailings will need to be made safe, landscaped in some way to minimise visual impacts in the Park, and ideally be covered with waste rock (the host marble).

Provision will need to be made for leachate from the remaining tailings to be managed so that it does not contaminate watercourses.

Buildings, concrete slabs, pipelines, power lines etc will need to be removed and the area cleaned up.

The shafts will have to be secured to prevent accident to people or wildlife.

3.3 Construction Camp

No construction camp is being considered on site. It is currently proposed to transport construction personnel daily from by bus from Swakopmund. Only a few security personnel will be accommodated on site.
3.4 Mine Plan & Layout of Infrastructure & Buildings

A drawing showing the overall layout of the mine infrastructure is presented in Figures 1.3 and 1.4. It is understood that the plant, tailings and waste rock dumps will be confined to the existing disturbed area – as far as practically possible.

The components of the mine and infrastructure will include:

- Existing tailings,
- Future tailings site where it was started previously,
- Waste rock dumps, if some of this material cannot be accommodated in mined out voids underground (no site has been indicated by NRR for the waste rock stockpile, but on mine closure it could be used to cover the tailings),
- Mine entrances (drives),
- Mine shafts (for ventilation),
- Processing plant (Figure 1.4 shows a preliminary layout, which is subject to engineering design to follow),
- Loading shed,
- Buildings (offices, workshops, storerooms, etc.),
- Ablution block,
- Training facilities,
- Canteen,
- Clinic,
- Offices,
- Parking,
- Container stores,
- Site roads,
- Any paved stockpile areas,
- Parking areas,
- Concrete bases for machine installations or loading areas,
- Crushers, mills, flotation systems etc.,
- Pipeline (on previous alignment),
- Powerline – refurbishment of the existing one,
- Water storage tanks (potable water, process water),
- Sewage treatment plant,
- Specialised storage facilities – explosives, fuels, chemicals, hazardous substances (refer Section 3.5 below),
- External portable silos for binder components (at least one with a capacity of 40m$^3$),
- Stockpile bins.

The mine and tailings will occupy an area of about 19ha (see the red outline in Figure 1.4). The area to be disturbed will be smaller than for the previous mine.

3.5 Specialised Storage: explosives, fuels, chemicals, hazardous substances & waste

There are specialised requirements for:

- Explosives stores,
- Fuels and other hydrocarbons require tanks that are bunded to contain all potential spills,
- Chemical stores & Hazardous substances, contained indoors.
The above may require permits under the relevant legislation. Special measures are also required for Hazardous substances – their transport, storage, and final disposal.

3.6 Dust & Noise Suppression Underground

Dust will be generated underground by blasting, tipping, loading and transporting. Dust will be suppressed by means of water sprays.

Above ground, dust will be generated on the access road, the short haul road from the mine entrance, crushing, screening and stockpiling. Dust suppression on any haul roads will be achieved by spraying with water. If mining is undertaken at any more distant localities then hauling above ground will result in dust generation, which will need to be minimised.

3.7 Stripping and Stockpiling of ‘topsoil’ layer from areas to be disturbed

Soil cover is minimal on and near the site, but the top layer contains seeds and what little organic matter may exist. Therefore the top layer is considered valuable for rehabilitation. The top 250mm should be stripped from all areas that will be built on, compacted, contaminated or disturbed. This soil should be stockpiled for later rehabilitation of disturbed areas and tailings.

3.8 Water Demand & Supply

Water resources in the Erongo Region are very limited, largely due to the mining sector.

NRR has applied to Namwater for 250,000 m$^3$ per annum for all purposes combined. The general rule of thumb is 1 tonne of water for every tonne of rock processed. However NRR expects to recover about 50% of the process water after processing by operating thickeners and penstock system at the tailings dam.

Storage on site for a two day supply will be required (i.e. about 700 m$^3$ storage capacity).

LMS (Oct, 2012) explained that the water is needed for:

- Drilling,
- Processing,
- Dust suppression in the mine and on unpaved roads, crushers, conveyors, stockpiles,
- Workshops / and vehicle wash bays,
- Domestic use (treated / potable water),
- Evaporation losses (e.g. from the tailings dam).

Drilling water could be supplied from the existing borehole within the EPL and the existing twin header tanks. A usage rate of 4 litres / second is estimated for drilling dust suppression (water sprays), wash down etc.

Supply will come from the excess of an existing desalination plant. Areva built a desalination plant at Wlotzkasbaken, 30km north of Swakopmund in 2010. It can currently produce 20Mm$^3$ of potable water per year. The desalination plant was designed to be expanded to a capacity of 40Mm$^3$ / year should it be required. It was originally designed to supply 12 Mm$^3$ for Ariva’s Trekkopje Mine, which is currently on care and maintenance. The surplus of about 8Mm$^3$ is to be made available for users in the Erongo Region. The surplus water is supplied into the Mile 6 Reservoir and pumped to Swakopmund via an existing pipeline.
The potential supply to NLZM is via an offtake from the Rössing Pipeline. This is a 700mm steel pipe with a capacity of 1,100m$^3$/h. There is an existing take off point since before closure of NLZM in 1992. A new 7km pipeline of 110mm diameter will be built from that point to the mine. It can be laid on the ground, except where it crosses watercourses where it will need to be raised on piers to prevent damage by episodic river flow. There is a potential risk to the pipeline from Park users in 4x4 vehicles. Burying the pipe is not recommended as there is little or no soil in many places and excavating in rock would leave permanent scars unnecessarily.

In the interim the site can continue to be supplied with potable water by truck / tanker, which is supplied at regular intervals for human consumption.

Mine dewatering is needed to remove inflows from mining and limited groundwater ingress. This could potentially be used in the mine with an oil separating devise and silt trap. The mine dirty water system is designed to handle a maximum of 10 litres/ second. Any water from that source would be supplied to the process water tank for the mill.

Consideration will need to be given to recovering and recycling as much water as possible, for example:

- from the process before discharge to tailings,
- from the tailings dam.

The design of the tailings dam is important to manage evaporation losses. NRR proposes to build small cells, to minimise surface area and hence evaporative losses. The cells may be lined to prevent infiltration. Flocculants could also be considered to hasten the settling of fine particles – thus improving water recovery.

### 3.9 Power Demand & Supply

The maximum power demand for the underground mine is estimated for Stage 1 at 767 kW. ErongoRED has informed NRR that they are able to supply 500 kW, which is considered sufficient for Stage 1 only.

LMS (Oct, 2012) states that additional power will be required for the processing plant. The total demand for the full mining and processing operation is estimated at 2 MW, but this has to be confirmed during the feasibility study. A diesel generating plant is being considered as an alternative. NamPower is also investigating a new power station in the Erongo Region in two years time, but the feasibility thereof is not yet confirmed.

The existing power line has been inspected and the poles were found to be fit for use, but the line will have to be refurbished.

It is assumed that the power line will be 22kV as it will be connected to an existing 22 kV line (refer to Figure 1.1).

Power will be stepped down to 525V, via a transformer, for use in the mine and reticulated within the mine via 525V armoured cables. Here it will be used to operate ventilation fans, diamond drills, compressors, pumps, lighting, etc.

An emergency back-up power supply will be provided by a generator on site.
3.10 Development of Declines and Drives Underground

There are two existing declines (ramps) from the surface to the lowest point in the mine. One accesses the upper section of the North ore bodies. The other (“main decline”) accesses all other areas.

The primary access to the mine will be via a single decline, with separate internal ramps for each stoping area. The existing main decline is too small (2.1 wide by 2.4m high) for the proposed 12 t diesel trucks that will haul the ore to the surface. The decline will therefore be stripped to 3.0m wide by 3.5m high with an arched profile. Ore drives will be of similar dimensions but can have gradients as steep as 1 in 6. The grade and curvature of bends also needs to be improved in places. All such development will be completed using hand held equipment.

The existing decline also has the disadvantage of being very close to the old stopes, which presents certain risks that need to be managed during this development. The main development layout is required to access and drill all the main mining blocks, being N20, North, South and Junction zones. For future purposes, the single decline system will be developed at an acceptable safe distance from the stopes.

It is also proposed to develop a new exploration level at 170mRL to develop the North and N20 areas. The access drive will be developed with a gradient of 1 in 50.

Figure 1.6 (p.10) shows a view of the developed drives linking the four mining target areas - N20, North, Junction and South areas.

The main drives will be developed in the country rock (marble) rather than the ore. The rock waste produced from the stripping will be backfilled into existing stope voids. The available void space is calculated at 150,000 m$^3$.

The ore will be removed by small haul trucks via the existing and new ramps to be developed.

The shafts (existing and future) will be primarily for ventilation, but will also be fitted with ladders to provide escape ways.

3.11 Shafts: Hoisting and Ventilation Requirements

The old mine has a vertical shaft extending to approximately 180m below surface and 3m by 2m in cross-section.

Existing and new shafts will also be needed for ventilation. The air flow requirements are determined by the demand of diesel trucks. The estimated total ventilation requirements for the mine, to support a production rate of 250,000 tonnes per annum, is 38m$^3$/s.

A single air duct for pumping air into the mine is proposed. However, the air flow velocity at any point should not be high enough to pick up dust. Thus the flow velocity in the drives, where man access is required, should generally be limited to 6m/s (LMS, Oct 2012).

Should increased air flow be required, investigation would be needed – probably regarding the use of existing shafts to the surface.
A separate exhaust ventilation system will be connected to the decline and stopes on each level.

3.12 Backfill & Materials: Waste Rock & Tailings

Disposal of some of the waste rock in worked out voids is proposed to avoid costly hauling to the surface. Disposal of tailings underground is not proposed by NRR due to the risks of failure of retaining walls and resulting mud flows.

Limited backfilling may only be carried out where necessary for structural purposes and subject to economic constraints. Waste rock would most likely be used – with or without the addition of binders, such as cement. Each situation will be subjected to engineering design to ensure stability and mine safety.

3.13 Disposal of Excess Waste Rock on Surface

During development in Stage 1 and 2, it is assumed that not all waste rock will be disposed of underground. Space constraints and logistics may necessitate hauling or hoisting some of the waste rock to the surface for disposal.

Waste rock dumps will be as close to the mine portal as practical to reduce haulage. If any waste is disposed of above ground, consideration could be used to cladding the tailings as a rehabilitation measure. Since the waste rock is marble it would pose no environmental hazard.

3.14 Stockpiling of Ore

During Stage 2, a ROM pad will be constructed near the crushing circuit. This stockpile would hold an estimated 10,000 tonnes of ore prior to plant commissioning. The volume of this stockpile would be approximately 15,000 m³.

3.15 Tailings from Previous Mine Dump

The existing tailings pile left by previous mining operations is approximately 700,000 tonnes (see Old Tailings Dump in Figure 1.3)

Metallurgical tests have shown potential for recovery of metals, particularly in the lower portions of the tailings pile where the zinc grades were found to be higher. Further optimisation work is being undertaken.

3.16 Tailings from New Processing Plant

During mining and processing operations, a tailings dam will be needed to dispose of roughly 220,000 m³ per annum. LMS (Oct, 2012) states that it will need to be 90,000 m² (9 hectares) to allow for a rate of rise of 1 m per annum. It is proposed that the New Tailings Dump will be on the site of the existing, relatively unused dump that is shown in Figure 1.3.

The final volume and height of tailings will depend on mine life and engineering constraints.
Engineering design will be aimed at recovering as much water as possible from the tailings. It is assumed that a penstock system will be used. Additional measures could include removal of some of the water at the tailings thickener stage before pumping to the tailings dam.

The addition of flocculants to speed up settling can be considered, at a cost, if necessary. This will depend largely on the particle size distribution resulting from milling. The coarser the sediments, the better for settling.

At this stage the coarsest particles are expected to be 75 microns, but this has to be confirmed by more tests – for optimum recovery of metals in the process. Thus far insufficient information is available on the physical and chemical properties of the tailings, including the chemical residues from reagents.

No detailed proposal is currently available for rehabilitation of the tailings, which is difficult in this desert environment. Trimming and shaping into more natural looking forms would be desirable. If possible, cladding the tailings with waste rock would reduce the visual impacts. Coarse sand could also be used for covering. Revegetation of tailings would be extremely unlikely to be effective due to the climate and chemical reagents in the tailings.

### 3.17 Underground Mining

LMS (Oct, 2012) has provided details of the proposed underground operations. While much of it will be of relevance to mine safety and health matters (not dealt with in this EIA), the environmental impacts of underground operations will have few environmental impacts. Only a brief summary of underground activities is provided below.

Underground mining was preferred to open pit mining because:

- Less than 1/3 of the ore is minable by open pit (164,000 tonnes),
- The ore bodies are relatively small in relation to the host rock – so that the stripping ratio is high (16 waste to 1 ore),
- Mining costs per tonne were estimated to be cheaper than open pit mining, and
- Open pit mining would produce far more waste dumps and surface disturbance in the National Park.

The mine will use simple robust methods and equipment and using hand held equipment. Drilling and Blast will follow standard industry practice. Various mining options have been considered by LMS – one of which is favoured:

- Open stoping is preferred.

Previous mining relied on hand held drilling of short holes (2m to 5m) into the ore. In the new mining operation, the use of long hole drilling involving and open stoping method is proposed. NRR considers that the competent nature of the rock will allow for the proposed open stope method of each ore shoot without support. At deeper mining levels the mining method may be reviewed if necessary.

The target production rate has initially been set at 250,000 tonnes per annum. The development rate required is 4.5 m/day operation average to sustain production. This includes horizontal waste and ore development. The planned vertical advance rate is 20.5 metres per year.

The mine will operate 24 hours / day and 7 days per week.
The country rock and ore shoots are comprised of competent rocks and have few joints or discontinuities (Dr John James, cited in LMS, Oct 2012).

Although the host rock is very competent, the need for support in certain situations is apparent – for example, when mining below old stopes. LMS has discussed various types of support, which will be subject to engineering design for particular situations. Appropriate engineering design will seek to ensure that deeper ore deposits are not sterilised.

Ore will be loaded by diesel loader onto diesel mine trucks and hauled to the surface.

Dust suppression by spraying the broken rock with water prior to loading is standard practice in the industry.

**Figure 1.6** (p.10) shows a “cross section” of the old mine (South and Junction zones), and the new targets in the North and N20 zones to the northwest of the old mine. The solid colour shows the ore shoots to be mined. The proposed mining method is open stoping, with access from the existing decline which may be enlarged to 3m wide by 3.5m high, arched above to allow for hauling by diesel trucks.

### 3.18 Crushers

A system of crushers will reduce the ore to suitable sizes for milling.

Trucks from the mine will tip the ore onto the ROM pad. A loader will then feed into a receiving bin that will feed the crusher system: -

- A hydraulic hammer boom to break down oversized rock on a 250 to 300mm bar spacing,
- Primary (jaw) crusher,
- Secondary crusher,
- Screens to sort material,
- Stockpiles and bins hold materials at various stages in the process,

Dust suppression using water sprays is standard practice. Dust extraction canopies over the transfer chutes with accompanying bag house can also be used. Personnel will be issued with certified and appropriate dust masks.

### 3.19 Milling Plant

The grinding mill will receive crushed and screened material from the crusher systems. Water is added before milling.

Milling to a particle size of 75 microns will be carried out. Further metallurgical work is required to determine optimum size for grinding.

A milling rate of 25 to 30 tonnes per hour is proposed.

Mill will largely determine the final particle size that will be disposed of to tailings, and therefore will be one of the factors affecting the potential for dust generation from the tailings.

However, from the milling onwards the process is a wet process.
3.20 Processing Plant

A brief outline of the process is provided by LMS (Oct, 2012). The processing method involves differential flotation producing two concentrate products:

- a zinc concentrate, and
- a lead concentrate.

LMS also provides details of various metallurgical tests that were carried out to determine the optimum parameters such as particle size, chemical reagents, pH, flotation residence time, and chemical additives to enhance the differences in flotation between the different minerals. It is known to NRR that the ore consists mainly of sphalerite, galena, pyrrhotite and pyrite intergrown with carbonate.

LMS (p.171) explains as follows: "The general practice in the separation of zinc–lead and iron rich ores is to depress the sphalerite and pyrite/pyrrhotite with sodium cyanide and zinc sulphate to selectively float the lead mineral, galena. Galena floats quite readily in the presence of cyanide and it is actually required in some cases to activate the galena, probably due to its cleaning action on the galena particle surfaces. The best flotation conditions of galena are obtained in slightly alkaline circuits with a pH of about 8.5. Sphalerite and marmatite rarely float well without pre-activation with copper sulphate."

"At NLZM a fairly large proportion of the gangue consists of pyrite and pyrrhotite which also gets activated with the addition of copper sulphate. To overcome this problem the pH is raised to about 11 and up to 12 with the addition of lime to depress the pyrite. Pyrrhotite depression even at high pH levels can be problematic and sometimes be very ineffective. Reagents specially developed for pyrrhotite depression then have to be used, like some of the polyacrylamides."

During the experimental work the following chemicals were used:

- Sodium cyanide (NaCN) 100 g/t
- Zinc sulphate (ZnSO₄) 300 g/t
- Sodium ethyl xanthate (SEX) 100 g/t and 20 g/t
- Copper sulphate (CuSO₄) 500 g/t
- Sodium carbonate (Na₂CO₃) was added to raise the pH to 11
- Sodium iso butyl xanthate (SIBX) 100 g/t and 50 g/t
- Polyethylene glycol (PEG)

Polyacrylamides may also be used for the depression of pyrrhotite. Commercial pyrrhotite depressants include Cytec 7261 and Cytec 7262. The former was used at 80 g/t to 100 g/t.

NRR currently proposes the following Flotation Reagents. However the list is not necessarily comprehensive and is subject to change. Material Safety Data Sheets (MSDS) for the following hazardous substances are provided in Appendix C.

- Calcium Hydroxide (Lime, hydrated) Ca(OH)₂
- Copper Sulphate CuSO₄
- Pro-Flot SC-A2, Aqueous mixture
- Quicklime CaO
- Sodium Cyanide NaCN
- Sodium Isopropyl Xanthate C₃H₇OCS₂Na
- Zinc Sulphate O₄SZn * 7H₂O
The process concludes with drying of concentrate and storage in sea containers ready for shipment.

The concentrator plant will work 24 hours x 7 days per week. Shift operators will work a 45 hour week.

No smelting process is proposed at the mine. The product will be exported as a concentrate.

### 3.21 Concentrate handling / bagging & Container storage

A container storage yard, with a levelled and compacted floor will accommodate this activity. Bulk concentrates will be produced with storage on site in bunkers. Loaders will be used to fill 20 foot sea containers which are transported with the use of a side loading container truck to dispatch the concentrates to port.

A weigh bridge for trucks is planned to be installed on site.

### 3.22 Plant maintenance

It is proposed that maintenance of the plant will be outsourced to maintenance contractors – probably based in Swakopmund.

### 3.23 Sewage Treatment Plant and disposal system

Domestic sewage from the mine precinct will need to be treated on site. NRR is considering a low energy biological treatment process.

The system involves two solids interceptors and one multi-media biological filter. The latter stage involves bacteria, fungi and worms. A harvestable sphagnum peat is produced. Water leaving the biological filter is disinfected with chlorine tablets, and the treated water should comply with the SA Department of General Standards.

According to Förtsch (pers comm) who promotes the system in Namibia, the treated water could be used in the process (subject to tests to ensure that dissolved substances like soap residues do not interfere with the chemical reagents) or for dust suppression on roadways. For dust suppression at the crusher or any place where water spray may drift onto people, the quality would need to be carefully monitored.

### 3.24 Waste disposal: Solid, Liquid and Hazardous waste

No burying of any waste on site will be permitted. Solid waste from offices and canteen will either be incinerated in a high temperature diesel incinerator, or removed regularly in containers to the General Waste facility at Swakopmund. In a letter from Swakopmund Municipality dated 13 June 2013 (see Appendix N) it was stated that they receive only general waste and that NRR must apply to dispose there as they are outside the Municipal area.

Hazardous waste will have to be disposed of at the Hazardous Waste facility at Walvis Bay.

Recycling of suitable, non-combustible materials, such as metals and glass is recommended.
Some of the reagents are recovered in process water that is recovered from the tailings dam. This is circulated back to the process plant and a little remains in the tailings material or in the concentrates that are produced. No direct release of the reagents to the environment takes place, although some may leach though the tailings into the ground if liners are not used.

Servicing of vehicles will produce lubrication oils and hydraulic fluid, which will need to be sent for recycling or disposed of to a hazardous waste facility such as at Walvis Bay.

3.25 Transport to Walvis Bay: Road & Port

It is proposed to transport the products in 20 foot shipping containers, which can each be loaded with 28 tonnes of concentrate. Containers are preferred to bulk shipping as they are environmentally secure and present a low risk of contamination – mechanical failure excepted.

The port of Walvis Bay is approximately 50km from the mine. Namport has confirmed their capacity to handle the proposed container traffic in a meeting with NRR on 19 September 2013 (Claridge, pers comm).

The containers can be stored at the mine or at the port awaiting shipment, but the logistics and impacts on road traffic need to be considered. The mine will produce approx 30,000 tonnes of concentrates per year – i.e. roughly 580 tonnes / week. This would amount to about 2 trucks per day each carrying two 20 foot containers per trip. Transport can be limited to weekdays if necessary, and to off-peak hours.

3.26 Rail Transport option to Port of Walvis Bay

The question of rail transport was raised since the railway is so close. However, this option is unlikely to be economical due to loading and unloading costs, and NRR would be constrained by TransNamib schedules. It has therefore not been considered further.

3.27 Stage 3: Closure & Rehabilitation

No details of the proposed closure and rehabilitation plan have been made known to CCA.

The following has been inferred by CCA from other information provided by LMS (Oct, 2012) or assumed as necessary to achieve an acceptable level of rehabilitation in a National Park.

- Before commencing construction activities the ‘topsoil’ will be removed from all affected areas and stockpiled for rehabilitation following mine closure;
- All structures will be removed including concrete platforms and foundations unless they can be used for some tourist or Park facilities by agreement with the Parks Department;
- All infrastructure will be removed – pipelines, power lines, buildings, headgear etc.;
- Shafts will be fenced during operations, as they need to remain open for ventilation, and will remain fenced following mine closure;
- All compacted soils, such as roadways, sites beneath slabs, and stockpile areas will be ripped to loosen soil;
- Stormwater retention dams should be retained to trap runoff from tailings?
- Tailings represent the most difficult rehabilitation. The existing tailings are visible for many kilometres and are conspicuous due to their dark colour. They can be trimmed
off to resemble natural landforms, and then can be clad with waste rock (marble), or coarse quartzitic sand from a river bed, or crushed stone from a nearby granite quarry. These options should be discussed in advance with the Directorate of Parks, and the colour and reflectivity of the material must be taken into account to minimise visual impacts.

3.28 Employment Numbers & Salaries: Mine & Processing Plant

The mine and processing plant will provide full time employment for categories of staff and project stages shown in Tables 3.2 and 3.3.

Table 3.2   Employment by Staffing categories and Stage of Development (Mine only)

<table>
<thead>
<tr>
<th></th>
<th>Stage 1</th>
<th>Stage 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management &amp; Supervision</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Technical Staff</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Labourers</td>
<td>25</td>
<td>48</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>39</strong></td>
<td><strong>62</strong></td>
</tr>
<tr>
<td><strong>Total Salaries per Month (Mine only)</strong></td>
<td>USD 56,000</td>
<td>USD 90,000</td>
</tr>
</tbody>
</table>

Table 3.3   Employment by Staffing categories (Stage 2: Processing Plant & Tailings Dam only)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Supervisors</td>
<td>2</td>
</tr>
<tr>
<td>Operators (technical)</td>
<td>30</td>
</tr>
<tr>
<td>Labourers</td>
<td>4</td>
</tr>
<tr>
<td>Artisans &amp; assistants</td>
<td>8</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>44 persons</strong></td>
</tr>
<tr>
<td><strong>Total Salaries per Month (Processing plant)</strong></td>
<td>USD 52,140</td>
</tr>
</tbody>
</table>

NRR considers that it will not be difficult to recruit labourers and tradesmen. Unemployment rates are high. They expect to be able to source skilled underground workers from mines in the north of Namibia that have been closed. NLZM will also have an advantage in that the mine is closer to Swakopmund than most other mines.

It is intended to hire a limited number of experienced operators to start operations and then to hire locally and train on site. As production ramps up, trained crews will be split in two and new workers added to be trained by experienced workers.

NRR’s policy will be to pay average salaries in comparison to other mines in Namibia. Professional staff will be paid normal monthly salaries with discretionary annual bonus.

The Mine Manager will be responsible, amongst other things, for Health and Safety and Environmental Protection. The environmental management function will be split over the management areas with the Mill Manager being responsible for producing site wide environmental reports.
The processing plant will operate 24 hours per day, 7 days per week. The shift operators will work a 45 hour week.

3.29 Housing for Mineworkers

The workforce will be drawn from Swakopmund as far as possible. No company housing will be provided on a permanent basis. Staff will be transported by bus from and to Swakopmund and Walvis Bay to support the scheduled shifts.

NRR has confirmed the availability of sufficient housing in Swakopmund and Walvis Bay with estate agents (Claridge, pers comm).

NRR is considering offering staff a housing allowance as part of their package so that they can provide their own accommodation.

Therefore no housing will be provided at the mine site.

3.30 Emergency & Health services

The adequacy of existing emergency services to handle large scale emergencies - fire, evacuation, hospitals, etc - is currently unknown.

NRR proposes to:

- Enquire with other mines in close proximity regarding possible medical response sharing,
- Develop emergency response procedures in the event of accidents,
- Institute procedures for pre-employment health tests, and ongoing blood tests (e.g. lead levels in blood) and health checks during employment,

3.31 Occupational Health & Safety

Occupational Health and Safety is not dealt with in this EIA or EMP. Therefore it is recommended that NRR consult with other specialists in this field of expertise.

LMS (Oct, 2012 p.143) states that the mine “will operate a safety first policy and will operate under the guidance that if a job cannot be done safely it does not get done at all. The small size of the project and the low number of workers on site will assist in maintaining high standards”.

NLZM intends to formulate and operate under a comprehensive set of Standard Operating Procedures, and will include suitable training and induction programmes for all personnel.

It will be necessary to comply with all relevant legislation concerning health and safety. It is recommended that specialist health and safety officers be employed in the planning, construction and operational stages.

Regular blood tests will be carried out to test levels of metals (e.g. lead and zinc) in the blood. If exceedances of standards are found then individuals may need to be removed from the job and treated. Regular training and refresher courses are needed, as well as on site
management – for example, to enforce the wearing of dust masks and hearing protection where appropriate.

3.32 Summary of Capital & Operational Costs by Development Stage

The proposed mine development plan has been separated into a two stage process structured as follows.

**Stage 1**: Delineate and upgrade Mineral Resources from the current JORC resource of 668,000 tonnes indicated and inferred toward a target 1.0Mt resource base with a JORC classification of Indicated.

- The activities include a surface drilling program of up to 5,000 metres to test a number of new surface targets identified by aerial electro magnetics survey (VTEM).

- Establish surface and underground infrastructure to support exploration works followed by mine development. Develop access to underground drill positions as required for Stage 1 drilling.

- Commence an underground diamond-drilling program of approximately 10,000 metres, to upgrade the resource base to a target of greater than 1Mt of Mineral (Ore) Resources.

**Stage 2**: Develop the underground mine to support consistent production at 250,000 tpa and build a 250,000 tpa concentrator with associated surface infrastructure.

- Should the results from Stage 1 meet the project economic requirements, then Stage 2 will commence with approval from the Board of NRR.

- Stripping the main decline to allow the passage of mining trucks. If low profile equipment can be sourced, this stripping of the decline may not be needed.

NRR has provided preliminary financial information based on their financial model, which will be updated to greater levels of accuracy during the Feasibility Study. **Table 3.4** provides current estimates of Capital and Operating Costs for Stage 1 and Stage 2 of the project development.

<table>
<thead>
<tr>
<th></th>
<th>Stage 1 (USD) (over 2 years)</th>
<th>Stage 2 (USD) (over 9 years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital Expenditure</td>
<td>2.1 Million</td>
<td>5.33 Million</td>
</tr>
<tr>
<td></td>
<td></td>
<td>14.50 Million</td>
</tr>
<tr>
<td>Operating Expenditure</td>
<td>2.4 Million</td>
<td>31.15 Million</td>
</tr>
<tr>
<td></td>
<td></td>
<td>48.25 Million</td>
</tr>
<tr>
<td>Sub-totals</td>
<td>4.5 Million</td>
<td>36.48 Million</td>
</tr>
<tr>
<td></td>
<td></td>
<td>62.75 Million</td>
</tr>
<tr>
<td>TOTAL INVESTMENT (USD)</td>
<td></td>
<td>103.73 Million</td>
</tr>
</tbody>
</table>

The target of this investment is a JORC compliant Mineral Resource of 1.0 Mt.
Using a combined metal grade of 10% base metals and 40g/t silver the in ground value of the target resource is approximately USD220/t adding to a total value in the ground of USD 220 Million.

If justified by exploration results, the mine production could exceed the base case estimate of 250,000 tonnes / year.

NRR has based all their operating estimates on running the mining and processing themselves rather than using a mining contractor.
4 THE PROJECT ENVIRONMENT

4.1 Climate

Data from the nearest weather station, close to the Namib Lead Mine, was available for the three year period from January 2009 till December 2011. This data was presented by Airshed (2013). Their full report is contained in Appendix D and summarised below, particularly in regard to winds.

SLR (Dec, 2012) and SLR (Oct, 2013) also provided climatic information as part of their specialist study on surface water and groundwater, especially for rainfall and evaporation. This was based on long term records from Rössing (28 consecutive years) and Swakopmund (88 years with some years’ data missing). SLR’s reports are presented in Appendix E and F respectively.

Temperature

The temperature ranged from 5 °C to 40 °C. The highest daily temperature in the 3-year period was recorded in March and the lowest in June. Mendelsohn et al (2002) show that, in terms of average monthly temperatures, the hottest month is normally February and the coolest is normally August. Running counter to this trend, high daily temperatures occur during the late winter and spring when easterly winds are associated with subsiding air from the interior of the country.

Rainfall & Fog

The area is characterised by the extreme aridity of the Namib Desert. Average values for rainfall are not very helpful here because rainfall is so variable. It is quite common for no rain to fall in a particular year or more, while in another year the annual average can be received in a single rainfall event.

Since Namib Lead & Zinc Mine is roughly midway between Rössing and Swakopmund, SLR (Oct, 2013) interpolated between these two sets of data to estimate the monthly rainfall at the mine as shown in Table 4.1, below. The mean annual rainfall for the mine is thus estimated at 21.7mm.

<table>
<thead>
<tr>
<th>MONTH</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
<th>YEAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rössing Mean</td>
<td>3.7</td>
<td>4.0</td>
<td>11.0</td>
<td>4.3</td>
<td>1.5</td>
<td>0.5</td>
<td>0.5</td>
<td>0.7</td>
<td>0.7</td>
<td>0.4</td>
<td>1.0</td>
<td>1.1</td>
<td>29.0</td>
</tr>
<tr>
<td>Swakopmund Mean</td>
<td>1.7</td>
<td>1.5</td>
<td>4.6</td>
<td>2.5</td>
<td>0.7</td>
<td>1.1</td>
<td>0.3</td>
<td>0.0</td>
<td>0.4</td>
<td>0.4</td>
<td>0.5</td>
<td>0.5</td>
<td>14.3</td>
</tr>
<tr>
<td>Average Namib Mine</td>
<td>2.7</td>
<td>2.7</td>
<td>7.8</td>
<td>3.4</td>
<td>1.1</td>
<td>0.8</td>
<td>0.4</td>
<td>0.1</td>
<td>0.5</td>
<td>0.4</td>
<td>0.8</td>
<td>0.8</td>
<td>21.7</td>
</tr>
</tbody>
</table>

The above data is presented graphically in Figure 4.1 below – the green columns representing mean monthly averages interpolated from the Rössing and Swakopmund data. Note that rainfall is more likely in summer with March enjoying the highest average, based on long term records.
Additional details such as depth-duration rainfall (rainfall intensity) data is provided in SLR’s reports – refer to Appendices E & F.

Precipitation is not limited to rainfall, and the area receives frequent fog from the sea. Condensation onto plants, rocks and soil results in significant moisture that is available to plants, invertebrates and larger animals. Precipitation from fog is important for life in the Namib Desert close to the coast.

**Evaporation & Relative Humidity**

Rössing keeps a record of monthly Class-A evaporation pan data, which SLR converted to open water values. This provides an indication of the likely evaporation from ponds or dams at the mine site. The mean annual evaporation is 1,668 mm, which is approximately 76 times the annual precipitation. The open water monthly evaporation data is shown in Figure 4.2, below.

**Figure 4.1: Comparison of Mean Monthly Rainfall in the Region (SLR, Oct 2013)**

**Figure 4.2: Average Monthly Open Water Evaporation for the Region (SLR, Oct 2013)**
Despite the lack of rainfall, the relative humidity (RH) reaches quite high levels in summer. February or March is typically the most humid month, with an average RH of 70 – 80% (Mendelsohn et al, 2002). June or July is normally the least humid month with about 30 – 40% on monthly average, but even drier during the warm easterly winds. Relative humidity fluctuates considerably even over periods of days, depending on wind direction.

Winds

Wind data from the available records over three years is represented by Wind Roses compiled by Airshed (2013) and shown below. The wedge shapes show the direction from which the wind blows. The colour represents the wind speed.

The first wind rose in Figure 4.3 shows the winds for the entire two year recording period, while the second and third wind roses show the difference between day and night – with strong westerly winds being common during the day and northerly or westerly winds at night.

Figure 4.4, shows the wind roses per season. Spring and summer show higher wind speeds in general, with direction varying between north and south-west. Autumn and Winter are much calmer, except when the easterly winds blow. The yellow to red colours show that these easterlies are the strongest winds. Because they are also very warm and dry, they are responsible for more wind erosion and dust dispersion than other winds. This is supported by the study by Linus (2010) on contamination of soils by dust containing metals. Linus found that levels of contamination were higher downwind of the old mine and tailings in a west–southwesterly direction – as a result of the east wind. This is also confirmed in the orthophoto Figure 1.2, which shows a “plume” of dust stretching from the tailings towards the west-southwest. Thus it is the easterly winds that are of greatest concern for dust dispersion. Note that the wind roses in Figures 4.3 and 4.4 below are based on only three years’ data and therefore may not accurately represent average wind directions over a longer period, but they indicate the dominant trends.
Figure 4.3: Period Wind Rose for the Namib Lead and Zinc site for the period (Jan 2009 to Dec 2011), and Diurnal Wind Roses for the same period. (Airshed, 2013)
Figure 4.4: Seasonal Wind Roses for Namib Lead and Zinc site for the period (Jan 2009 to Dec 2011) (Airshed, 2013)
4.2 Geology

The mine site is situated west of the Rössing Mountain range. The ore is hosted in limestone/dolomite that has been subject to intense structural deformation and metamorphism to form the Karibib marbles. The origin of this marble is geologically very old marine sediments deposited on a continental shelf. The lead and zinc ore is hosted in this coarse grained marble. The mineralization process was of the intrusive-related replacement type. Several phases of folding are evident in the area, and appear to be one of the controlling factors on the location and concentration of ore sulphides (LMS, Oct 2012).

Major folds of the marble formation are evident in the orthophoto as a pale band (Figure 1.2 p.6) and Figure 4.5. Dolerite dykes (intrusions) are shown as black lines. Some inferred faults affecting the mine are shown as red lines.

![Figure 4.5: Geological Setting within part of the EPL 2902 (SLR, Oct 2013)](image_url)

The mineralised shoots lie in the Karibib Formation marbles, just above the contact with the underlying Arandis formation. Within the usually coarse, massive marbles are fine grained quartz biotite feldspar gneiss, pegmatites and calc-silicate rocks. The ore occurs as multiple, narrow shoots, as shown in Figure 4.6. The mineralization is pyrrhotite, iron rich sphalerite, galena and pyrite with silver associated with galena and indium associated with sphalerite.

There is the possibility that numerous ore shoots may join up at greater depth to form much larger veins.
Figure 4.6: Long Section showing the ore bodies (N20 and North zones) and previously mined ore shoots (Junction and South Zone) (LMS, 2012)

LMS provides the results of a geotechnical evaluation, which shows that the rock is extremely competent and that the required ground support over the anticipated ore widths is minimal (LMS, Oct 2012 Appendix 7).

4.3 Soils

Consistent with the desert climate and slightly elevated position, the soils in the affected area are very thin and show little or no profile development. They are derived in situ mostly from the host marbles, dolerite and much less from the narrow ore shoots that reach the surface. Small amounts of wind blown sand are also present in the surface layers.

Linus (2010) undertook a study on the degree of contamination of the soil by previous mining. She took 560 soil samples, 357 from the surface and 203 from 35cm depth. These were collected along 16 lines radiating from the old tailings at the mine and along the compass directions up to 8km from the tailings. These were submitted to Niton XRF analysis.

The following elements were found in soils but did not show any relationship to the tailings, and were therefore discarded: Ag, Au, Co, Mo, Pb, Se, Sb, Sn, Sr, U, W, and Zr. Fe (Iron) did show a relationship between concentrations and distance from the tailings, but it was not considered to be of environmental concern and was therefore also discarded.

Eight elements showed a relationship between the element concentration and the tailings as well as being of environmental concern. These were Lead (Pb), Zinc (Zn), Cadmium (Cd), Copper (Cu), Nickel (Ni), Arsenic (As), and Manganese (Mn).

Element concentrations from samples taken from 35cm depth did not show as strong a relation to the tailings. It was inferred that the contamination generally did not penetrate the soil very much.

A “plume” of contaminated soil can be seen on the orthophoto images in Figures 1.2 & 1.3 spreading in a west-south-westerly direction. This corresponds to the pattern of contamination that was most obvious in Linus’ study. This pattern is the result of strong easterly winds that are warm and dry, which mobilise dust from the tailings - and possibly during dry processing such as crushing during the previous mining era. The visible “plume” is about 1.5km long but Linus found elevated levels of metals up to 8km from the tailings.
The existing levels of contamination were regarded as “hazardous” (Linus, 2010 p.56). The concentrations of all 8 heavy metals analysed did exceed the available international guideline levels for soils under residential, agricultural and industrial land use. Further details of Linus’ study are provided in Section 8.1.

Airshed (2013) took soil samples for analysis, as part of their air quality study, and found elevated levels of metals near the mine. Their report is contained in Appendix D.

The studies by Linus and Airshed can be used as baseline data against which to measure any future increase in the concentrations of metals that may result from further mining.

4.4 Topography & Hydrology

SLR (Dec, 2012) conducted a Hydrological Assessment of the catchment conditions, direction of flows, and volumes of flows generated in related to rainfall. The full hydrological report is contained in Appendix E. The key findings of that study are also reproduced in their summary report – the Groundwater and Surface Water Assessment (SLR, Oct 2013) which is contained in Appendix F.

The mine site is at an elevation of approximately 280m above sea level. Overall the EPL slopes from the Rössing Mountain range in the east towards the plains in the west (see Figures 4.7 & 4.8, below)

The mine is situated adjacent to a low ridge formed by a dolerite intrusion, which is clearly seen on the orthophoto images (Figure 1.2). Apart from two dolerite ridges the land within the proposed Mining Licence area is rolling to fairly flat, with occasional small hills of marble outcropping above the gravel plains.

SLR found that the drainage does not enter the Omaruru Catchment, which is about 60km to the north, or the Swakop River catchment, which is less than 5km kilometres to the south and south-east. Instead the drainage from the mine and EPL area flows westwards into the desert and towards the sea. However, no significant channel reaches the sea, which is approximately 25 km away.
At a local level, SLR defined two catchments as shown in Figure 4.8, below. Catchment A (yellow outline) and Catchment B (green outline) meet along a drainage divide that runs through the mine locality. Both drain south-westwards along poorly defined watercourses and washes. Catchment B is separated by a drainage divide from the Swakop River catchment (brown line).
SLR (Oct, 2013) found that surface water can mobilise contaminants, and transport them along drainage lines in a westerly direction. However, since the mine and infrastructure is located very close to a drainage divide, there will be very little runoff generated upslope of the mine and infrastructure. In their report SLR has provided rainfall intensities derived from various sources, which can be used by engineers to design stormwater retention structures to retain stormwater on site. They also provided a hydrological basis for designing stormwater diversion channels, if necessary to prevent clean stormwater runoff from coming into contact with the mine and becoming contaminated.

From this they developed a Conceptual Stormwater Management Plan, based on a preventing all contaminated runoff in a 1: 50 year rainfall event – refer to Appendix F.
Photo 4.1: Marble plains with the Rössing Mountains in the background.

Photo 4.2: Folded marble band outcropping to the south-east of the mine.

Photo 4.3: One of the larger watercourses with intersecting marble outcrop north of the mine.
Photo 4.4: An indistinct watercourse east of the mine, with the tailings at top right.

Photo 4.5: Nara melons at one of the larger watercourses north of the mine. This Nara melon habitat is uncommon in the EPL.

Photo 4.6: Vehicle tracks on gravel plains cause considerable damage and remain unsightly for decades or longer. Strict controls are needed in this National Park environment.
4.5 Acid Rock Drainage Potential

SLR (Oct, 2013 p.25-26) included a discussion on the potential for the ore to result in acid rock drainage (ARD) that could result in contamination of surface water or groundwater.

In summary, the mineralization is “strongly bound within carbonate units” of mixed marble / calc-silicate and schistic rocks. The mineralization is sulphidic, comprising pyrrhotite, pyrite, sphalerite and galena. Magnetite and fluorite are also common.

The sulphide minerals strongly suggest that acid will be generated through the oxidation processes. In order to quantify the acid generating potential it would be necessary to conduct laboratory tests on representative samples. Despite the likely acid generating potential of the ore minerals, the presence of carbonate minerals within the host rock (marble and calc-silicate) suggests the potential for neutralising the acid.

SLR recommends that the following tests should be carried out on representative samples. A sampling plan needs first to be developed:

- Acid Base Accounting (ABA),
- Net Acid Generation (NAG) analysis,
- Synthetic Precipitation Leaching Procedure (SPLP) tests.

If samples are found to be potentially acid generating then further geochemical tests in the form of kinetic leach tests would be recommended.

SLR also recommended that the quality of seepage from the waste rock and tailings be investigated. The production of acid and resulting lowering of pH will promote metal dissolution, so that seepage from such waste facilities may contain high concentrations of metals and salts that have the potential to contaminate the underlying aquifer system.

The iron sulphide mineral rich tailings probably pose the major potential environmental concern, and therefore it was recommended that the tailings water be collected from site following pilot testing of the processing plant.

4.6 Hydrogeology

SLR (May 2012) undertook hydrogeological investigations involving the drilling and testing of 8 new monitoring boreholes because there were no other boreholes close to the mine in the National Groundwater (GROWAS) database from which to gather data. The new boreholes were drilled within a 2.5km radius of the mine. Quarterly sampling and monitoring of these boreholes was conducted – SLR (September 2012), SLR (December 2012), SLR (March 2013) and SLR (June 2013). These quarterly results were summarised in an annual report by SLR (August 2013) which is contained in Appendix G.

The key findings on the baseline groundwater conditions are summarised from SLR (October, 2013) – refer to Appendix F.

- From the borehole data SLR produced groundwater contours shown in Figure 4.9, below.
- The majority of boreholes have very low yields – less than 1 m$^3$/h, with one exception with a sustainable yield of 2 m$^3$/h;
Depth to the water table varies between 10 and 100 metres below ground level. Water levels in the monitoring boreholes remained fairly constant during the period of the quarterly monitoring tests. In the marbles and schists surrounding the mine it is likely that there is no regional water table, with the majority of groundwater being restricted to fractures and faults. Outside of these structures the bedrock generally has low transmissivity and is relatively impermeable. The mine shaft itself remains virtually dry and no high inflow conditions were encountered. In the rock hosting the mine, LMS (2012, p.12) reports “evaluated transmissivities ranging between 0.05 and 1.5 m$^3$/day which is regarded as low”.

At a local level, SLR reports (based on personal communications) that there is a fault running just to the east of the old tailings dam, which is interconnected with the mine shaft. During a one-off pumping to remove accumulated water in the mine, the water was being discharged onto the surface just to the east of the tailings dam, and some was returning to the mine, until the pipe was extended further east – then the water entering the mine ceased. This evidence suggests that most groundwater movement near the mine is limited to faults.

Sulphate concentrations vary across the area, with the two highest being located close to the mine. Eight boreholes showed sulphate concentrations above 1,200 mg/l, and one at 851 mg/l. In terms of the Namibian standards, sulphates should be less than 200 mg/l, while 1,200 mg/l is unfit for human consumption;

Nitrates vary greatly – from less than 1 mg/l to 50 mg/l. In terms of Namibian standards, nitrates should be less than 10 mg/l, while 40 mg/l is unsuitable for human consumption;

Total Dissolved Solids (TDS) in all boreholes are high – between 9,660 and 27,550 mg/l, which is well above the guideline levels for watering livestock in Namibia, which has a cutoff of 6,000 mg/l;

The water quality in all boreholes is poor, with a number of parameters being above the acceptable limits for the Namibian National Water Quality Standards for human consumption.
Figure 4.9: Groundwater Contours (from Monitoring Borehole Data) (SLR, Oct 2013)
4.7 Vegetation

A specialist botanical survey was carried out for this EIA by Burke (2012). The full report is contained in Appendix H to this EIA Report. It includes lists of species in each of the various habitat types that she identified within EPL 2902.

The botanical field survey covered the whole EPL but focussed in more detail on the target areas that had already been identified within the Mining Licence area. As shown in Figure 1.2 the ML area covers only a small portion of the EPL area, and only part of the ML area will be directly disturbed - refer Figure 1.7 (p. 11).

The study was intended to (a) guide environmental management by identifying areas that require special attention and (b) provide a tool for measuring and reporting on plant biodiversity impacts where necessary.

Burke mapped eleven (11) biotopes within EPL 2902. Figure 4.10 shows the extent of each biotope and the location of the 46 sampling points on an orthophoto basemap.

Figure 4.10: Vegetation Sampling Points in the EPL 2902 area and outlines of biotopes (blue)
Figure 4.11 identifies each biotype, with the marble band that hosts the ore shown in turquoise. The area shown in black was previously disturbed by mining, tailings, housing, access road and landing strip. The new mine infrastructure will be contained within the previously disturbed area, as shown in Figure 1.7, where vegetation cover appears always to have been very sparse in any event.

The only vegetation of great biodiversity significance which exists close to the mine is *Lithops ruschiorum*. Two populations of this endemic species were found nearby on dolerite and marble ridges, with one far to the north, and one in the south-east of the EPL. These lithops populations are roughly indicated with purple outline in Figure 7. None of these populations needs to be affected, but those close to the mine should be protected in some way against accidental damage by people moving around the site as they are difficult to see when not in flower (see Photo 4.7, p.56).

A small marble outcrop in the far south east is a high diversity “hotspot” containing *Lithops* and several other ‘special’ plant species such as *Hoodia*. This site will not be affected by the current mining proposal.

There are very few trees in the area. A few small trees, 3 - 4m high, occur along drainage lines. The only trees on the site are alien invasive *Prosopis* sp., which need to be destroyed.
Burke (2012) assigned relative conservation status to the biotopes identified in Figure 4.11 above. The conservation status is mapped in Figure 4.12, below. The colours in Table 4.2 correspond to the map below. Thus the marble outcrop in the far south-east is considered of greatest conservation importance (critical), the lighter green is the second most important. The black area is disturbed by previous mining and has the least conservation importance. The green cross hatched areas are the areas where populations of *Lithops ruschiorum* have been found, but others may also occur outside the area proposed to be mined.

### Table 4.2 Biotopes in the EPL 2902

<table>
<thead>
<tr>
<th>Biotope</th>
<th>Biotope assignation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arthraerua stand</td>
<td>General</td>
</tr>
<tr>
<td>Dolerite ridges</td>
<td>Rare</td>
</tr>
<tr>
<td>Gypsum plains</td>
<td>Rare</td>
</tr>
<tr>
<td>Marble outcrop</td>
<td>Critical</td>
</tr>
<tr>
<td>Marble plains</td>
<td>Rare</td>
</tr>
<tr>
<td>Mountain</td>
<td>Rare</td>
</tr>
<tr>
<td>Mountain footslopes and washes</td>
<td>None</td>
</tr>
<tr>
<td>Nara field</td>
<td>General</td>
</tr>
<tr>
<td>Plains and washes</td>
<td>Rare</td>
</tr>
<tr>
<td>Rivers</td>
<td>Rare</td>
</tr>
<tr>
<td>Rocky outcrops</td>
<td>General</td>
</tr>
</tbody>
</table>

![Figure 4.12: Biotope assignation (conservation importance) and known populations of *Lithops ruschiorum* habitat in EPL 2902 (green hatching)](image-url)
Appendix 1 of Burke’s (2012) report provides a list of all the plant species found in the EPL, and the biotopes in which they occur. In total 69 species were found including one protected species (*Hoodia* sp.). Sixteen (16) species are endemic – these are: -

- *Arthraerua leubnitziae*
- *Calostephane marlothiana*
- *Hermbstaedtia spathulifolia*
- *Lithops ruschiorum*
- *Jamesbrittenia barbata*
- *Zygophyllum stapfii*
- *Acanthosicyos horridus*
- *Aloe asperifolia*
- *Euphorbia lignosa*
- *Psilocaulon salicornioides*
- *Senecio engleranus*
- *Sesbania pachycarpa subsp. dinterana*
- *Sipagrostis damarensis*
- *Sipagrostis giessii*
- *Sipagrostis hochstetteriana var. hochstetteriana*
- *Zygophyllum cylindrifolium*

*Lithops ruschiorum* is listed by Loots (2005) as a red data species in Namibia, but its distribution is extensive in the central and northern Namib and its status is of *Least Concern.*
Photo 4.7: *Lithops ruschiorum*: These tiny succulent plants are very difficult to see when not in flower. The nearest population to the mine is on the dolerite ridge (black rocks). These would not be affected by the current proposal for mining but may be damaged during exploration.

Photo 4.8: *Aloe asperifolia*: These aloes were found in a few places within the EPL on rocky outcrops, but are not affected by the mine.

Photo 4.9: *Hoodia* sp., found in the biodiversity ‘hotspot’ on marble outcrops in the far south-east of EPL 2902. This site is not affected by the current mining proposal.
Photo 4.10: *Euphorbia lignosa* (top) and others in the ‘hotspot’ in the southeast of the EPL

Photo 4.11: *Sarcocaulon salmoniflorum*

Photo 4.12: One of only a very few trees (*Acacia reficiens*) in the EPL, and *Zygophyllum stapffii* at one of the watercourses.
4.8 Fauna (Vertebrates & Invertebrates)

4.8.1 General & Special Habitats

Irish (2012) undertook a biodiversity study for this EIA. Irish’s Report is contained in Appendix I, which includes species lists. The study was based on desktop study of Namibian biodiversity records, and a field survey.

Namibian biodiversity records are patchily spread, and endemic species tend to occur in narrow bands of about 5km width, but elongated parallel to the coast. No earlier biodiversity records were found within the EPL itself. For these reasons Irish included a larger area in the desktop study – being 10km each side of the mine site along a NNE-SSW axis, and 5km wide on either side of the mine. This area falls within a small portion of the quarter degree squares 2214BC, 2214BD, 2214DA (which includes the Swakop River, its estuary, and coastline) and 2214DB. Species occurring in those QDS were carefully evaluated and those that were unlikely to occur in the EPL area due to lack of suitable habitat were discarded.

Irish used the landscape classification by Burke (2012) – see Figure 4.13 - above, but simplified it into three habitat types for fauna as shown in Table 4.3.

<table>
<thead>
<tr>
<th>Landscape types according to Burke (2012)</th>
<th>Habitat types for fauna</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gypsum plains</td>
<td>Gravel plains</td>
</tr>
<tr>
<td>Marble plains</td>
<td>Gravel plains</td>
</tr>
<tr>
<td>Plains and drainage lines</td>
<td>Gravel plains</td>
</tr>
<tr>
<td>Rocky outcrops</td>
<td>Rocky outcrops</td>
</tr>
<tr>
<td>Dolerite ridges</td>
<td>Rocky outcrops</td>
</tr>
<tr>
<td>Marble outcrop</td>
<td>Rocky outcrops</td>
</tr>
<tr>
<td>Mountain footslopes and washes</td>
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</tr>
<tr>
<td>Mountains</td>
<td>Rocky outcrops</td>
</tr>
<tr>
<td>Arthraerua stand</td>
<td>Watercourses</td>
</tr>
<tr>
<td>Nara field</td>
<td>Watercourses</td>
</tr>
<tr>
<td>Rivers</td>
<td>Watercourses</td>
</tr>
</tbody>
</table>
While the EPL area is generally sensitive, with invertebrates often occupying very restricted ranges, two microhabitats deserve special mention:

- The Nara field, centered on -22.504°S 14.759°E, is uncommon habitat in the area and was treated as a separate landscape type by Burke (2012) as a special type of watercourse habitat. The Nara plants, typically associated with dunes, are far removed from similar stands and this renders them unique. Naras are also an important food source and many tracks of rodents and jackals were found under and around these plants. A porcupine was found in a rock shelter nearby and probably feeds here. The sand-dune living lizard *Meroles reticulatus* was also found in the Nara field. This restricted area with unusual biodiversity should be avoided by project development and by vehicles.

- The Rössing West Cave is located within EPL 2902 at -22.530°S 14.797°E. Information on it was summarised by Irish *et al.* (2000). Caves are particularly sensitive habitats, and important as bat roosting sites. This particular cave is far removed from the focus of developments and unlikely to be directly affected by it. However noise, movement, vibration and wood smoke are all known to drive bats from their roosts.

4.8.2 Invertebrates

Recorded invertebrates included 152 taxa, many of which are known only at the family level, and Irish considers it likely that there are thousands of species present in the study area.

The Central Namib is known for high levels of endemic species, with small distribution ranges. In another study, Irish (2009) found the median distribution range of 98 species to be
25 km$^2$. Endemic invertebrates amount to 33 species, but this is most likely under-recorded at species level. True invertebrate endemism levels may be as high as 80%.

Irish considers that potential as much as 80% of invertebrate species may be of conservation concern due to narrow distributions within the Namib, but no Namibian invertebrates have formal IUCN status.

Namibian invertebrates enjoy general protection under the Convention on Biodiversity, in terms of which Namibia has an obligation to conserve all its endemic species. However, no species has individual legal status. This is probably due to the lack of comprehensive studies on Namib invertebrates and this situation does not reflect their importance for conservation.

Gravel plains are highly sensitive to impacts, such as vehicle tracks. Rocky outcrops, such as the marbles that are exposed on and near the mine site, are far less sensitive to physical disturbance. Watercourses are less sensitive to vehicle tracks but are sensitive if any vegetation is damaged.

4.8.3 Fish & Amphibians

No fish or amphibians are known or likely to occur in the EPL due to the lack of suitable habitat.

4.8.4 Reptiles

Most of the reptiles occurring in the Central Namib have specialist adaptations to the desert conditions. Of the 20 species occurring in the study area, 14 species are endemic. One has legal status - the Namaqua Chameleon is CITES listed. Due to their slow movement they are often killed by vehicles.

Very few Namibian reptiles have been evaluated by the IUCN, and the zero number of listed threatened species is a reflection of this rather fact rather than a lack of any threats.

The Reticulated Desert Lizard (*Meroles reticulatus*) was found on a sandy watercourse and nara field more than 1km north of the mine site. These lizards normally occur in more sandy parts of the desert and this may represent a range extension.

4.8.5 Birds

According to Irish (2012) Some 40 species of birds are known or likely to occur in the EPL area. However, most bird species occurring in the Namib are highly nomadic (Brown pers comm) and therefore difficult to survey during a field visit (very few species were found on site during two day’s fieldwork). Birds in the Namib tend to follow rainfall and resulting vegetation growth, and in the case of large raptors, to cover enormous ranges – thus reducing their sensitivity to small areas of disturbance.

Irish lists four (4) of the species occurring here as endemic to Namibia – but all are widespread in the Namib.

Most bird species are protected by law in Namibia, apart from a few pest species and some that are huntable game. A few enjoy CITES status.
In terms of IUCN conservation status, the Lappet faced Vulture is classified as Vulnerable. This species tends to use the same nest (in large trees) year after year, but there are no large trees so they are unlikely to breed in the EPL area. They have very large ranges, and are prone to collisions with power lines. Four raptors (Augur Buzzard, Pale Chanting Goshawk, Rock Kestrel, and Peregrine Falcon are CITES listed but unlikely to be affected by the development. Rüppels Korhaan is endemic and CITES listed and is prone to collisions with power lines and road kills, but they are widespread and the project poses no particular threat to this species. This is true also for owls, which are CITES listed. Gray’s Lark and Stark’s Lark are both endemic but widespread in the Namib. Only birds with CITES status are considered of concern by Irish, but the project-related risk of any being captured for sale is very low.

A recent study in the Karoo by Shaw (2013) reports that Ludwig’s Bustard and other species of bustard are very susceptible to collisions with power lines. Shaw reports that Ludwig’s Bustard was considered globally Endangered in the IUCN Red List in 2010, as a result of collision mortality. This species also occurs in the Namib Desert.

Pallett (pers comm.) reports very high numbers of bustards (various species) killed in collisions with power lines in Namibia each year.

4.8.6 Mammals

Irish (2012) listed 21 species of mammals known or expected to occur in the EPL area. Seven (7) of these species are endemic (between 75% and 100%). These are:-

- The Namibian Wing-gland Bat and the Namib Long-eared Bat are likely to occur in low numbers only and no special treatment is proposed;
- The Namibian Pygmy Rock Mouse and the Namib Round-eared Elephant Shrew are associated with rocky outcrops and avoidance of development on rock outcrops is recommended;
- The Namaqua Brush-tailed Gerbil, Namib Brush-tailed Gerbil and Solitary Whistling Rat are all associated with watercourses. Avoidance of development in watercourses and preservation of watercourse vegetation will be needed to preserve their habitat.

One (1) species is Near-threatened – the Brown Hyaena. They were not found but they are likely to move through from time to time. Care must be taken not to attract them by allowing access to refuse or water.

Five (5) species enjoy legal protection. These are:-

- Klipspringer are Specially Protected Game, which are only expected to occur on the mountains in the northeast of the EPL (they do occur on the adjacent Rössing Mountain). They are unlikely to be affected by project;
- Steenbok are Protected Game, while Springbok and Gemsbok have legal status as Huntable Game, although hunting is not permitted in a National Park. All three occur near the mine but are unlikely to be directly affected by it. No special treatment is needed, except to prevent animals drinking any water that may be contaminated – e.g. leachate or surface runoff from the tailings;
- Aardvark are Protected Game. Signs were seen in the area, but they are likely to be uncommon visitors only. They are prone to vehicle collisions at night.
Photo 4.13: Porcupine in the hilly northeast near a Nara melon habitat.

Photo 4.14: Reticulated Desert Lizard in a sandy wash in the middle of the EPL, not affected by the mine.

Photo 4.15: Horned Adder found in the old explosives magazine at the mine.
4.9 Archaeology

Kinahan (2012a) undertook an archaeological survey of the EPL for this EIA. His report is contained in Appendix J, together with a draft set of “Archaeological Guidelines for Exploration and Mining in the Namib Desert” by Kinahan 2012b (Appendix K). Kinahan found that the area is of relatively low archaeological significance and the proposed mine would have little impact on the archaeology of the area. He found 8 sites with archaeological remains as shown in Figure 4.14, below. None of these sites is close enough to be affected by mining activities. Potential threats to these remains are vehicle tracks and use of shelters during exploration activities, but the mining as proposed will have no impact.

![Figure 4.14: Locations of Archaeological deposits on EPL 2902 (Kinahan, 2012)](image)

Historical mine buildings existed but had been extensively vandalised, and everything of value removed before the current project began. The remaining ruins were subsequently removed during clean up operations before this EIA was commissioned.

Since the area has little archaeological significance and the current mining proposal will not affect any of the identified sites, it will not be considered further in this EIA. However all personnel involved in exploration of the EPL, must be familiar with Kinahan’s guidelines mentioned above. If any future mining targets are identified, these should be subject to further archaeological investigation.

4.10 Land Uses

Until the Dorob Park was proclaimed in 2010, the study area was part of the West Coast Recreation Area, an area that enjoyed a lower conservation status than a National Park and where little or no control was exercised over off-road vehicles entering the area.
With the proclamation of the National Park, conservation will receive a higher priority and control over the activities of Park users can be on a par with the other established National Parks. However, permitting systems and access control are not yet in place.

One or two tourist concessions use the EPL area, including the old mine site, and visit places of interest with mineral deposits amongst other attractions. A public participant from Charly’s Desert Tours asked whether they would be allowed to pass through the EPL and visit the mine during operations. Mr D.Claridge, project manager for NRR, replied that it would be possible to pass through the EPL but not have access to the mine itself for safety and security reasons.

Other recreation use of the area (possibly unauthorised) was reported by NRR staff working at the mine site during exploration activities. NRR staff said that tourists or recreational users were coming through the area on occasion, and were not necessarily staying on tracks. NRR had no authority to prevent this, and they were concerned that additional tracks may result which could be unfairly blamed on the exploration activities.

4.11 Pre-Existing Environmental Damage / Condition of the Environment

The EPL is criss-crossed with numerous vehicle tracks, mostly thought to be the result of prospecting activities during recent and older exploration periods, while recreational use may also have contributed to the damage. The level of such damage is aesthetically undesirable and therefore unacceptable in a National Park, but, in the opinion of the author it is unlikely to have resulted in any significant ecological impacts, apart from possible road kills of invertebrates and slow moving reptiles.

High intensity disturbance from the previous mine site covers a relatively small area around the shafts, the adjacent processing plant location, the old and new tailings sites, access road and landing strip for light aircraft.

The previous disturbances near the mine are shown in Figure 1.3. The satellite image was dated 2010 before NRR began to clean up the site and remove the remains of old houses and other structures. In addition to the derelict structures there were piles of rubbish, but by May 2012 during the environmental fieldwork this had been cleaned up and removed, and the last loads of rubble were being removed to a stockpile adjacent to the old mine entrance.

The new works at the mine will affect a much smaller area on the surface than previously because there will be no mine housing. Figure 1.3 shows the footprint of the new mine works (above ground) and tailings in relation to the old. It is clear that the new mine and infrastructure will have a much smaller footprint than the old. The water supply pipeline and the power line will be replaced and repaired respectively on the same alignments as the old ones.

Close to the old mine are a few alien invasive Prosopis trees that need to be destroyed, but that was the only alien vegetation found.

By far the greatest visual impact of the old mine is the tailings, which were not rehabilitated in any way, and which are visible for kilometres due to their dark and unusual colour and geometric profile. It is proposed to reprocess the old tailings. The new tailings, once completed will need to be rehabilitated to reduce their visual impact.

Contamination of soils by metals in dust blown from the mine and tailings was dealt with in Section 4.1 above.
4.12 Socio-economic Environment

There are no dwellings in or near EPL 2902. There appear to be some activities east of the Rössing mountain but the nearest residents are in the Swakop River valley more than 12km to the south, and at Arandis over 20km to the east-northeast, and Swakopmund 25km to the south-west.

Arandis was a company settlement developed by Rössing Uranium Mine to house their staff, but it was recently proclaimed as a town.

Swakopmund is a very old town that developed as a recreational resort and tourist destination. As a result, the town’s population increases two or threefold during the holiday seasons. It has experienced much growth in recent years from increased tourism as well as increased mining activity in the Erongo Region.

Namibia as a whole suffers from very high unemployment rates (approximately 50%) and high unemployment rates are true for the Erongo Region as well.

So far, NRR has not undertaken a labour survey. It is assumed that skilled labour can be recruited from Swakopmund and Walvis Bay, as well as areas in the north of Namibia where some underground mines have closed, but the details are currently not available.

Likewise training needs still need to be established. Arandis has an important training centre, the Namibian Institute of Mining and Technology (NIMT), which was established and largely funded by Rössing to provide technical skills training to people in a variety of trades – in order to help make the benefits of mining more economically sustainable.

It is proposed that staff will be housed in Swakopmund and Walvis Bay, but so far no survey has been made to confirm the availability of suitable housing in these towns.

The adequacy of health care facilities in Swakopmund and Walvis Bay has also not been established. In particular, the adequacy of emergency services and hospitals to cope with accidents and large scale emergencies has not been investigated.

The socio-economic benefits to the local towns should be considerable – through salaries spent and service industries that will be supported by the mine.
5 LEGAL & POLICY FRAMEWORK

5.1 Introduction

A review of applicable laws and policies was carried out by Envirolex (2012) for this EIA. Laws and policies with which the project must comply were highlighted, and the requirements for permits were identified.

Envirolex’s detailed legal and policy review is contained in Appendix L and should be referred to in full for all practical and legal purposes. Only a brief summary is offered here, but for specific details the reader is referred to the full report.

Envirolex’s review does not include occupational health and safety, which is beyond the scope of this Environmental Impact Assessment.

In terms of Namibia’s Constitution, all international agreements to which Namibia is a party form part of the law of Namibia.

5.2 Applicable Laws

5.2.1 The Constitution of Namibia

The Constitution of Namibia is the supreme law of Namibia, and it includes the protection of the environment. For example in clauses such as;

- “…maintenance of ecosystems, essential ecological processes and biological diversity of Namibia and utilisation of living natural resources on a sustainable basis for the benefits of all Namibians…”; and
- “…duty to investigate complaints concerning the over utilisation of living natural resources, the irrational exploitation of non-renewable resources, the degradation and destruction of ecosystems and failure to protect the beauty and character of Namibia.”

5.2.2 Environmental Management Act, No. 7 of 2007

The Environmental Management Act (EMA) came into effect, with regulations on 06 February 2012. The EMA establishes the requirements for Environmental Impact Assessments (EIAs) and the content thereof, as well as Environmental Management Plans (EMPs).

The EMA establishes twelve important principles that must guide all environmental management in Namibia.

PART II Principles of Environmental Management

(1) “The principles set out in subsection (2) –
(a) guide the implementation of this Act and any other law relating to the protection of the environment;

(b) serve as the general framework within which environmental plans must be formulated; and

(c) serve as guidelines for any organ of state when making any decision in terms of this Act or any other law relating to the protection of the environment."

(2) “The following are the principles of environmental management:

(a) renewable resources must be used on a sustainable basis for the benefit of present and future generations;

(b) community involvement in natural resources management and the sharing of benefits arising from the use of the resources, must be promoted and facilitated;

(c) the participation of all interested and affected parties must be promoted and decisions must take into account the interest, needs and values of interested and affected parties;

(d) equitable access to environmental resources must be promoted and the functional integrity of ecological systems must be taken into account to ensure the sustainability of the systems and to prevent harmful effects;

(e) assessments must be undertaken for activities which may have a significant effects on the environment or the use of natural resources;

(f) sustainable development must be promoted in all aspects relating to the environment;

(g) Namibia’s cultural and natural heritage including, its biological diversity, must be protected and respected for the benefit of present and future generations;

(h) the option that provides the most benefit or causes the least damage to the environment as a whole, at a cost acceptable to society, in the long term as well as in the short term must be adopted to reduce the generation of waste and polluting substances at source;

(i) the reduction, re-use and recycling of waste must be promoted;

(j) a person who causes damage to the environment must pay the costs associated with rehabilitation of damage to the environment and to human health caused by pollution, including costs for measures as are reasonably required to be implemented to prevent further environmental damage;

(k) where there is sufficient evidence which establishes that there are threats of serious or irreversible damage to the environment, lack of full scientific certainty may not be used as a reason for postponing cost-effective measures to prevent environmental degradation; and

(l) damage to the environment must be prevented and activities which cause such damage must be reduced, limited or controlled.”
Listed Activities

The regulations (GN 4878 of 06 February 2012) list a number of activities (project types) that may not be undertaken without an Environmental Clearance certificate. Of potential relevance to this mining project they may include the following activities:

- Transmission and supply of electricity;
- Construction of facilities for waste sites, treatment of waste and disposal of waste;
- Any activity entailing a scheduled process in terms of the Atmospheric Pollution Prevention Ordinance, 1976;
- Mining & processing: any process requiring a licence in terms of the Minerals (Prospecting and Mining Act) 1992;
- Change of land use, including use for nature conservation to any other land use, water use and disposal;
- The abstraction of groundwater or surface water for industrial or commercial use;
- Construction of canals or channels including the diversion of the normal flow of water in a riverbed;
- Construction of dams, reservoirs or weirs;
- Construction of industrial and domestic wastewater treatment plants and related pipeline systems;
- Manufacture, storage, handling or processing of any substance defined in the Hazardous Substances Ordinance, 1974. Also deals with effluent or waste, transport and disposal – indeed everything related to hazardous substances, including fuels;
- Communication masts and lightening conductors;

The application for an Environmental Clearance must be comprehensive in these respects.

5.2.3 Nature Conservation Ordinance, No.4 of 1975 (as emended)

This ordinance deals with parks and nature reserves, hunting and protection of wild animals (including birds and their eggs) animals, and the protection of indigenous plants including picking, utilisation or disturbance of plants. The ordinance lists protected plants, and requires a permit to destroy or move/remove certain species.

5.2.4 Forest Act, No. 12 of 2001

Unless approved by the Director of Forestry, no person shall cut, destroy or remove any vegetation on a sand dune or drifting sand or on a gully, or any living tree, bush or shrub within 100 metres of a watercourse. Bee hives are also protected under the Act.

5.2.5 Atmospheric Pollution Prevention Ordinance, No.11 of 1976

All of Namibia, except Caprivi is a controlled area. Nobody may carry on a schedules process in a controlled area without a current registration certificate.

The provisions of t ordinance relate to:

- Air quality and green house gas emissions,
- Mineral waste,
- Biodiversity,
- Communities and socio-economic health and safety.
Envirolex points out that, in terms of this ordinance, NRR will be carrying out scheduled processes regarding the processing of both lead and zinc ore. Any fuel burning appliances for refining (or electricity generation) may be applicable under the ordinance. Dust is also relevant and must be monitored.

Vehicles that pass through towns such as Walvis bay and Swakopmund must be compliant with regard to emissions of noxious or offensive gases (or smoke).

5.2.6 Electricity Act, No. 4 of 2007
This does not appear to be applicable, but refer to Section 2.1.5 in Envirolex (2012).

5.2.7 Foreign Investment Act, No. 27 of 1990 (as emended by Foreign Investment Amendment Act 24 of 1993)
In issuing any certificate of Status Investment (projects that are granted preferential status), the Minister of Finance has to consider the impact of the development of the environment.

5.2.8 Soil Conservation Act, no. 76 or 1969 as amended in South Africa to March 1978
This Act may be of relevance in regard to any disturbance of the soil which results in any form of erosion or pollution of water by silt or drift sand.

5.2.9 Hazardous Substances Ordinance, no.14 of 1974
This deals with the import, manufacture, storage and sale of scheduled substances – which include lead.

Some of the key points regarding transport of “hazardous or dangerous goods” are summarised as follows: -


- The SA Bureau of Standards (SABS) Codes of Practice on the Transportation of Dangerous Goods by Road have been incorporated as regulations into Namibia’s Road Transport and Traffic act 22 of 1999 (as amended).

- Transportation of Hazardous Waste must be accompanied by a “manifest” which accompanies each load until it is responsibly and legally disposed of. A copy of the manifest is then returned to the point of origin for control and auditing purposes.

5.2.10 Road Traffic and Transport Act, No.22 of 1999
5.2.11 Labour Act, No.11 of 2007 (including Health and Safety Regulations)

This Act also has regulations relating to the transport, labelling and handling of hazardous substances, and exposure of people such substances.

Hazardous substances include lead and silica.

The Act also regulates exposure of employees to dust noise and other work hazards to health and safety. Protective clothing equipment must be provided and its use enforced by the employer. NRR should refer to the Act for details as occupational health and safety is not dealt with in this EIA. It is recommended that NRR should employ the services of an occupational health and safety specialist.

5.2.12 Minerals (Prospecting and Mining) Act, No.33 of 1992

The Act controls all mining in Namibia and licensing thereof. It also deals with “Accessory Works” such as power lines and substations, water boreholes, pipelines, airfields, workshops, stores and offices, explosives magazine, processing plant, waste disposal on site, and any camp or temporary or permanent residence.

An EIA and EMP is required.

Any spilling or pollution or loss of flora or fauna must be reported to the minister and steps must be taken to remedy the same. NRR should also take all reasonable steps to ensure that pollution does not occur and that destruction or endangerment to plant or animal life is minimised.

5.2.13 Petroleum Products and Energy Act, No.13 of 1990


The regulations generally deal with the transport, sale and storage of petroleum products. Refer to the details in Envirolex (2012) Section 2.1.12.

5.2.14 Public Health Act, No.36 of 1919

This appears to apply within the jurisdiction of local authority areas but it may be of relevance to North River Resources in regard to water supply provision, and waste disposal within municipal boundaries.

5.2.15 Regional Councils Act, No.22 of 1992

The Regional councils (in this case Erongo Regional council) is responsible for planning and co-ordination of regional policies and priorities. In this case the project falls within a recently gazetted National Park.

5.2.16 Mines, Works and Minerals Ordinance, No.20 of 1968: Regulations (GN143, GG2927 of 01 October 1968)

These regulations, which are extremely outdated, provide a comprehensive framework for the protection of health and safety in mining operations. There are many overlaps between these regulations and the regulations on health and safety promulgated under the 1992 Labour Act. In situations where there is a conflict between the provisions of these regulations
and those promulgated under the Labour Act, those regulations which provide for more stringent health and safety protections should take preference and be applied. Where appointment of competent or qualified persons are provided for under both sets of regulations, written appoints should be made under BOTH sets of regulations.

5.2.17 Water Act, No.54 of 1956

The Act gives the Minister of Agriculture, Water and Forestry (MAWF) the power to investigate water resources, plan water infrastructure, … control pollution, conserve water resources, inspect water works etc. It deals with both surface and groundwater.

Permits are required for water abstraction and discharge of effluent. It regulates the quality of water that may be discharged to the environment.

Section 23 makes it a criminal offence to wilfully or negligently pollute public or private water in such a way that renders it less fit for use, including environmental use – or use by ecosystems or living organisms.

5.2.18 Namibia Water Corporation Act, No.12 of 1997

This act places obligations upon Namwater rather than directly NRR to conduct it’s functions in an environmentally sustainable manner.

5.2.19 National Heritage Act, No.27 of 2004

No archaeological remains may be disturbed or destroyed without a permit from the Heritage Council. Archaeological sites have been found within the EPL (Kinahan, 2012) and NRR has a responsibility not to impact these in any way. Furthermore, if any new archaeological sites are found they must immediately be reported to this Council.

5.2.20 Aviation Act, 1962

Regulations exist in section 22 of the Act in GN 1 of 2001, GG 2467 2001. Of relevance, no aircraft shall fly less than 500 ft above the ground or water (except during take off and landing). This is intended to reduce disturbance to people and wildlife everywhere – not limited to National Parks.

5.3 Domestic Policies

Envirolex (2012) mentions, in more detail, the following policies that may have relevance to the proposed mine.

5.3.1 National Environmental Health Policy, 2002

5.3.2 Minerals Policy of Namibia,2003

5.3.3 General Environmental Assessment Guidelines for Mining (Onshore and Off-shore) Sector of Namibia

This has largely been superseded by the Environmental Management Act.

5.3.4 Policy for the Conservation of Biotic Diversity and Habitat Protection, 1994
5.3.5 **Waste Management Policy**

5.3.6 **Policy for Prospecting and Mining in Protected Areas and National Monuments**

This policy permits the issue of mining licenses in Protected Areas, except in places of particular sensitivity or ecological or tourist significance. Each case is considered on merit following an EIA and an EMP is required.

5.3.7 **National Water Policy White Paper, 2000**

5.3.8 **Water Supply and Sanitation Policy, 2008**

The policy emphasizes water demand management.

It indicates that water use allocation should be determined according to economic value added by the consuming activity - that is after domestic requirements have been met.

Any industrial, commercial or mining activity should pay the full cost of water provision, taking into account the scarcity of water and the cost of future water supply augmentation.

5.4 **International Conventions**

The following conventions have been ratified by Namibia and as such they constitute international law.

5.4.1 **Convention on the Protection of Biological Diversity**

The Namib Desert hosts many endemic species of flora and fauna, i.e. all or nearly all of the world population of those species lies within Namibia. As a signatory to the Convention on Biodiversity, Namibia has an obligation, under international law, to protect its endemic species and ensure their continued survival in their natural habitat. Irish (2012) has emphasized the fact that many faunal species have very limited distributions in the Namib.

5.4.2 **Vienna Convention for the Protection of the Ozone Layer, 1985**

This deals with activities that have harmful effects on the atmosphere’s ozone layer.

5.4.3 **United Nations Framework Convention on Climate Change, 1992**

5.4.4 **Kyoto Protocol on the Framework Convention on Climate Change, 1998**

5.4.5 **Basel Convention on the Control of Transboundary Movement of Hazardous Wastes and their Disposal, 1989**

5.5 **Regional Agreements**

5.5.1 **Southern African Development Community: Protocol on Mining**

5.5.2 **Southern African Development Community: Protocol on Energy**

These agreements probably have little relevance at a project level.
6 PUBLIC PARTICIPATION PROGRAMME

6.1 Description of the Public Participation Process

Consultations with the authorities, parastatals, and the public began as soon as sufficient information was available on the project proposal – in May 2013. The letters included an invitation to attend the public meeting and/or to express any concerns in writing.

6.1.1 Authority consultations

Letters were sent to the relevant authorities, together with a Public Information Document (PID). The letters were delivered by hand in Windhoek, and by post elsewhere. The recipients included: -

- Ministry of Environment & Tourism (MET) – Environmental Commissioner (Terms of Reference/Scope of Work),
- Ministry of Environment & Tourism – Directorate of Parks, Dorob Park,
- Ministry of Agriculture, Water & Forestry (MAWF) – Hydrology & Geohydrology,
- Ministry of Mines & Energy (MME),
- Ministry of Trade & Industry (MTI),
- Ministry of Health & Social Services (MoHSS),
- Erongo Regional Council,
- Arandis Town Council,
- Swakopmund Town Council,
- Walvis Bay Town Council.
- NamPort,
- NamPower,
- ErongoRED (power utility company),
- NamWater,
- Roads Authority,
- TransNamib.

Letters of reply were received from: -

- Swakopmund Town Council (16 May 2013 & 13 June 2013), and
- Ministry of Trade & Industry (17 June 2013).

Representatives from MET, for the Dorob National Park, attended the public meeting in Swakopmund (see details below).

The Public Information Document is contained in Appendix M. Copies of all the above correspondence is contained in Appendix N.

6.1.2 Public consultations: Round One

An advertisement was placed in three national newspapers on 07 May and 13 May 2013. The advert invited people to the public meeting on 21 May 2013, and also invited any interested and affected parties to register as such. Copies of these adverts, in the Namibian, Republikein and Allgemeine Zeitung, are presented in Appendix O.
A Public Information Document (PID) was prepared and sent to all known I&APs as well as those people that we thought might be interested. The PID included information on the company and the project proposal, and invited people to attend the public meeting and/or register as interested and affected parties.

Since there are no residents within at least 10km of the mine, it was difficult to identify potential Interested & Affected Parties (I&APs). Invitations, with the PID were sent to a large number of people, especially in the Erongo area, whom we thought might be interested – e.g. other mines such as Rössing, people who had participated in other environmental studies in relation to the mining sector, etc. The key I&AP was the Directorate of Parks and we notified both the Director of Parks in Windhoek and the Director/ Warden of the Dorob Park.

The public meeting was held in Swakopmund on 21 May 2013. The main purpose of the meeting was to inform people about the project proposals, to explain the EIA process and opportunities for public input, and to hear and record any environmental or social issues and concerns. The meeting was attended by 12 members of the public – representing MET (Parks and NACOMA), mining companies, tourist companies, freight service providers, Arandis Town Council, trans Namib and Erongo Parks. In addition seven people from North River Resources and two from Colin Christian & Associates environmental consultants attended.

Minutes of the meeting were sent to all registered interested and affected parties (refer to Appendix P.)

One written submission was received from a tour company and one from a freight services company. These are contained in Appendix Q.

6.1.3 Public consultations: Round Two

A second advertisement was placed in three national newspapers on 7 November and 14 November 2013. It invited interested parties to attend a public meeting on 21 November 2013, and also to register as I&APs. Invitations were also sent, by email or fax, to everyone who had already registered as an I&AP. The advertisement is contained in Appendix R

The Draft EIA was made available for public comment on the North River Resources website with effect from 14 November 2013.
(http://www.northriverresources.com/Operations_documents.aspx)

A notice was sent to all registered I&APs by email or fax to notify them of the availability of the Draft EIA Report, and to invite them to comment. Two opportunities were provided for comment – either in writing, or at the public meeting on 21 Nov 2013. A copy of the notice is presented in Appendix S. The notice was also sent to the Director of Parks in Windhoek and the Chief Warden, Erongo.

The second public meeting was held in Swakopmund on 21 November 2013. Unfortunately, it was poorly attended (only 8 members of the public, 4 from North River Resources, and 2 from Colin Christian & Associates). A few people had gone to the wrong venue, at the Municipal Offices, despite the correct street address being given in the advert. However, they were redirected and found their way to the correct venue and the meeting started a bit late once everybody was there. The purpose of the meeting was to present the findings of the EIA, and to hear any responses from the public. The minutes and attendance register is contained in Appendix T.
6.1.4 Authority Consultations: Directorate of Parks

The Draft EIA report was delivered to the office of the Director of Parks, Mr Colgor Sikopo, on 15 November 2013 with a letter requesting their comment on the EIA and any input they wished to make to the EMP. The letter also requested representation by Parks at the public meeting. A copy of the letter is presented in Appendix U.

A telephonic reminder was made to the office of Mr Boniface Sichombe – deputy chief control warden, Erongo, a few days before the public meeting. Although neither Mr Sichombe or Mr Gawiseb were able to attend, they agreed to send a representative. Unfortunately, nobody from Parks attended the meeting.

The Draft EIA report was delivered to the office of Mr Siegfried Gawiseb - Chief Control Warden: Erongo Region (Swakopmund) on 21 November 2013 with a copy of the letter to the Director of Parks, as mentioned above, requesting comment.

Mr Christian telephoned Mr Sichombe and Mr Gawiseb on 02 December 2013 to establish whether they still intended to provide comment on the EIA report. They indicated that they would try to do so by 4 December 2013.

6.1.5 Comment on the Draft EIA from the Public and Parks

Only one written response was received – from Mr Bernd Seefeldt. His fax and a reply from CCA, are presented in Appendix V.

As at 09 December no response had been received from Parks.

6.1.6 Register of Interested and Affected Parties (I&APs)

Registration of I&APs was ongoing throughout the EIA process. A Register of all Interested & Affected Parties was kept and is presented in Appendix W – updated till December 2013. Those who had attended public meetings were added, as well as anyone who approached CCA in response to advertisements or word of mouth and requested to be registered.

6.2 Results of the Public Participation Process / Summary of Issues & Concerns

The following is a summary of the Issues and Concerns raised from all sources – public meetings, written submissions from the public, letters from authorities, and specialist sub-consultants and professional experience.

Please note that issues and concerns have been listed as they were raised by various parties before any assessment has been made. Therefore the appearance of an issue here does not imply that the issues will necessarily give rise to any significant impact. These issues are assessed in this EIA at an appropriate level of detail, and within the limits of practicality.
Mine planning, including Closure & Rehabilitation:

- Size of the mining licence area?
- Size of area to be affected? Will the mine be limited to the already disturbed area on the surface?
- What is the mine site layout?
- Where will waste rock be disposed of?
- Will the old tailings dam be able to function properly for the new tailings?
- Closure and rehabilitation plan
- Safety measures for after the mine has closed?
- What is the plan for the tailings after mine closure?
- Where would the money come from for the rehabilitation of site after closure? Will there be a fund established by NRR for rehabilitation, and increased every year?
- Integrate rehabilitation costs into feasibility studies.
- Ministry of Trade & Industry requested to see the EIA – including the identified environmental risks and management plan.
- Emergency Response Plan for accidents or spillages?
- Planning, demarcating and restricting vehicle movement to existing tracks.

Water:

- Water Demand
- Where will water come from?
- Pipeline route?
- Recovery of water from the tailings? Is it helpful to use a flocculent to settle fine particles quicker?
- Contamination of groundwater or surface water.
- Would there be any potential runoff of contaminated water to the Swakop River?
- Rock fractures - would they allow for the contamination of the ground water?
- How high is the water table?

Sanitation:

- How will sanitation be provided for at the mine?
- Can sewage be treated and recycled?

Chemical Contaminants:

- What chemical re-agents would be used?
- Copper sulphate and other chemicals – how will they be stored?
- Protea Chemicals offered assistance with procedures for the transport of hazardous chemicals and hazardous waste.
- Emergency Response Plan for accidents or spillages?

Dust & Soil Contamination

- What soil type is under the existing tailings?
- You say the ore is transported damp?
- Concern about dust as a contaminant.

Occupational Health and Safety:

- Health and safety of mine workers working with lead and other metals in dust?
- International standards?
Flora:

- Potential destruction of *Lithops* plants.
- Could *Lithops* plants be transplanted to a safe location?
- Concern for special habitats during possible future exploration or mining e.g.
  - *Lithops* populations – those known and need for further surveys before further exploration,
  - Dolerite outcrops,
  - Watercourses especially the Nara melon field north of the mine
  - Diversity hotspot in the south-east of the EPL,
  - Gypsum plains, and
  - Marble plains.
  - Planning for re-establishments of plants if any plant communities need to be disturbed – including saving topsoil, gathering seed for later planting.
- Need to minimise the footprint of activities – also helps to save rehabilitation costs.
- Destruction of the soil and surface of gravel plains by vehicle tracks.
- Creating awareness of soil and plant issues amongst all planners and site staff.
- Eradicating the alien invasive tree, *Prosopis* sp. from the mine site.
- If shade trees are required use local species such as *Acacia erioloba* or *Acacia reficiens* – water with treated sewage water.

Fauna:

- Impose speed limits (40kph or less) on access road and any tracks used to minimise road kills,
- Educate employees to respect life, not to kills snakes etc.
- Discourage scavenger species.
- Prevent wildlife getting access to contaminated water such as from the tailings.

Birds:

- Collisions & electrocutions with power lines

Invertebrates:

- Distinct populations occur in very narrow (5km) bands parallel to the coast. Very limited distributions of many taxa make them vulnerable.

Power:

- Power is in short supply in Namibia and southern Africa.
- ErongoRED has said there will be sufficient power for Phase 1. Has Namwater confirmed that they can meet the demand?
- Have you considered using solar power?
- Use of solar water heaters?

Transport:

- What will be the traffic impact? There are already many deaths on the road.
- The gravel road crosses the railway – is any special engineering required?
- Emergency Response Plan for accidents or spillages?
Waste Disposal:

- Municipality of Swakopmund requested to be kept informed about the progress of the project, and said they have no facilities for hazardous waste.
- The mine is outside the municipal boundary. If the mine wants to dispose of any general waste at the Municipal landfill they must apply in advance in writing.

Tourism & Visual impacts:

- Concerns of Tour companies
- Charly’s Mineral Tours has been operating in the area for 46 years and the mine itself was on the tour. Would they still be able to access the EPL area and the mine itself?
- Security – unauthorised people moving through the EPL
- Prevent proliferation of vehicle tracks.

Archaeology, Historic & Cultural heritage issues:

- Concern was expressed that derelict mine houses had been removed.
- Prevent proliferation of vehicle tracks, especially on substrates that are not self rehabilitating.
- Need for staff awareness of the National Heritage act.
- Make use of the Archaeological Guideline Document and procedures for reporting any chance finds.

Economic Feasibility / Sustainability:

- Financial viability and sustainability – concern about possible drop in commodity prices.
- Target market?
- Where does lead get used?

Employment:

- What percentage of employees will be Namibians?

Housing for staff:

- Is sufficient housing available in Swakopmund and Walvis Bay to house mineworkers?

Economic Benefits to Namibia:

- Have you considered participation with Epangewu?

Mining in National Parks:

- A few public participants criticised the fact of mining in National Parks and complained that the Government policy of mining only strategic minerals in Parks was not adhered to by MME. Mr Christian agreed that this was the case, and pointed out that while MME continued to issues EPLs in Parks it would be difficult to prevent mining because companies spent a lot of money on exploration.
In conclusion to this sub-section, the reader is reminded that the issues and concerns listed above were expressed by interested and affected parties. They are recorded here in the interests of transparency and compliance with the EIA regulations. Those issues that could potentially be significant are assessed in Sections 8 & 9 to determine whether, and to what degree they will give rise to significant environmental and social impacts.
7 ASSESSMENT CRITERIA

In the following section, the potential impacts of the mining and related activities will be assessed in accordance with internationally recognized criteria used by environmental assessors. These criteria are explained in this section, below.

In line with the Environmental Management Act, a broad definition of “Environment” is used, which includes both bio-physical and socio-economic components. In an agricultural context it is easy enough to envisage that adverse impacts on the natural resources such as grasses will in turn affect grazing capacity and hence the economic productivity of affected farms. Creation of employment opportunities for some local people will provide a socio-economic benefit to some of the people who need it most.

The EA Policy of Namibia seeks to achieve a balance between negative and positive impacts, and between bio-physical impacts and social and economic gains to society. Therefore, both negative and positive impacts on the environment will be assessed. To the extent that it is practically possible, this study will seek to recommend measures to mitigate negative impacts and enhance positive impacts.

This assessment is made on the basis of the current proposals. Should these proposals change in any material way, or the mining area be extended beyond EPL 3112, then additional assessment would be needed.

In the following sections, for each activity with the potential for significant environmental impacts, a discussion of the impact is presented. Where possible, the discussion is followed by a table that summarizes the assessment according to the following criteria.
<table>
<thead>
<tr>
<th>Table 7.1 Assessment Criteria</th>
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</thead>
<tbody>
<tr>
<td><strong>Nature of impact</strong></td>
</tr>
<tr>
<td><strong>Extent</strong></td>
</tr>
<tr>
<td><strong>Duration</strong></td>
</tr>
<tr>
<td><strong>Intensity (or magnitude)</strong></td>
</tr>
<tr>
<td><strong>Probability</strong></td>
</tr>
<tr>
<td><strong>Confidence</strong></td>
</tr>
<tr>
<td><strong>Significance</strong></td>
</tr>
<tr>
<td><strong>Mitigation</strong></td>
</tr>
<tr>
<td><strong>Further investigation or monitoring</strong></td>
</tr>
</tbody>
</table>
8 ASSESSMENT OF BIO-PHYSICAL IMPACTS

8.1 Impacts on Soil

The depth of soil at the mine site is naturally shallow and is probably derived mainly by in situ weathering of the host marble and the dolerite intrusion. A little windblown sand is also in evidence but is not the dominant source of soil material.

Since the mine is underground, mining itself will impact on soil only if new shafts to the surface are made. The processing plant, offices and stores will be constructed close to the old mine facilities and within the area previously disturbed. No evidence was found that any soil was moved during the previous operations, except at the shafts. No other stockpiles were found and no rehabilitation was undertaken.

The main impact on soil will be a degree of contamination by metals contained in the ore and tailings as a result of dust dispersed by winds, and by water adjacent to the tailings.

Linus (2010) found evidence of soil contamination by wind blown dust in downwind directions from the existing tailings – especially in a west-southwesterly direction from the source up to 8km from the source. Her results provide a baseline for comparison with future studies on soil contamination resulting from the new mine operations.

Linus (2010, p.1) cites Hahn (2005); “The tailings material is composed of calcite and siderite as the major minerals, with gypsum, sphalerite, pyrrhotite, chlorite, goethite, lepidocrocite, magnetite, galena, mica, and quartz as the other minerals”. Soil samples (560 in total) were taken along 16 lines radiating from the old tailings along the 16 compass directions. Linus originally analysed for Ag, Au, Co, Mo, Rb, Se, Sb, Sn, Sr, U, W and Zr but these did not show any clear relation to the tailings. Fe was also analysed but not considered to be of concern. Eight metals were clearly related to the tailings source and were environmentally harmful, namely Lead (Pb), Zinc (Zn), Cadmium (Cd), Copper (Cu), Nickel (Ni), Arsenic (As), and Manganese (Mn). These were the focus of her study. All of these were compared to international guideline values and were found to exceed guideline values for soils close to the source (old tailings) and in some cases as far as 8 km from the source (i.e. for Zinc).

Linus found that Lead, Zinc, Cadmium and Manganese showed elevated concentrations in the WSW direction – i.e. the direction of dispersion resulting from the easterly winds.

Airshed (2013) analysed soil samples for 32 metallic elements. The samples were taken at 500m and 1,000m from the tailings – four (4) in downwind directions and four (4) in upwind directions, plus one sample from the tailings. Fifteen (15) elements had higher concentrations in the tailings than in the soil samples. All elements that were measured at higher concentrations in the tailings than in the soil also showed elevated concentrations in at least one downwind location. Airshed’s results also provide a basis for comparison with future monitoring and assessment.

No mitigation appears to have been implemented during the previous mining operations so that the tailings have continued to release contaminants that have been deposited by wind in the nearby soils.

Immediately adjacent to the old tailings dump and processing plant site, another source of contamination was considered - being rainfall runoff from the tailings, stockpiles of ore, and
dust laden surfaces close to the crusher. However, Linus (2010) found that the patterns of soil contamination were closely related to wind directions and not to drainage patterns.

In order to protect soil from contamination and other impacts, it is common practice in mining and civil engineering projects to remove soil from areas that will be disturbed and/or contaminated, and stockpile that soil for later replacement during rehabilitation. In this case, however, stripping of soil is recommended only for any areas that will be mined on the surface – such as where any new ventilation shafts daylight at the surface. For all other areas it is recommended that soil be left in place unless it is necessary to remove it for engineering reasons (e.g. to level sites). The botanist (Burke, pers comm) was consulted and was in agreement with this recommendation.

The reasons for recommending that soil be left in place are:

- The soils close to the site are already contaminated to some degree by metals and to remove it may only allow those metals to escape into the wider environment through the action of wind and water erosion. The status quo by contrast is relatively stable;
- The area of the new plant is the area that is most contaminated already and it is considered undesirable to remove that soil for the reason given above;
- In some cases, heavy metals were at higher concentrations at 35 cm below surface than on the surface (e.g. lead). Therefore to disturb the soil profile would expose these elements to surface erosion again.

The largest area to be impacted is the new tailings disposal site, which is situated mainly on marble bedrock and there is no topsoil.

The most important mitigations for soil contamination will be:

- Control of dust at source (haul roads, crusher, conveyors and stockpiles) by spraying down with water, dust screens etc (refer to Airshed, 2013 in Appendix D);
- Rehabilitation of tailings by covering with waste rock to prevent wind erosion;
- Engineering the areas susceptible to contamination so that rainfall runoff that may be contaminated is intercepted and diverted to retention ponds to evaporate.

### Table 8.1 Contamination of Soil by Metals, and erosion

<table>
<thead>
<tr>
<th>Nature of impact</th>
<th>Contamination of soil from metals in wind dispersed dust or rainfall runoff from tailings, crusher and plant areas.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extent</td>
<td>Up to 8km from the crusher and tailings.</td>
</tr>
<tr>
<td>Duration</td>
<td>Long term – lifespan of the project or beyond</td>
</tr>
<tr>
<td>Intensity (or magnitude)</td>
<td>Medium close source, but decreasing with distance. Considered Low beyond a few kilometres, and Low with effective mitigation.</td>
</tr>
<tr>
<td>Probability</td>
<td>Highly probable</td>
</tr>
<tr>
<td>Confidence</td>
<td>Medium</td>
</tr>
<tr>
<td>Significance</td>
<td>Medium significance – the assessed impact should have an effect on the decision unless it is effectively mitigated. Can be reduced to low with mitigation of dust and stormwater</td>
</tr>
<tr>
<td>Mitigation</td>
<td>Control of dust at source – refer to Section 8.2 for details. Where any soil has to be removed, stockpile for later replacement.</td>
</tr>
<tr>
<td>Further investigation or monitoring</td>
<td>Design of the mine and processing site. Annual soil sampling to determine changes in soil contamination levels and the need for additional mitigation. Monitoring dust fallout – refer Section 8.2</td>
</tr>
</tbody>
</table>
8.2 Impacts on Air Quality

Airshed (2013) undertook an Air Quality Impact Assessment for the re-commissioning of the mine. There full report is contained in Appendix D.

Based on three years’ wind data from a small weather station near the mine site, Airshed concluded that the wind field is dominated by winds from the west and northwest. However, the strongest winds (though of shorter duration) are from the east — mainly during the daytime in winter or early spring. These hot, dry, strong winds are responsible for most of the dust dispersion that occurs. This is based on historical dust contamination investigated by Linus (2010) and Airshed (2013) as mentioned in the previous section on soil contamination.

Airshed (2013) compiled an emissions inventory based on a mining production rate of 200,000 tonnes per annum to be unloaded at the new ROM pad, and waste rock to be disposed of in mined out voids underground as proposed.

The main sources of dust emissions will be:

- Offloading of mined ore at the ROM pad,
- Loading of ore to the crusher feed bin,
- Loading and unloading of the crushed ore stockpile,
- Wind erosion from the ROM stockpile, crushed ore stockpile and tailings,
- Trucks moving on the short unpaved haul roads,
- Mainly light vehicles on the unpaved access road, busses during shift changes, and 2 trucks per day for product leaving the site,
- Crushing and screening operations.

The relative contributions to dust are presented in Figure 8.1 below — for PM$_{10}$ particles and Total Suspended Particles (TSP) respectively.

![Figure 8.1: Source Contributions to PM$_{10}$ emissions and TSP emissions from the NLZ Mine (Airshed, 2013)](image-url)
Airshed then modelled the wind dispersion of dust. They considered both the very fine PM$_{10}$ particles that are of concern for human and animal health, and the Total Suspended Dust (TSP) deposition. The predicted concentrations were then compared with appropriate air quality standards.

PM$_{10}$ concentrations were predicted to exceed the SA NAAQS (South African Air Quality Standards) and the WHO AQG (World Health Organisation Air Quality Guidelines) in the immediate vicinity of the processing plant area, but not outside the mine boundary. This applies to both the highest daily, and annual average concentrations – as shown in Figure 8.2 and Figure 8.3, respectively. These show the results before any mitigation is implemented.

![Figure 8.2: Predicted Highest Daily PM$_{10}$ concentrations due to Namib Lead & Zinc Mine Sources.](image1)

Maps compiled by: Airshed Planning Professionals (Pty) Ltd

Figure 8.2: Predicted Highest Daily PM$_{10}$ concentrations due to Namib Lead & Zinc Mine Sources. SA NAAQ 24-hour Standard is set at 75 µg/m$^2$ (effective 01 Jan 2015) with 4 exceedances permitted per year. WHO 24-hour Guideline value is 50 µg/m$^2$.

![Figure 8.3: Predicted Annual Average PM$_{10}$ concentrations due to Namib Lead & Zinc Mine Sources.](image2)

Maps compiled by: Airshed Planning Professionals (Pty) Ltd

Figure 8.3: Predicted Annual Average PM$_{10}$ concentrations due to Namib Lead & Zinc Mine Sources. SA NAAQ (from 01 Jan 2015) is 40 µg/m$^2$. WHO Annual Average Guideline is 20 µg/m$^2$. 
Dust deposition, and particularly the deposition of metals from the ore, is one of the main concerns regarding the impacts of the mine on life in the surroundings. The very strong east winds cause significant wind erosion and deposition of dust that includes metals. Although there are no human settlements in the EPL 2902 area, the mine lies within the Dorob National Park, where impacts on flora and fauna must be considered.

The predicted annual average dust deposition rates are below the South African Residential limits for all areas except the immediate vicinity of the processing plant, even before mitigation. The total dust deposition (in mg/m$^2$/day) is shown in Figure 8.4 for comparison to dust deposition limits.

The annual concentrations of metals deposited in dust can be estimated as follows. Firstly, in Figure 8.5, the total dust deposition due to the easterly winds (the worst dispersion) is shown within a 10km by 10km area. Secondly, the percentage of that dust which is comprised of each metal is provided in Table 8.2, below the diagram.
Table 8.2 provides the highest deposition rates for each of the key metals that were more abundant in the existing tailings than in the surrounding soil. These can then be compared with the identified international standards in the last column. Lead, cadmium and arsenic deposition rates are predicted to be lower than the identified standards and guidelines. No standards were found for any of the other elements.

<table>
<thead>
<tr>
<th>Element</th>
<th>Symbol</th>
<th>Concentration in existing tailings (%)</th>
<th>Predicted Highest Deposition Rate (µg/m²/day)</th>
<th>Standards or Guidelines Identified</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iron</td>
<td>Fe</td>
<td>27.8%</td>
<td>427</td>
<td>Not available</td>
</tr>
<tr>
<td>Calcium</td>
<td>Ca</td>
<td>10.4%</td>
<td>160</td>
<td>Not available</td>
</tr>
<tr>
<td>Manganese</td>
<td>Mn</td>
<td>2.2%</td>
<td>34.0</td>
<td>Not available</td>
</tr>
<tr>
<td>Zinc</td>
<td>Zn</td>
<td>1.6%</td>
<td>23.8</td>
<td>Not available</td>
</tr>
</tbody>
</table>
| Lead         | Pb     | 0.34%                                  | 5.2                                           | 275 µg/m²-day⁻¹ (Poland)  
250 µg/m²-day⁻¹ (Germany & Belgium)  
100 µg/m²-day⁻¹ (Switzerland) |
| Tungsten     | W      | 0.043%                                 | 0.65                                          | Not available                                          |
| Copper       | Cu     | 0.020%                                 | 0.31                                          | Not available                                          |
| Strontium    | Sr     | 0.010%                                 | 0.15                                          | Not available                                          |
| Arsenic      | As     | 0.0087%                                | 0.13                                          | 5 µg/m²-day⁻¹ (Ireland)  
4 µg/m²-day⁻¹ (Germany) |
| Tin          | Sn     | 0.0054%                                | 0.083                                         | Not available                                          |
| Bismuth      | Bi     | 0.0033%                                | 0.051                                         | Not available                                          |
| Cadmium      | Cd     | 0.0032%                                | 0.049                                         | 20 µg/m²-day⁻¹ (Belgium)  
5 µg/m²-day⁻¹ (Germany)  
2 µg/m²-day⁻¹ (Switzerland & Austria)  
0.27 µg/m²-day⁻¹ (Netherlands) |
| Silver       | Ag     | 0.00078%                               | 0.012                                         | Not available                                          |
| Zirconium    | Zr     | 0.00071%                               | 0.011                                         | Not available                                          |
| Mercury      | Hg     | 0.00055%                               | 0.0084                                        | Not available                                          |

Given the age of the existing tailings, Airshed considers it possible that the accumulation of almost 50 years of metal deposition has resulted in lead, zinc, arsenic and cadmium concentrations in exceedance of guideline values as reported in Linus (2010). This is very likely in this arid environment where leaching into the soil is very slow. For example, zinc concentrations in soil were elevated up to 8km from the source. The impacts of additional soil contamination due to new mining operations will act in combination with any existing impacts on life in this fragile desert environment.

Therefore, Airshed (2013) has recommended the implementation of an Air Quality Management Plan (AQMP), which includes air quality monitoring, reporting, reviewing and adjusting mitigation measures in response to the levels of contamination and changes recorded – in order to achieve specific objectives. The AQMP is summarised in Table 8.3.
### Table 8.3 Mitigation Measures / Air Quality Management Plan

<table>
<thead>
<tr>
<th>Activity</th>
<th>Management measures</th>
</tr>
</thead>
</table>
| **Crushing and screening**    | • Regular clean up of loose material around the crusher area — at least once per week, more often if necessary,  
• Wetting loose material,  
• Addition of chemical surfactants to water sprays to lower water surface tension and increase binding properties,  
• Target control of at least 50% |
| **Materials handling**        | • Water sprays on dry material at off-loading points,  
• Wetting of material on ROM pad,  
• Minimise drop height from truck onto stockpiles (can achieve a control efficiency of 25%)  
• Keep material to be handled by dozers and wheeled loaders moist to achieve 50% control efficiency,  
• Clean up spillage regularly,  
• Reduce tipping speeds. |
| **Unpaved roads – haul & access roads** | • Target control of 90%  
• Chemical suppressants on all roads (access ~ and haul ~) especially between the mine entrance and ROM pad. Water sprays together with chemical surfactants,  
• Speed limits of 20km/hr for haul trucks.  
• Quarterly inspections to ensure effectiveness of chemical stabilisation. |
| **Wind erosion**              | • Airshed, 2013 cites the findings of Ritcey, 1989 and Jewell and Newson, 1997 – that rock cladding of the sides of tailings dams has been shown in various studies to be effective in reducing wind erosion of slopes. Airshed recommends the application of a layer of rock fragments at least 300mm thick to the entire surface of the tailings. Marble waste rock should be used for this, subject to sufficient material being available. This would have the added advantage of reducing visual impacts because it will blend well with the surroundings. It may also help to minimise any mobilisation of metals by rainfall.  
• Wind breaks can be considered as an alternative short term solution during operations.  
• Disposal of the tailings underground would be the most effective method – post mine closure - but this is not proposed by NRR.  
• Water sprays on the flanks of the tailings and stockpiles, especially before and during easterly winds would also help a great deal during operations. Sprays have to be placed on the windward side.  
• Linus noted that a crust had formed on the tailings over time. There may be chemical means to encourage this natural crust formation. |
| **All the above**             | • Ensure that an internal environmental officer is tasked with daily monitoring, reporting and implementation of controls.  
• Ensure that operators are effectively trained and given periodic reminders and refresher courses as needed to maintain objectives.  
• Achieve dust deposition rates less than 1200 mg/m²/day at dust bucket immediately downwind of the works. |
Monitoring should include seek to:­

- Determine actual dust deposition rates to assess the need for improved controls, at all sources,
- Monitor dust levels, including PM$_{10}$ concentrations at work stations on site for reasons of occupational health and safety,
- Quantify the nuisance risk to the surrounding environment,
- Set up dust monitoring network of at least:­
  - One dust bucket in each of the four main wind directions, and
  - One dust bucket south-east of the plant (for the prevailing wind), and
  - One each to the west-northwest, and west-southwest of the plant to determine the deposition rates during the easterly winds.
- The dust deposited in these buckets should be analysed for metals to determine the impacts of the tailings on downwind receptors.

<table>
<thead>
<tr>
<th>Table 8.4 Impacts of PM$_{10}$ Dust</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nature of impact</strong></td>
</tr>
<tr>
<td><strong>Extent</strong></td>
</tr>
<tr>
<td><strong>Duration</strong></td>
</tr>
<tr>
<td><strong>Intensity (or magnitude)</strong></td>
</tr>
<tr>
<td><strong>Probability</strong></td>
</tr>
<tr>
<td><strong>Confidence</strong></td>
</tr>
<tr>
<td><strong>Significance</strong></td>
</tr>
<tr>
<td><strong>Mitigation</strong></td>
</tr>
<tr>
<td><strong>Further investigation or monitoring</strong></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 8.5 Impacts of Dust Deposition Rates including Metals</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nature of impact</strong></td>
</tr>
</tbody>
</table>

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### Extent

- Exceedance of SA residential standards only very close to the plant and well within the ML area.
- Dust deposition will affect as far as 10km in a westerly direction during east winds.

### Duration

- Short & Medium term 0-15 years (life of mine).
- The impacts as far as 10km are expected to occur mainly (or only) during easterly winds.

### Intensity (or magnitude)

- Medium, but requiring mitigation and occupational health protection measures.

### Probability

- Highly probable

### Confidence

- High (Further investigation required to determine the effectiveness of mitigation measures).

### Significance

- Medium significance – the assessed impact should have an effect on the decision unless it is effectively mitigated. Can be reduced to low.

### Mitigation

- As per Table 8.3 above.

### Further investigation or monitoring

- Monitoring during operations. Also for a year or two post closure to determine actual emission rates, especially from the tailings.

### 8.3 Impacts on Natural Vegetation (including Alien Invasive Plants)

Burke (2012) in Appendix H provided a detailed description of the vegetation and habitats in the EPL area. The salient points are summarised in section and Section 4.5 above. The only important vegetation close to the mine are two populations of *Lithops ruschiorum*, which need not be affected at all by mining, processing or placement of tailings. However the potential exists for them to be damaged by exploration activities that may still be carried out. These populations are not included in the target areas for mining that have been made known to CCA at the time of writing. If exploration proceeds into these areas, the Lithops will need to be more carefully mapped in relation to exploration drilling sites.

Apart from the above, the area to be disturbed has already been disturbed and does not contain any other important vegetation. Burke refers to the area previously disturbed as a “technotope” which is shown in black in Figure 4.12 (p.54).

The only alien invasive vegetation found were a few Prosopis sp. trees just north of the existing tailings. These should be destroyed to prevent them from spreading. The best method is to cut them down and immediately wet the remaining stumps thoroughly with diesel. If they re-grow, then the new and old stems should be painted with a mixture of diesel and Garlon.

Provided no new mining targets are identified, and any future exploration drilling takes care to avoid Lithops populations, then the impacts on vegetation should be of low significance.

<table>
<thead>
<tr>
<th>Table 8.6 Potential Destruction of Natural Vegetation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nature of impact</strong></td>
</tr>
<tr>
<td><strong>Extent</strong></td>
</tr>
<tr>
<td><strong>Duration</strong></td>
</tr>
<tr>
<td>Intensity (or magnitude)</td>
</tr>
<tr>
<td>------------------------</td>
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<tr>
<td>Probability</td>
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<td>Confidence</td>
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<td>Mitigation</td>
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<td></td>
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<tr>
<td>Further investigation or monitoring</td>
</tr>
</tbody>
</table>

Beyond the mining area, the potential exists for exploration activities or undisciplined recreational driving to cause damage to plants by leaving the well-established vehicle tracks. This must therefore be the subject of strict instruction as part of the induction of all new employees and anyone who is admitted to the site. New tracks must not be created.

8.4 Impacts on Fauna: Vertebrates & Invertebrates

8.4.1 General & Special Habitats

Irish (2012) undertook a specialist study on fauna, based on available records from the quarter degree squares within which the EPL falls, plus a short field investigation. Irish’s report is presented in Appendix I, and a summary is provided in Section 4.6 above.

Figure 1.7 (p. 11) shows that the proposed mining affects an area of approximately 1.3km in a north-south direction by 0.7km in an east-west direction. This amounts to a footprint of less than 1km$^2$, including the underground portions of the mine with some ventilation shafts opening to the surface.

The footprint on the surface is even smaller than 1km$^2$, including the plant, short haul road, buildings and tailings. The vegetation cover is extremely sparse within that area. No special vegetation will be affected within this footprint.

With the above in mind we can proceed to assess the impacts on invertebrates, reptiles, birds and mammals.

Applicable to all fauna are the following recommendations:

- Namib Desert habitats are highly sensitive to disturbance. Therefore every effort should be made to limit the footprint of the development to the area already disturbed by the previous mine and installations;
- Speed limits should be imposed on all roads and tracks to prevent unnecessary vehicle collisions and road kills, both day and night. During the day slow moving reptiles such as chameleons are vulnerable to vehicles. At night a variety of nocturnal animals and birds (e.g. owls) are vulnerable to collisions on the roads;
Discourage scavengers (and reduce consequent human-wildlife conflict) by not disposing of any refuse on site. If bins have to be kept out of doors they must be made animal-proof;

Educate employees to respect the life in the desert which they share.

8.4.2 Impacts on Invertebrates

Irish (2012) recognizes that the Central Namib is known for its high levels of endemicity amongst invertebrates. He also cites Irish (2009) in which he found that the median distribution of 98 invertebrates studied was 25km$^2$. If this figure is accepted as typical of species present, then only 4% of an invertebrate’s habitat would be adversely affected by the mine. Very few of the species have known ranges and this analysis is only indicative, but it suggests that the impact on any population of invertebrates would be low.

Irish (2012) identified three habitat types with varying degrees of sensitivity:

- Gravel plains were the most vulnerable, especially to damage of the substrate by vehicles that leave the existing tracks. Within that habitat type, the development will be confined to an area that was previously disturbed by mining and tailings;

- Rocky outcrops are less vulnerable to vehicles but still important habitats for invertebrates. In this case the rocky habitat that is affected by the mine is limited to a small portion of the dolerite ridge near N20 (in Figure 7). If new ventilation shafts are sunk then very small parts of this rocky ridge would be lost;

- Watercourses are the least vulnerable for invertebrates, except for the vegetation in those watercourses which is important. The mine footprint, as proposed will not affect any watercourse. The possibility of contaminated runoff having an impact will be dealt with in a later section.

The impacts upon invertebrates of elevated metals in soils, especially in the WSW direction from the existing tailings, is not known. A ‘plume’ of visible soil contamination is visible on the satellite image (Figure 1.7) over an area of about 1.5km by 0.3km – i.e. almost 0.5km$^2$.

The predicted dust deposition rates for metals are within international standards for lead, cadmium and arsenic (the only three for which standards are available – see Table 8.2, Section 8.2). However, the accumulation of metals in the soil over time in this arid environment with very low leaching potential, is not taken into account.

For this reason a precautionary approach is needed and dust emissions must be controlled during construction, operations and post closure stages to mitigate against increasing soil contamination levels.

Honey bees are often attracted to water in the desert, and may be adversely affected by drinking any contaminated water. These bees can also become very aggressive and are potentially dangerous to humans. Individuals who are allergic to their venom can be placed in a life threatening situation. Open water (e.g. rainwater pools, storage tanks or containers) should not be allowed close to work stations where attracting bees may present a hazard to people.
Table 8.7 Impacts on Invertebrates

| Nature of impact | • Very little will be destroyed by the footprint of the mine and infrastructure, which lies within an already disturbed area.  
• Metals in soils may impact some invertebrate species.  
• Driving off existing tracks causes damage to habitats. |
| --- | --- |
| Extent | • Footprint of mine & infrastructure less than 1km² (less than 100ha) within existing disturbed area.  
• Metals in soil unknown.  
• Driving off tracks in EPL, but this can be avoided. |
| Duration | Long term – lifespan of the project and beyond. |
| Intensity (or magnitude) | • Low for footprint (due to previous disturbance and small size).  
• Unknown for metals.  
• On tracks depends on mining company discipline. |
| Probability | • Definite for footprint.  
• Unknown for metals in soil.  
• On tracks depends on mining company discipline. Operating the mine does not require off track driving. |
| Confidence | • High for the footprint.  
• Low for metals in soil. |
| Significance | Medium significance. The effectiveness of mitigation is undetermined, but significance can probably be reduced to low. |
| Mitigation | A precautionary approach is advised with regard to metals in soils and mitigation is recommended regarding dust. Education of all site personnel to respect all life in the desert. |
| Further investigation or monitoring | Ongoing air quality monitoring. Periodic soil sampling to determine whether metals in soil are increasing. |

8.4.3 Impacts on Reptiles

Reptiles are vulnerable to the extent that their habitats are destroyed. They may also be susceptible to metals in soil as many reptiles eat invertebrates, which may have elevated levels of metals. If certain metals are bio-accumulated up the food chain, then predator populations may be more seriously affected than their prey populations.

As for invertebrates, the areas affected by the footprint of the development, and by metals in soils, is small while the areas covered by any reptile species is large.

Slow moving species such as chameleons may be killed on roads if drivers are not trained to be cautious and aware of such species. Snakes may be killed because personnel are afraid of them. Overall the impacts on the population of any reptile species are expected to be low.

Table 8.8 Impacts on Reptiles

| Nature of impact | • Very little habitat will be destroyed by the footprint of the mine and infrastructure, which lies within an already disturbed area.  
• Metals in soils may impact some reptile species.  
• Driving off existing tracks causes damage to habitats, and chameleons may be killed unnecessarily. |
| --- | --- |
### Extent
- Footprint of mine & infrastructure less than 1km² (less than 100ha) within existing disturbed area.
- Metals in soil unknown.
- Driving on and off tracks in EPL.

### Duration
- Long term – lifespan of the project.
  - In the case of metals in soils, also beyond the project lifespan.

### Intensity (or magnitude)
- Low for footprint (due to previous disturbance and small size).
- Unknown for metals.
- Road kills depend on driver awareness and discipline.

### Probability
- Definite for footprint.
- Unknown for metals in soil.
- Road kills depend on driver awareness and discipline.

### Confidence
- High for the footprint.
- Low for metals in soil.

### Significance
- Medium significance. The effectiveness of mitigation is undetermined, but significance can probably be reduced to low.

### Mitigation
- A precautionary approach is advised with regard to metals in soils and mitigation is recommended regarding dust.
- Driver awareness, training and discipline.
- Impose a 20km/hr speed limit on roads (also for dust minimisation), and take care driving day and night.
- Avoid driving over chameleons and other slow moving reptiles.

### Further investigation or monitoring
- Ongoing air quality monitoring.
- Periodic soil sampling to determine whether metals in soil are increasing.
- Checks for roads kills on the mine access road.
- Prohibit killing of wildlife including snakes.

---

### 8.4.4 Impacts on Birds, including impacts of the Power line

Bird populations in the Namib tend to be nomadic or have very large ranges. The destruction of habitat within the footprint of the mine and infrastructure is very small. Metals in soils may also affect birds, especially those that eat invertebrates or reptiles. Thus the potential exists for accumulation up the food chain where birds are the top predators. Impacts of this kind may not necessarily be lethal but may affect breeding success. This would be very difficult to determine. Since birds are nomadic or have large ranges (especially raptors) the likelihood of metals having serious impacts on birds is considered to be low.

Powerlines are a more direct threat to birds, especially large species such as bustards and korhaans that fly into them, or raptors that may sit on poles and get electrocuted. Shaw (2013) recommended that all new power lines should be fitted with bird diverting devices. It is recommended that bird deflectors be placed along the entire 8km length of the power line during the necessary refurbishment of the line. NamPower should be consulted regarding the best type and source of deflectors.

The Lappetfaced Vulture was considered in particular because it is classified as “vulnerable”. However, this bird is known to have very large ranges, and there are no large trees in the ML area where it could nest. Owls are prone to being killed on roads at night. Driver awareness training and speed limits should overcome this.
All the endemic species are widespread in the Namib.

Overall the impacts on birds are expected to be low.

### Table 8.9 Impacts on Birds, including impacts of the power line

| Nature of impact | • Very little destruction of habitat.  
|                  | • Metals in soils may accumulate up the food chain.  
|                  | • Power lines may cause fatalities to large birds.  |
| Extent           | • The footprint of the development,  
|                  | • Metals in soil unknown extent  
|                  | • The 8km power line  |
| Duration         | Long term – lifespan of the project. For metals the impacts could be longer.  |
| Intensity (or magnitude) | Low |
| Probability      | Improbable for the footprint.  
|                  | Probable for the power line.  
|                  | Unknown for metals in soils.  |
| Confidence       | High for the footprint  
|                  | Medium for the power line  
|                  | Low for metals in soils  |
| Significance     | Medium, reduced to low with bird deflectors on the power line  |
| Mitigation       | • Minimise habitat destruction within the footprint.  
|                  | • Mitigate against dust.  
|                  | • Fit bird deflectors on power line during refurbishment.  
|                  | • Seek ways to discourage birds drinking at retention ponds  
|                  | • Speed limit of 20km / hour on access road and haul road.  
|                  | • Take particular care when driving at night to avoid birds such as owls.  |
| Further investigation or monitoring | Monitoring beneath the power line for bird kills is recommended.  |

### 8.4.5 Impacts on Mammals

All of the mammal species have wide distributions and no population should be significantly affected by loss of habitat. However impacts could occur as mammals are attracted to water, which may be contaminated with metals or reagents – e.g. leachate collected from the tailings. Therefore any dams or places where water can form pools should be fenced off, and animals discouraged from drinking near the mine.

As for reptiles and birds, impacts of metals in soils could impact on predator species if metals bioaccumulate up the food chain. This impact would be very difficult to study and a precautionary approach is recommended by mitigating dust emissions.

The brown hyaena is near-threatened and may move through the area occasionally. They should be discouraged from scavenging by ensuring that no scraps of food or bins are accessible to them.

Hunting or persecuting game must be forbidden in terms of employment contracts and employer awareness must be ensured through training.
Aardvarks occur in the area and are at risk of being killed on the access road at night. Driver training and awareness is essential, as well as enforcement of a 20km/hour speed limit on the access road and haul road.

Overall the impacts on mammals are expected to be low.

<table>
<thead>
<tr>
<th>Table 8.10 Impacts on Mammals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nature of impact</td>
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<tr>
<td>Extent</td>
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<td></td>
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<tr>
<td></td>
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<tr>
<td>Duration</td>
</tr>
<tr>
<td>Intensity (or magnitude)</td>
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<tr>
<td>Probability</td>
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<td>Significance</td>
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<td>Mitigation</td>
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<td></td>
</tr>
<tr>
<td>Further investigation or monitoring</td>
</tr>
</tbody>
</table>

8.5 Impacts on Groundwater Levels / Resource

The impacts of groundwater abstraction or dewatering of the mine were considered by SLR (Oct, 2013) and are summarised below.

Process water and domestic water will be supplied by pipeline from a Namwater supply. The groundwater is saline and unsuitable for human consumption and for process water. This groundwater is only suitable for drilling purposes. Dewatering of the mine is expected to be very limited or even unnecessary because there is very little seepage into the existing mine shafts.

For the above reasons the impact on groundwater levels is expected to be low. Furthermore, the consequence of any lowered groundwater level is also expected to be low because there are no known users within or near the EPL, the groundwater is of poor quality, permeability is low except possibly along a fracture, and measured borehole yields are low. Therefore the groundwater is not a significant resource.

If it is used (e.g. for drilling), or in the unlikely event of occasional dewatering of the mine being needed, an abstraction permit will be required from the Ministry of Agriculture & Water (MAWF).
Table 8.11 Impact on Groundwater Levels (Groundwater Resources)

<table>
<thead>
<tr>
<th>Nature of impact</th>
<th>Potential for lowering the groundwater level by abstraction or dewatering mine.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extent</td>
<td>Expected to be local – within the EPL boundaries</td>
</tr>
<tr>
<td>Duration</td>
<td>Medium – lifespan of the mine. Any drawdown would probably recover after mine closure.</td>
</tr>
<tr>
<td>Intensity (or magnitude)</td>
<td>Low</td>
</tr>
<tr>
<td>Probability</td>
<td>Improbable whether mitigated or not</td>
</tr>
<tr>
<td>Confidence</td>
<td>Medium</td>
</tr>
<tr>
<td>Significance</td>
<td>Low significance, whether mitigated or not</td>
</tr>
<tr>
<td>Mitigation</td>
<td>None required</td>
</tr>
<tr>
<td>Further investigation or monitoring</td>
<td>Monitoring of groundwater levels in relation to any abstraction or dewatering. SLR suggests drilling additional monitoring boreholes.</td>
</tr>
</tbody>
</table>

8.6 Impacts on Groundwater Quality (Contamination from offices, ablutions, waste collection / treatment and refuelling sites)

SLR (Oct, 2013) assessed the impacts of contamination from the above sources, assuming that the mine complies with all legislation and permitting requirements. Adequate bunding of fuel installations and correct handling, storage and movement of hazardous substances is also assumed. It is proposed to treat domestic waste water on site and possibly re-use it in the process. Appropriate engineering and prevention of spillages is necessary in all cases.

SLR has recommended groundwater monitoring, with additional boreholes, in order to identify any contamination so that remediation can be undertaken if necessary. Remediation may involve pumping and treatment using technologies appropriate to the type of contamination.

Preventing contamination through appropriate engineering design, and strict controls during operations is usually cheaper and more effective than clean up after contamination has occurred.

Table 8.12 Impacts on Groundwater Quality (offices, ablutions, waste collection / treatment and refuelling sites)

<table>
<thead>
<tr>
<th>Nature of impact</th>
<th>The potential exists for contamination of groundwater from the above sources.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extent</td>
<td>Expected to be very local and within the EPL boundaries</td>
</tr>
<tr>
<td>Duration</td>
<td>Medium term – limited to the life of the mine</td>
</tr>
<tr>
<td>Intensity (or magnitude)</td>
<td>Low</td>
</tr>
<tr>
<td>Probability</td>
<td>Probable (in the unmitigated case) but improbable if mitigated</td>
</tr>
<tr>
<td>Confidence</td>
<td>High</td>
</tr>
<tr>
<td>Significance</td>
<td>Medium (in the unmitigated case) but low if mitigated</td>
</tr>
<tr>
<td>Mitigation</td>
<td>Engineering design and sizing of all installations to ensure containment, and operation according to strict management and controls to prevent spillage etc. Bunding / lining of refuelling tanks / sites. Ensure compliance with MAWF permitting requirements. Keep clean-up kits available in case of any spillage. Establish emergency clean up procedures.</td>
</tr>
</tbody>
</table>
Further investigation or monitoring | Monitor groundwater quality to detect any contaminants that leave the site. Numerical modelling.

8.7 Impacts on Groundwater Quality (Seepage from Tailings)

The impacts of the seepage of supernatant from the tailings storage facility and resulting contamination of groundwater have been assessed by SLR (Oct, 2013). Tailings liquor produced during processing and pumped to the tailings will contain metals in solution, including lead and zinc. This could infiltrate through fractures in the underlying marble to reach groundwater.

It is expected that the low conductivities in the marbles will limit the migration of any contaminants. SLR also recommends placing tailings on top of marbles only and either grouting identified fractures, or lining the tailings. They also recommended collecting the supernatant / tailings liquor and recycling it in the process.

<table>
<thead>
<tr>
<th>Table 8.13 Impacts of Seepage from Tailings contaminating groundwater</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nature of impact</strong></td>
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<tr>
<td><strong>Extent</strong></td>
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<td><strong>Duration</strong></td>
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<tr>
<td><strong>Intensity (or magnitude)</strong></td>
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<tr>
<td><strong>Probability</strong></td>
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<tr>
<td><strong>Confidence</strong></td>
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<tr>
<td><strong>Significance</strong></td>
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<tr>
<td><strong>Mitigation</strong></td>
</tr>
<tr>
<td><strong>Further investigation or monitoring</strong></td>
</tr>
</tbody>
</table>

8.8 Impacts on Groundwater Quality of Acid Rock Drainage

SLR (Oct, 2013) has assessed the impacts of potential acid rock drainage, and their assessment is summarised as follows. Since the ore body contains sulphide minerals, it is possible that acid rock drainage may occur locally. Natural factors that are expected to limit the impacts are the low conductivities of the marble host rock, and the low rainfall.

Since there are no local groundwater users and the groundwater quality is poor anyway, the consequences are considered by SLR to be medium in the unmitigated case and low in the mitigated case.

SLR recommended that tests (e.g. Acid Base Accounting) be conducted to ascertain the potential for Acid Rock Drainage, and the degree to which the underlying marble would result in buffering of any ARD.
SLR also recommended that the tailings be placed only on the marble – as proposed by NRR. This should help to buffer any acid rock drainage.

<table>
<thead>
<tr>
<th>Table 8.14 Impacts on Groundwater Quality (Acid Rock Drainage)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nature of impact</strong></td>
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<tr>
<td><strong>Extent</strong></td>
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<td><strong>Duration</strong></td>
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<tr>
<td><strong>Intensity (or magnitude)</strong></td>
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<td><strong>Probability</strong></td>
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<td><strong>Confidence</strong></td>
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<tr>
<td><strong>Significance</strong></td>
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<tr>
<td><strong>Mitigation</strong></td>
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<tr>
<td><strong>Further investigation or monitoring</strong></td>
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</tbody>
</table>

8.9 Impacts on Volumes of Surface Water Runoff

An assessment of the hydrological impacts was carried out by SLR (Oct, 2013). The resumption of mining and processing would have only a minor impact on surface water runoff because the site is close to the catchment boundary and thus the catchment at this point is very small. Some dirty water will need to be impounded and either recycled for process water or allowed to evaporate. However, the small amounts intercepted will not cause a significant reduction to the runoff downstream.

There are no known users of surface water downstream. Wildlife may drink from temporary rainwater pools after rain.

For reasons of containing contaminated surface water, retention structures should remain in place after mine closure in order to intercept solids in suspension and allow contaminated water to evaporate.

Since the volumes of runoff affected downstream are very small, and the consequences are very low, this impact has low significance and mitigation is unnecessary.

<table>
<thead>
<tr>
<th>Table 8.15 Impacts on Volumes of Surface Water Runoff</th>
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<tbody>
<tr>
<td><strong>Nature of impact</strong></td>
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<tr>
<td><strong>Extent</strong></td>
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<td><strong>Duration</strong></td>
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<tr>
<td><strong>Intensity (or magnitude)</strong></td>
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<td><strong>Probability</strong></td>
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<tr>
<td><strong>Confidence</strong></td>
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<tr>
<td><strong>Significance</strong></td>
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</table>
Mitigation
Further investigation or monitoring
Not required regarding volumes, but see below regarding water quality
Not required

8.10 Impacts on Surface Water Quality

SLR (Oct, 2013) provided an assessment of the impacts of contamination of surface water from the mine site and new tailings dam. The assessment includes the potential contamination by lubricants and fuels from machinery, vehicles and storage facilities.

Although rainfall is very low on average, rainfall events do occur where several year’s rainfall is received in a single event (e.g. 30mm or even 50mm in one day). Although rainfall is infrequent, when it occurs there is potential for contamination from the mine area – due to metals in dust, refuelling installations, lubricants from machinery and vehicles, and possibly chemical spills.

Rainfall runoff from the tailings will also be contaminated with metals and the reagents used in the process.

Therefore it is imperative that stormwater retention ponds be constructed, suitably sized to contain at least the 1 in 50 year rainfall event. This will help to settle suspended solids, and retain water with contaminants in solution. The water should then be pumped out and re-used in the process, or be treated to comply with water quality standards before being released into the environment. Release of water to the environment requires a Permit from the Ministry of Agriculture, Water and Forestry.

Since wildlife such as oryx, springbok and a wide range of smaller mammals and reptiles are likely to drink from the retention ponds, it is recommended that the ponds be fenced off to prevent animals from drinking contaminated water.

Pooling of water in hollows around the mine site must be prevented.

<table>
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<tr>
<th>Table 8.16 Impacts on Surface Water Quality</th>
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<tr>
<td>Nature of impact</td>
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<tr>
<td>Extent</td>
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<tr>
<td>Duration</td>
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<tr>
<td>Intensity (or magnitude)</td>
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<tr>
<td>Probability</td>
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<td>Confidence</td>
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<tr>
<td>Significance</td>
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<tr>
<td>Mitigation</td>
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</table>
Affairs) or preferably re-use water in the process. After mine closure the above mitigation will be reduced but the retention ponds will still capture sediment, and most of the water will normally evaporate. Retention ponds should be fenced to prevent animals from drinking contaminated water. Fences should be maintained after mine closure (by Parks authority?). Prevent pooling of rainwater around the mine site. Regular clean up of crushed ore spillages.

| Further investigation or monitoring | More accurate topographic delineation of the surface water catchments. Revised stormwater retention plan. Engineering design of collection channels and retention ponds, including sizing for the 1 in 50 rainfall runoff event. Design of operations for water treatment or re-use, including appropriate pumping procedures. |

8.11 Impacts of Solid & Liquid Waste Storage, Treatment and Disposal

Decisions regarding waste disposal must take into account the following issues:

- The project lies within a National Park,
- The risks posed to fauna, whether invertebrates or vertebrates, both large and small. Fauna with very local distributions are a particular concern in the Namib. Large game animals with wide distributions in Namibia are also of concern,
- Several species of fauna are scavengers and can remove waste from bins and any disposal pits – producing litter and presenting a risk to those animals,
- Litter is unsightly and substances like plastics may be eaten by animals, often with fatal consequences. Items like bottles and wire may trap or ‘snare’ fauna as well,
- In years with good rainfall the possibility of extensive grass growth may present the risk of fire starting and spreading.

For all the above reasons the following are strongly recommended:

- Waste shall not be burned or buried within the EPL at all. The only exception to burning may be in a high temperature incinerator designed for this purpose with appropriate safety specifications;
- As far as practically possible, recyclable waste should be separated at source and sent to companies that collect recyclables (e.g. glass, metals, paper, and plastic);
- All temporary storage bins for waste must be secure against scavenging animals and birds, and against wind;
- The design and management of facilities for sewage treatment and disposal should make use of technologies that are tried and proven in Namibian conditions. Maintenance of such systems must be to a very high standard. Treated water should be recycled via the processing plant. No water shall be disposed of to the environment;
- General waste that cannot be recycled should be sent to the Municipal waste disposal site at Swakopmund. The Swakopmund Municipality requires that NRR must apply to dispose there as they are outside the Municipal area (see letter dated 13 June 2013 (Appendix N).
- All hazardous waste has to be sent to a licensed Hazardous Waste Disposal facility such as that at Walvis Bay. A manifest must accompany each load and all relevant legislation must be complied with (refer Legal & Policy report in Appendix L). Any lubrication oils and used hydraulic fluids, if they are not recyclable, should also be sent to a licensed hazardous waste...
facility. It is recommended that a specialist company be employed to manage, transport and dispose of hazardous waste.

Provided all the above recommendations are strictly enforced, there should be no significant impact of waste.

<table>
<thead>
<tr>
<th>Table 8.17 Impacts of solid and liquid waste – storage treatment and disposal</th>
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<tbody>
<tr>
<td><strong>Nature of impact</strong></td>
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<td><strong>Extent</strong></td>
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<td><strong>Intensity (or magnitude)</strong></td>
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<td><strong>Significance</strong></td>
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<td><strong>Mitigation</strong></td>
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<tr>
<td><strong>Further investigation or monitoring</strong></td>
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**8.12 Impacts of Electricity Demand**

The demand for electrical power in Namibia, is an issue to be considered because the supply and demand situation is becoming increasingly difficult, not only in Namibia but also in South Africa, which has historically supplied about half of Namibia’s electrical energy.

The demand in Namibia has increased rapidly in recent years, with much of the increased demand coming from the mining sector. Namibia’s demand now exceeds 530MW (with a peak in 2012 of 560MW).

The mine and processing plant altogether will have an electrical energy demand of approximately 2MW. This is less than 0.4% of the countries demand, which is of low significance. However, it should be borne in mind that the demand acts cumulatively with all the other demands and measures to save electricity in the design of the process and infrastructure must be considered. For example, solar water heating should be used, and energy efficiency should be taken into account in design, and in the selection of machinery and appliances.

<table>
<thead>
<tr>
<th>Table 8.18 Impacts of electricity demand</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nature of impact</strong></td>
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<tr>
<td><strong>Extent</strong></td>
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<tr>
<td><strong>Duration</strong></td>
</tr>
<tr>
<td><strong>Intensity (or magnitude)</strong></td>
</tr>
</tbody>
</table>
8.13 Impacts of Power Line (excluding Birds)

An existing power line has to be refurbished. The most important impact is the access track used during refurbishment and maintenance. Tracks remain for decades or even longer, especially on gravel plains. Only a single track along the power line shall be used and this must be strictly enforced.

The power line will have a very minor visual impact from the B2 tar road but this is considered to be insignificant.

The impacts on birds are the most important ecological impact, and that was assessed in section 8.4.4 above.

<table>
<thead>
<tr>
<th>Table 8.19 Impacts of power line to the mine (excluding birds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nature of impact</td>
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<tr>
<td>Extent</td>
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<td>Duration</td>
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<tr>
<td>Intensity (or magnitude)</td>
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<td>Probability</td>
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<tr>
<td>Significance</td>
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<tr>
<td>Mitigation</td>
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<tr>
<td>Further investigation or monitoring</td>
</tr>
</tbody>
</table>

8.14 Visual Impacts & Lighting

Refer to Photos 2.1 – 2.3 (p.17-19) for current visual impacts, mainly due to the tailings.

The mine is not visible from the nearest road – the N2 tar road, which is 8 km away. The area is used by at least one tour company which includes mineral tours in the services they offer (refer Appendix Q). The mine itself is underground and all that is visible on the surface is some heaps of overburden where the shafts open to the surface. The infrastructure will have a visual impact locally during mine life, but it will be removed following mine closure. The old tailings will be reprocessed and thus removed.
The main visual impact will be the new tailings, which will be larger than the old. NRR considers that it will not be economical to dispose of the tailings underground, and therefore they will remain after mine closure as a permanent visual impact. The dark mass of the old tailings is visible from many kilometres away and is clearly an unnatural form and colour in the landscape.

This impact cannot be eliminated but it can be mitigated to a significant degree by trimming off the dump following closure to make a more natural looking landform, then covering it with a layer of waste marble from the mine. In Section 8.2, Table 8.3 (p.88) a layer marble fragments of 300mm thick was recommended for dust suppression in the long term, subject to the volume of waste marble available. This will have a number of advantages: -

- The marble layer will cause the dump to blend with its surroundings as it is the same colour as the bedrock which outcrops all around the site;
- It will help to prevent erosion of the dump by wind and rainfall, thus reducing the impact of soil contamination by metals from the tailings; and
- It may help to buffer any acid rock drainage of surface water from the tailings.

Lighting of the site during construction and maintenance is not of great concern as there are no sensitive receptors. However, the design of lighting should be considered to direct light only to where it is needed – in the interests of energy efficiency and minimising electricity consumption.

<table>
<thead>
<tr>
<th>Table 8.20 Visual impacts and lighting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nature of impact</td>
</tr>
<tr>
<td>Extent</td>
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<tr>
<td>Duration</td>
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<tr>
<td>Intensity (or magnitude)</td>
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<td>Probability</td>
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<td>Confidence</td>
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<tr>
<td>Significance</td>
</tr>
<tr>
<td>Mitigation</td>
</tr>
<tr>
<td>Further investigation or monitoring</td>
</tr>
</tbody>
</table>

8.15 Impacts of Water Demand

Water resources in the Erongo Region are very limited, largely due to the mining sector and the coastal towns. The water demand for the Namib Lead and Zinc Mine and processing is estimated at 250,000 m$^3$ per annum for all purposes combined.

Supply will come from the excess of an existing desalination plant built by Areva at Wlotzkasbaken. It can currently produce 20Mm$^3$ of potable water per year. There is reportedly an allowance available of about 8Mm$^3$ per annum for users in the Erongo Region. Since Areva is currently on care and maintenance, a surplus of an additional 12Mm$^3$ is available, however this may be temporary as the Areva mine may restart.

Based on 250,000 m$^3$ of the 8Mm$^3$ allowance, the demand amounts to about 3% of the reported allowance at present.
NRR expects to recover about 50% of the process water from the tailings dam and from thickeners before pumping to the tailings to the tailings dam. The demand of 250,000 m$^3$ is make up water – after allowing for losses due to evaporation, water adhering to tailings etc.

The design of the tailings dam is important to manage evaporation losses. NRR proposes to build small cells, to minimise surface area and hence evaporative losses. The cells may be lined to prevent infiltration. Flocculants could also be considered to hasten the settling of fine particles – thus improving water recovery.

<table>
<thead>
<tr>
<th>Table 8.21 Impacts of Water Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nature of impact</td>
</tr>
<tr>
<td>Extent</td>
</tr>
<tr>
<td>Duration</td>
</tr>
<tr>
<td>Intensity (or magnitude)</td>
</tr>
<tr>
<td>Probability</td>
</tr>
<tr>
<td>Confidence</td>
</tr>
<tr>
<td>Significance</td>
</tr>
<tr>
<td>Mitigation</td>
</tr>
<tr>
<td>Further investigation or monitoring</td>
</tr>
</tbody>
</table>

8.16 Impacts of Water Supply Pipeline

The potential supply to NLZM is via an offtake from the Rössing Pipeline. This is a 700mm steel pipe with a capacity of 1,100$m^3$/h. There is an existing take off point since before closure of NLZM in 1992.

A new 7km pipeline of 110mm diameter will be built from that point to the mine. It can be laid on the ground, except where it crosses watercourses where it will need to be raised on piers to prevent damage by episodic river flow. There is a potential risk to the pipeline from Park users in 4x4 vehicles. Burying the pipe is not recommended as there is little or no soil in many places and excavating in rock would leave permanent scars unnecessarily. The pipe can simply be anchored by bolts into the bedrock where needed.

The pipe is too small to impede the movement of wildlife and ostriches.

The main impacts will be during construction when vehicle tracks may be unnecessarily proliferated. Concrete or brick piers are needed to make pipe bridges, but these are removable. Drilling into bedrock for fixing bolts will have a minor visual impact only after they are removed.

The pipeline must be removed upon mine closure, together with all fixings, piers, concrete etc.

If possible the pipeline should be constructed in the same corridor as the power line so that a single access track can be used.
### Table 8.22 Impacts of Water Supply Pipeline

<table>
<thead>
<tr>
<th>Nature of impact</th>
<th>Potential for unnecessary proliferation of tracks, or remains of installation not removed after closure.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extent</td>
<td>In the EPL near the pipeline route.</td>
</tr>
<tr>
<td>Duration</td>
<td>Long term – lifespan of the project and possibly beyond</td>
</tr>
<tr>
<td>Intensity (or magnitude)</td>
<td>Low</td>
</tr>
<tr>
<td>Probability</td>
<td>Probable, but improbable if mitigated.</td>
</tr>
<tr>
<td>Confidence</td>
<td>Medium (contractual means and enforcement measures must be considered)</td>
</tr>
<tr>
<td>Significance</td>
<td>Low, but requiring mitigation</td>
</tr>
<tr>
<td>Mitigation</td>
<td>Use of single access track only to be enforced. If possible combine with the power line service track. Removal of all infrastructure and fixings, piers etc after mine closure.</td>
</tr>
<tr>
<td>Further investigation or monitoring</td>
<td>Contractual means, plus compliance monitoring.</td>
</tr>
</tbody>
</table>

### 8.17 Impacts on Road Traffic and Namport

It is proposed to transport the products in 20 foot shipping containers, which can each be loaded with 28 tonnes of concentrate. Containers are preferred to bulk shipping as they are environmentally secure and present a low risk of contamination – mechanical failure excepted.

The mine will produce approx 30,000 tonnes of concentrate per year – i.e. roughly 580 tonnes / week. This would amount to about 2 trucks per day each carrying two 20 foot containers per trip. Transport of the product can be limited to weekdays if necessary, and/or to off-peak hours.

In addition the work force will be transported by bus daily from Swakopmund and possibly Walvis Bay. Since there are three shifts, this will require three return trips per day.

This volume of traffic will have no significant impact on roads, although it is of course cumulative with growth in traffic from all other sources. At the coast road safety is frequently reduced by fog, and it is recommended that all mine-related traffic should travel with lights on.

Namport has confirmed their capacity to handle the proposed container traffic in a meeting with NRR on 19 September 2013 (Claridge, pers comm). Namport has their own environmental management system within their area of control.

<table>
<thead>
<tr>
<th>Nature of impact</th>
<th>Additional heavy vehicles on the road to Walvis Bay (2 per day). Busses carrying workers for three shifts per day.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extent</td>
<td>Mine to Walvis Bay</td>
</tr>
<tr>
<td>Duration</td>
<td>Long term – lifespan of the project</td>
</tr>
<tr>
<td>Intensity (or magnitude)</td>
<td>Low</td>
</tr>
</tbody>
</table>
8.18 Mine Closure & Rehabilitation Plan

A Closure & Rehabilitation Plan will be developed that will include the following activities:

**Underground & Shafts**
- Ensuring that backfilling of waste is secure will be ongoing during operations and upon closure of mine;
- Cast reinforced concrete slabs over the shafts at the surface before covering with waste rock (marble) and soil. This is safer than fencing, which will corrode in due course and is less able to keep animals and people out.

**Infrastructure**
- Remove all buildings, plant, equipment, machinery and chemicals from site for safe and legal disposal;
- Remove all concrete slabs, fixings, etc;
- Remove the pipeline and power line.

**Tailings**
- Trimming of the dry tailings storage facility to prevent ponding of water and remove hard lines for reasons of visual impacts;
- Cover the tailings with a layer of broken waste rock (marble) to reduce erosion and reduce visual impacts.

**Retention ponds**
- Maintain any diversion channels leading to retention ponds so that they continue to operate effectively for many years after closure;
- Retention ponds should remain in place so that they can intercept rainfall runoff from the site for many years after mine closure.

**Replacing of soil, trimming of cut slopes**

Where it was necessary to remove soil before construction, e.g. where buildings and foundations had to be placed, the soil must be replaced and graded to give a natural appearance.

Where ground has been made uneven, e.g. by cutting into slopes for the purpose of levelling, the slopes must be reinstated to their natural slope angle and made to look as natural as possible.
Sweeping of tracks in the EPL

It is standard practice within EPLs in Namibian Parks to sweep tracks that are no longer required, leaving only those main tracks that are approved by the Directorate of Parks.

The gravel plains are the areas where tracks are least able to be repaired by natural means.

Consultation with Directorate of Parks

The EPL should be left in a condition that is acceptable to the Directorate of Parks, and to this end consultation and planning with Parks should be continuous throughout the mine planning, operations, and closure stages – taking into account the end use and visual impacts of the site.

<table>
<thead>
<tr>
<th>Table 8.24 A Closure &amp; Rehabilitation Plan is intended to ensure that the impacts of mining do not continue, or are mitigated to an acceptable level after mine closure.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nature of impact</strong></td>
</tr>
<tr>
<td><strong>Extent</strong></td>
</tr>
<tr>
<td><strong>Duration</strong></td>
</tr>
<tr>
<td><strong>Intensity (or magnitude)</strong></td>
</tr>
<tr>
<td><strong>Probability</strong></td>
</tr>
<tr>
<td><strong>Confidence</strong></td>
</tr>
<tr>
<td><strong>Significance</strong></td>
</tr>
<tr>
<td><strong>Mitigation</strong></td>
</tr>
<tr>
<td><strong>Further investigation or monitoring</strong></td>
</tr>
</tbody>
</table>
9 ASSESSMENT OF SOCIO-ECONOMIC IMPACTS

9.1 Benefits of Direct Employment

Details of employment numbers and total monthly salaries were provided in Section 3.28. NRR will have a policy of paying average salaries in the industry in Namibia.

During Stage 1, the mine itself will employ approximately 39 people and the total of their salaries will amount to approximately USD 56,000.

During Stage 2 mining, this will be increased to approximately 62 people on the mine, earning a total of USD 90,000 per month. The numbers employed include 48 labourers (77%).

In addition, Stage 2 processing will employ approximately 44 persons earning a total of approximately USD 52,140 per month. The numbers employed include mainly skilled personnel - 30 technical operators (68%) and few labourers.

In summary, at full production, the mine and plant will employ a total of 106 people with combined earnings of approximately USD 142,140 per month.

NRR will give priority to employing Namibians who have the necessary skills. They also intend to provide in service training for a number of staff, with experienced staff training less experienced recruits. Training will benefit people beyond the life of mine by improving their chances of employment after the mine is closed.

The salaries mentioned above will include medical aid benefits. Housing allowances may also be included as part of the package.

Staff will be sourced locally and from around Namibia, so the benefits may be country-wide.

<table>
<thead>
<tr>
<th><strong>Table 9.1 Benefits of Direct Employment</strong></th>
</tr>
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<tbody>
<tr>
<td><strong>Nature of impact</strong></td>
</tr>
<tr>
<td><strong>Extent</strong></td>
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<tr>
<td><strong>Duration</strong></td>
</tr>
<tr>
<td><strong>Intensity (or magnitude)</strong></td>
</tr>
<tr>
<td><strong>Probability</strong></td>
</tr>
<tr>
<td><strong>Confidence</strong></td>
</tr>
<tr>
<td><strong>Significance</strong></td>
</tr>
<tr>
<td><strong>Mitigation/ enhancement</strong></td>
</tr>
<tr>
<td><strong>Further investigation or monitoring</strong></td>
</tr>
</tbody>
</table>
9.2 Other Economic Benefits to Namibia

NRR’s estimates of capital expenditure and operating expenditure were provided in Section 3.32.

The total investment in Namibia (CAPEX and OPEX) over 7 years is estimated at over USD 103 million. Much of the expenditure will go to Namibian consultants, contractors, local service industries, as well as to salaries of employees. Some will be spent on equipment and machinery that will need to be imported.

The project will have significant benefits for Namibia, including:

- Foreign investment;
- Reduction in Namibia’s trade deficit through exports;
- Company taxes, mining royalties, value added tax, and PAYE taxes on employee salaries;
- Outsourced technical services: e.g. mechanical engineering services to maintain and repair equipment, and maintenance of vehicles;
- Outsourced transport services, including services for the management and disposal of hazardous waste;
- Non-technical services such as accounting, auditing, and banking;
- Various other multiplier effects.

<table>
<thead>
<tr>
<th>Table 9.2 Other Economic Benefits to Namibia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nature of impact</td>
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<tr>
<td>Extent</td>
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<tr>
<td>Duration</td>
</tr>
<tr>
<td>Intensity (or magnitude)</td>
</tr>
<tr>
<td>Probability</td>
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<tr>
<td>Confidence</td>
</tr>
<tr>
<td>Significance</td>
</tr>
<tr>
<td>Mitigation</td>
</tr>
<tr>
<td>Further investigation or monitoring</td>
</tr>
</tbody>
</table>

9.3 Impacts related to Tourism in the Dorob National Park

The affected area is sensitive due to the fact that it lies within a National Park, which seeks to promote conservation and tourism.

However, the EPL area does not offer unique scenery such as the Moon Landscape.

The affected mine area is used by a tour company, which takes tours including some with a focus on minerals. Charly’s Tours included the mine itself in their mineral tours and requested that they still be allowed access to the mine, which may not be possible for safety reasons during operations.
It has also been reported (by NRR) that recreational users quite often move through the area. These recreational users do not benefit the Park and may actually do damage by driving off the tracks, but the Park has historically provided a service to such recreational users. To date the Directorate of Parks has not implemented a permit system in Dorob Park.

It is difficult to say whether any adverse impacts on tourism would be significant or not. At present there does not appear to be much formal tourism within the EPL which is actually benefiting the Park, and it is expected that the impact on tourism will be low during the life of mine. In the long term, after mine closure, and with potential increasing facilities and tourism in the Park, the residual impact of mining will depend on how well the area has been managed and rehabilitated (e.g. existing unsightly tracks and the rehabilitation of the tailings). The tailings comprise the most significant visual impact and ongoing potential for contamination of soils and water if not adequately rehabilitated.

NRR has already conducted a major clean up by removing the ruins of old mine houses and other buildings.

The mining licence area itself will not be suitable for the establishment of tourist facilities in the future because there is no source of potable water – the local groundwater being naturally of very poor quality.

| Table 9.3 Impacts on Tourism in the Dorob National Park |
| Nature of impact | Tourism is currently at a low level in the EPL. |
| Extent | The EPL |
| Duration | Medium term (definite) but potentially Long term – beyond mine life depending on the quality of rehabilitation |
| Intensity (or magnitude) | Medium, can be reduced to low with rehabilitation |
| Probability | Highly probable |
| Confidence | Medium |
| Significance | Medium. Can be reduced to low. |
| Mitigation | Good management of tracks, dust, water and rehabilitation (tailings and mine site). |
| Further investigation or monitoring | Monitoring and rehabilitation of tracks. Planning for closure and implementing of rehabilitation measures. |

In addition to the above, uncontrolled access represents a risk to the public in a mining area, and a risk to NRR who may be held responsible for any accidents. Therefore the following security recommendations are made:

- NRR should consult with Parks and establish access controls to prevent unauthorised access to the mine site;
- Parks need to establish a permit system to allow only permit holders into the Park;
- Consideration should be given to fencing the mine precinct. Since fencing has a minor impact and may damage small plants like Lithops, it should be done in consultation with Parks. Earlier in this EIA we have recommended erection of game fencing around water retention dams (contaminated water). The appropriate type of fencing, if any, needs to be decided in each case. Fencing would also be useful to define an area outside of which no mine-related activities will be allowed.
9.4 Impact on HIV/AIDS and of this Disease on the Project

Development projects often have an impact on the spread of HIV/AIDS as people move from other parts of the country to work on the construction or operation of the mine. Approximately 20% of Namibia’s population is infected with HIV, which is the number one cause of death in the country. It is often associated with tuberculosis (TB) which has the highest case rate in the world in Namibia (www.namibiaaidsawareness.org/AIDSNam.html).

HIV/AIDS has serious economic consequences for families affected because it frequently affects the economically active members of the family.

Any mining project is likely to attract people into the area from other parts of the country. Workers are often separated from their families, which favours the spread of the disease, with new residents of a mining area becoming infected or infecting others.

This problem also has serious implications for the employer, as staff who have been trained up to do a job may be lost to the disease. Not only is this a personal tragedy for those affected, but it affects the sustainability of the workforce.

Therefore it is strongly recommended that NRR should provide an HIV/AIDS awareness- and education- programme for all their staff as part of their induction to employment. The Ministry of Health and various NGOs can be approached for assistance.

9.5 Emergency Services & Hospital Services

In the event of any accidents at the mine or plant, emergency services and hospital services would be needed. The adequacy of the available services, e.g. to deal with potentially large numbers of injured people has not been established.

NRR proposes to: -

- Enquire with other mines in close proximity regarding possible medical response sharing,
- Develop emergency response procedures in the event of accidents.

9.6 Occupational Health and Safety (OHS)

OHS is a specialised field that is not dealt with in this EIA, however some questions were asked during the public participation programme.

NRR will be responsible to comply with all relevant legislation affecting occupational health and safety. Some examples of some of the issues to be managed are: -

- The use of water sprays to suppress dust,
- Extraction fans and bag filters,
- Dust masks, gloves and hard hats to be worn by all employees,
- Hand washing before eating or smoking,
- Hearing protection where noisy activities are conducted.

NRR will institute procedures for pre-employment health tests, and ongoing blood tests (e.g. lead levels in blood) and health checks during employment. If the levels of metals in blood exceed certain standards, then the person can be removed from the job and treated. Any
such remedial action should also lead to investigation of the cause, so that it can be remedied by adapting procedures according to the need.

It is strongly recommended that NRR should employ specialists in the OHS field to develop a health and safety programme with the required compliance monitoring programme.
10 SUMMARY & CONCLUSION

10.1 Summary

Table 10.1 provides a summary of the assessments in Sections 8 & 9. The significance rating means the significance for a decision to approve the project as explained in Section 7 (p.81). A negative significance or adverse impact is indicated as (-). A positive impact or benefit is indicated as (+). A high (-) significance would indicate a potential fatal flaw, being an impact that cannot be adequately mitigated. Medium (-) significance would indicate an impact that needs to be mitigated to an acceptable level in order for the project to be approved. Low (-) significance means that the issue would not affect a decision to approve the project, although mitigation may still be required.

Possible mitigation measures are summarised in the third column. In the fourth column the recommendations for further investigation and for monitoring are summarised by key words.

<table>
<thead>
<tr>
<th>Environmental Impact or Issue</th>
<th>Significance rating before &amp; after mitigation</th>
<th>Possible Mitigation</th>
<th>Further Investigation and/or Monitoring Recommended</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impacts on soil</td>
<td>Medium (-) Low with mitigation</td>
<td>Control of dust at source. Control of stormwater runoff.</td>
<td>Design of site. Annual soil sampling.</td>
</tr>
<tr>
<td>Impacts on air quality: dust (PM_{10} &amp; dust outfall including metals)</td>
<td>Medium (-) Low with mitigation</td>
<td>Refer Table 8.3, p.88. Water sprays, regular clean up, chemical suppressants, speed limits, tipping speeds, rock cladding of tailings, responsible person. Achieve dust deposition rates below 1200 mg/m^2/day downwind at source.</td>
<td>Design of plant must include dust suppression aspects. Monitoring dust outfall, &amp; analyse metals content. Monitoring PM_{10} concentrations in air – for health reasons.</td>
</tr>
<tr>
<td>Impacts on natural vegetation, including Lithops nearby</td>
<td>Low (-) Can be avoided</td>
<td>Staff awareness, Alien Prosopis must be eradicated.</td>
<td>Mapping if more exploration. Monitoring to confirm no damage.</td>
</tr>
<tr>
<td>Impacts on invertebrates</td>
<td>Medium (-) Probably reducible</td>
<td>Control footprint of development, metals in soil and limit driving to roads. Control contamination of soil and surface water. Staff awareness.</td>
<td>See soil, air quality, and surface water quality.</td>
</tr>
<tr>
<td>Impacts on reptiles</td>
<td>Medium (-) Probably reducible</td>
<td>Control contamination of soil and surface water. Driver awareness – avoid reptiles. Speed limit 20km/hr.</td>
<td>See soil, air quality, and surface water quality. Monitor &amp; report road kills for awareness training.</td>
</tr>
<tr>
<td>Environmental Impact or Issue</td>
<td>Significance rating before &amp; after mitigation</td>
<td>Possible Mitigation</td>
<td>Further Investigation and/or Monitoring Recommended</td>
</tr>
<tr>
<td>--------------------------------------------------------</td>
<td>-----------------------------------------------</td>
<td>-------------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------</td>
</tr>
<tr>
<td>Impacts on birds</td>
<td>Medium (-) Low with mitigation</td>
<td>Fit bird deflectors on powerline. Control contamination of soil and surface water. Driver awareness, at night</td>
<td>Monitor power line for bird kills</td>
</tr>
<tr>
<td>Impacts on mammals</td>
<td>Medium (-) Low with mitigation</td>
<td>Prohibit poaching in staff contracts. Prevent scavenging. Prevent drinking contaminated water – fencing. Speed limits 20km/hr.</td>
<td>Monitor and record any problems with wildlife for ongoing training and improvement</td>
</tr>
<tr>
<td>Impact on groundwater levels / resource</td>
<td>Low (-)</td>
<td>None thought to be necessary</td>
<td>Monitor levels</td>
</tr>
<tr>
<td>Impacts on groundwater quality (from acid rock drainage)</td>
<td>Medium (-) Low if mitigated</td>
<td>ARD study to determine acid-generating potential and buffering effect of marbles.</td>
<td>Groundwater monitoring - ongoing</td>
</tr>
<tr>
<td>Impacts on volumes of surface runoff</td>
<td>Low (-)</td>
<td>Not required</td>
<td>Not required</td>
</tr>
<tr>
<td>Impacts on surface water quality</td>
<td>Medium (-) Low if mitigated</td>
<td>Design and construct impoundments for dirty water. Prevent pooling of rainwater. Regular cleanup</td>
<td>Accurate survey and revised stormwater retention plan. Size retention dams for 1: 50year rainfall event. Design and operate water re-use system</td>
</tr>
<tr>
<td>Impacts of solid and liquid waste</td>
<td>Medium (-) Low if fully compliant</td>
<td>No disposal on site - use licensed disposal facilities, legal compliance, recycling.</td>
<td>Specialist contractor to handle hazardous waste</td>
</tr>
<tr>
<td>Electricity demand</td>
<td>Low (-) but may be further reduced</td>
<td>Design of installations, solar water heating, energy efficient machines and appliances</td>
<td>Design stage</td>
</tr>
<tr>
<td>Impacts of power line (excluding birds)</td>
<td>Low (-) but may be further reduced</td>
<td>Use single track (combine with pipeline track). Final removal.</td>
<td>Contracts with contractors.</td>
</tr>
<tr>
<td>Visual impacts &amp; lighting</td>
<td>Medium (-) Low with mitigation</td>
<td>Trim and cover tailings with layer of waste rock (marble)</td>
<td>Determine volume of waste rock required and plan for it.</td>
</tr>
<tr>
<td>Impacts of water demand</td>
<td>Medium (-)</td>
<td>Thickening of tailings. Maximise recovery of water from tailings</td>
<td>Determine ways to reduce consumption</td>
</tr>
<tr>
<td>Environmental Impact or Issue</td>
<td>Significance rating before &amp; after mitigation</td>
<td>Possible Mitigation</td>
<td>Further Investigation and/or Monitoring Recommended</td>
</tr>
<tr>
<td>------------------------------</td>
<td>---------------------------------------------</td>
<td>--------------------</td>
<td>---------------------------------------------------</td>
</tr>
<tr>
<td>Impacts of water supply pipeline</td>
<td>Low (-) but may be further reduced</td>
<td>Single access track. Combine with power line track. Final removal.</td>
<td>Contracts with contractors</td>
</tr>
<tr>
<td>Road Traffic &amp; Namport</td>
<td>Low (-)</td>
<td>Daylight hours and off-peak times</td>
<td>Determine low traffic times</td>
</tr>
<tr>
<td>Mine Closure &amp; Rehabilitation, incl. tracks</td>
<td>Medium (+) Must be a condition of approval</td>
<td>Rehabilitation is mitigation. NRR to provide a fund to cover the costs of rehabilitation.</td>
<td>Design and plan for rehabilitation from the start, including annual contributions to a separate rehabilitation fund.</td>
</tr>
<tr>
<td>Benefits of Direct Employment</td>
<td>High (+) Medium term</td>
<td>Enhancement of benefits by training, and housing allowances (encourage home ownership)</td>
<td>Seek to optimise benefits to staff</td>
</tr>
<tr>
<td>Other Economic Benefits to Namibia</td>
<td>High (+) Medium term</td>
<td>As above, plus bursaries for technical training</td>
<td>Seek to leave benefits – enhanced human resources – after mine closure</td>
</tr>
<tr>
<td>Impacts related to Tourism in Dorob Park</td>
<td>Medium (-) Reducible to Low</td>
<td>Management of tracks and rehabilitation of mine site and tailings</td>
<td>Planning for closure. Monitoring of tracks and compliance with EIA/EMP</td>
</tr>
<tr>
<td>HIV/AIDS</td>
<td>Not assessed</td>
<td>Staff education</td>
<td>Seek good trainers</td>
</tr>
<tr>
<td>Emergency &amp; hospital services</td>
<td>Not assessed</td>
<td>Develop emergency response procedures</td>
<td></td>
</tr>
<tr>
<td>Occupation Health &amp; Safety</td>
<td>Not assessed in EIAs</td>
<td>Employ a specialist in OHS. Protective clothing. Education &amp; training.</td>
<td>Run clinical health monitoring programme.</td>
</tr>
</tbody>
</table>

### 10.2 Environmental Economics Criteria

This section provides a qualitative assessment of the project in terms of the criteria used in the field of Environmental Economics. These criteria are explained in detail by Stauth (1983), namely: -

- The **Efficiency criterion**,
- The **Equity criterion**, and
- The **Intergenerational Equity criterion**

These criteria deal with environmental costs and benefits in a very broad sense, which include both bio-physical and socio-economic considerations. The environmental costs are not measured only in economic terms but also in terms of loss of amenity.

**Efficiency**: A project is considered to be efficient if there is a net benefit to society. In terms of this criterion, there may be some who are made better off while others are made worse off.
If those who gain from the project could theoretically compensate those who lose and still be better off, then the project can be said to be “efficient”.

In the case of the Namib Lead & Zinc Mine, the mining company and contractors, government and employees will all gain considerably. On the other hand there may be some loss of amenity or economic loss to tour operators or to the Directorate of Parks.

To the extent that overall gains exceed overall losses, the project satisfies the efficiency criterion.

**Equity**: The equity criterion relates to the distribution of costs and benefits in society. A project is considered to be equitable if it brings about a situation in which the distribution of social well-being is improved. Where there are winners and losers, if the winners actually compensate the losers in some way (not necessarily economic way) then the project can be said to be equitable.

Because of the lack of near neighbours, there will be few who lose anything. One or two tour companies may suffer some loss of amenity, which could perhaps be compensated by allowing limited visits to the mine by tour groups.

The party that stands to experience the greatest potential loss is the Directorate of Parks. To the extent that the mining area and EPL are damaged and not rehabilitated by NRR (as with the previous mining company) Parks may be disadvantaged - by loss of conservation potential and/or by the costs of cleaning up and rehabilitating in order to restore tourism potential. The particular areas of concern for rehabilitation have been identified as tracks, potential scarring of the mine site, potential loss of vegetation communities such as Lithops, unsightly tailings dumps, and/or contamination of soil and surface water.

In the unlikely event of NRR defaulting on its responsibility to clean up and rehabilitate the area, the party that has to pay for rehabilitation in their stead would be disadvantaged (e.g. Parks). To ensure that this does not occur, it is recommended that NRR establish a fund to cover the costs of rehabilitation in the event of bankruptcy or default.

It should be pointed out that NRR has so far undertaken a considerable amount of clean up work at their own cost.

**Intergenerational Equity (or Sustainability)**: This criterion considers the impacts on future generations. It extends the equity criterion to future generations. Thus it deals with questions of sustainability.

Mining is, by definition, unsustainable because it exploits non-renewable resources that will no longer be available to future generations. However, some of the benefits can endure to enhance the lives of future generations long after the mine is closed. Here are some examples:

- Training of personnel on the job can improve the pool of human resources in Namibia;
- Providing bursaries for people to attend training institutions such as NIMT would help to provide skills to people, by which they can earn a living even outside of the mining sector (e.g. in the building industry);
- Assisting Parks in some way to develop the Dorob Park and make it more amenable to tourism would encourage sustainable development.

NRR needs to engage with stakeholders and develop social strategies along these lines.
10.3 Conclusion

An Environmental Impact Assessment has been compiled for North River Resources’ proposal to re-open the old underground lead and zinc mine and develop a new processing plant and tailings dam on site.

Consultations with Interested and Affected Parties (I&APs) and the relevant Authorities have been carried out and their concerns have been assessed in the EIA. All public issues and concerns that were raised have been recorded in this report. An opportunity for public comment on the draft EIA report was provided via a final public meeting and an opportunity for written submissions, only one of which was received. Further consultation has been requested from the Directorate of Parks following their reading of the EIA/EMP.

Various specialist studies have been conducted on environmental aspects of concern – flora, fauna, soils, air quality and dust, archaeology, surface water and groundwater. No fatal flaws were identified, but environmental management is needed in relation to most of these environmental aspects.

The mine and tailings sites are already disturbed by previous mining and processing, and numerous tracks exist over the EPL area.

On the basis of the target area for mining that has been established to date, the mine is not expected to result in any new degradation of the area. This is because the footprint of the mine (above ground), plus the plant and the tailings lie within the previously disturbed area. Within kilometres of the old mine, soils show elevated levels of certain metals (including lead and zinc) particularly downwind of the old tailings - especially due to easterly winds.

Impacts on fauna should be manageable (e.g. preventing drinking of contaminated water and scavenging). The impacts of existing contaminated soil on invertebrates and carnivorous vertebrates are not established. However, in line with the precautionary principle in the Environmental Management Act, every effort must be made to minimise dust fallout from all sources and therefore avoid aggravating the levels of metal concentrations in soils. In the case of the tailings, protection against wind and water erosion needs to be ensured long beyond mine closure to prevent ongoing contamination of soil and water.

It is possible to avoid impacts on sensitive flora, which lie outside the footprint of the development. However, great care needs to be exercised if more extensive drilling exploration is carried out – to avoid impacts on the nearby Lithops populations.

Regarding water quality, although the marbles are expected to provide significant buffering ability, recommendations have been made for further study on the potential for acid rock drainage and to confirm the buffering capacity of the carbonates. This is necessary before mining commences.

The tailings represent the greatest long term concern, as a potential source of dust containing metals, contaminated stormwater runoff, and adverse visual impacts. Long term solutions are most likely to involve trimming and covering the tailings with a layer of marble rock.

Measures to prevent contaminated stormwater from the leaving the site need to be designed to be effective after mine closure when water will no longer be pumped out of retention dams.
Recommendations for management and mitigation have been made throughout Sections 8 & 9, as well as in the specialist reports. Please refer to the Environmental Management Plan (EMP) in Sections 11 – 14 below. Some of the practical details will need to be further developed with the mine design engineers.

Regular compliance monitoring will be needed to ensure that the mine complies with the recommendations in the EIA/EMP. Regular monitoring is also needed in regard to dust fallout, metals concentrations in soils, the quality of surface water and groundwater, and the status of the vegetation near the mine.

Despite a history of disturbance, the area is nevertheless sensitive due to its location in the Dorob National Park. However, given the context of previous disturbance, small footprint and mining underground, it is considered that the economic benefits will outweigh the limited adverse impacts on the natural environment. To ensure this, a high standard of environmental management and rehabilitation is needed. It is recommended that NRR should set up a fund for rehabilitation, in a separate account that can be used in the event of bankruptcy or default. NRR should put aside a predetermined amount each year into this fund for the express purpose of rehabilitation. The annual amount should be based on the size of operation, expected rehabilitation costs from the feasibility study, and some $/tonne rate. The mine site, tailings, and the redundant tracks within the EPL need to be rehabilitated. The amount of the fund and the annual contribution to it still need to be determined.

The project does not appear to present any adverse socio-economic impacts, provided that health and safety issues for mine personnel are well managed, and the handling, transport and disposal of hazardous waste is in compliance with the law.

The socio-economic benefits of the projects can be enhanced. NRR should also endeavour to support initiatives to benefit human resources in Namibia, in the interests of leaving sustainable benefits after the end of the short life of the Namib Lead and Zinc Mine.

In the opinion of the Environmental Scientist, an Environmental Clearance can be issued – subject to compliance with the recommendations for environmental management in this EIA and an EMP.
North River Resources (Pty) Ltd incorporating Namib Lead & Zinc Mining (Pty) Ltd

PROPOSED RECOMMISSIONING OF LEAD & ZINC MINE ON EPL 2902

ENVIRONMENTAL MANAGEMENT PLAN INCLUDING CLOSURE AND REHABILITATION

C049

December 2013
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11 INTRODUCTION TO EMP

An Environmental Impact Assessment was conducted for North River Resources (Pty) Ltd (NRR) for the proposed recommissioning of the old Namib Lead and Zinc Mine on EPL 2902. The EIA was conducted by Colin Christian & Associates CC (CCA, 2013).

The EIA Report made many recommendations for the mitigation of environmental impacts, including broad recommendations for closure and rehabilitation.

This Environmental Management Plan (EMP) further develops the recommendations of the EIA into particular management measures for each environmental aspect of concern that was identified in the EIA. This EMP is “preliminary” because further work will be needed in terms of quantification and engineering design (for example, the required capacity of stormwater retention dams, and the volume of waste marble required to cover the tailings).

Each section in the EMP below deals with a different environmental aspect (e.g. soil, vegetation, water, etc) and the management measures required to protect that environmental aspect. Also identified are recommendations for monitoring (e.g. dust and metals fallout), as well as additional work needed during the project design stage.

The details contained in this EMP need to be integrated and implemented throughout the project life cycle – from planning and design stages, construction, operations, closure and rehabilitation, and post closure stages.

12 ENVIRONMENTAL MANAGEMENT PLAN

12.1 Geology

Impacts

- Mining out the ore shoots, as well as waste rock (marble);
- Creation of tailings;
- Some waste rock can be disposed of in worked out voids underground, but some should be used for rehabilitation of tailings.

Management Measures

- Removal of rock is inevitable and cannot be mitigated;
- After trimming tailings, a layer of waste marble should be used to cover the tailings.

Monitoring / Planning / Further Investigation

- Engineers to calculate / model the amount of waste rock required;
- Plan for the removal of sufficient waste rock to the surface and plan stockpiling for later closure.
12.2 Soils

Impacts

- Soils are already contaminated due to previous mining operations. There is a risk of aggravating the contamination of soils by metals in dust and rainfall runoff;
- Disturbance of soils to create platforms or new shafts resulting in soil loss by erosion and/or release of metals into the environment;
- Driving off road causes considerable damage to the substrate that can be visible for decades – especially on gravel plains.

Management Measures

- Control of dust emissions at source;
- Restrict removal of soil to sites where absolutely necessary. Where any soil must be removed, stockpile and protect stockpile against erosion by wind and water for later replacement during rehabilitation;
- Staff must be restricted to the mine site and not be allowed to do any recreational driving in the EPL. If any activity requiring movement away from the mine is required, it should be limited to existing tracks and subject to strict controls by management;
- To control recreational driving in the EPL by people not connected to the mine, signs should be put up – for which the approval of Parks would be requested.

Monitoring / Planning / Further Investigation

- Design of mine and processing site;
- Plan the removal of soil – as restricted as possible;
- Plan the location and protection of soil stockpiles;
- Annual soil sampling to determine whether there is any increase in metal concentrations in soils that would indicate the need for improved mitigation measures.

12.3 Air quality (and consequent soil contamination)

Impacts

- $\text{PM}_{10}$ concentrations of dust in the air pose a health risk to site staff and must be addressed as a matter of occupational health and safety;
- The dispersion of dust by wind results in soil contamination as the dust contains metals;
- Metals in soils may have impacts on living organisms, and will affect the quality of surface runoff.

Management Measures

- Refer also to detailed recommendations by Airshed (2013)

Crushing and screening:

- Regular clean up of loose material around the crusher area – at least once per week, more often if necessary;
- Wetting loose material;
Addition of chemical surfactants to water sprays to lower water surface tension and increase binding properties;
Target control of at least 50%.

**Materials handling:**
- Water sprays on dry material at off-loading points;
- Wetting of material on ROM pad;
- Minimise drop height from truck onto stockpiles (control efficiency of 25%);
- Keep material to be handled by dozers and wheeled loaders moist (achieve 50% control efficiency);
- Clean up spillage regularly;
- Reduce tipping speeds.

**Unpaved haul road & access road:**
- Target control of 90%;
- Water sprays on all roads especially between the mine entrance and ROM pad;
- Add chemical suppressants to water sprays if necessary;
- Speed limits of 20km/hr for haul trucks;
- Regular inspections to ensure effectiveness of chemical stabilisation.

**Wind erosion from the tailings:**
- Airshed (2013) recommended that rock cladding is the most effective way to prevent wind erosion from tailings in the short and long term. Marble waste rock should be used for this (also to minimise visual impacts, and reduce mobilisation of metals by surface water). A layer of marble waste rock at least 300mm thick covering the entire tailings (after trimming) is recommended. This would be subject to sufficient waste marble being available – NRR would not be required to mine marble just for the purpose of rehabilitation. However, it is recommended that, instead of disposing of the waste marble in the mine, it should be brought to the surface and stockpiled around the tailings for later application. It is further recommended that the mine engineers, during the design stage, should calculate the volumes of waste marble that will become available from the mine, and calculate the volumes required to cover the tailings – to confirm the feasibility of this recommendation.
- Wind breaks can be considered as an alternative short term solution during operations.
- Water sprays on the flanks of the tailings and stockpiles, especially before and during easterly winds would also help a great deal during operations. Sprays have to be placed on the windward side.

**All the above:**
- Ensure that an internal environmental officer is tasked with daily monitoring, reporting and implementation of controls.
- Ensure that operators are effectively trained and given periodic reminders and refresher courses as needed to maintain objectives;
- Achieve dust deposition rates less than 1200 mg/m$^2$/day at dust bucket immediately downwind of the works.

**Monitoring / Planning / Further Investigation**
- Daily visual inspections for dust levels must be conducted by the person who is designated to be responsible on site;
In addition a specialist consultant should be appointed to conduct regular measurement and monitoring of dust – in order to:

- Determine actual dust deposition rates to assess the need for improved controls at all sources;
- Monitor dust levels, including PM$_{10}$ concentrations at work stations on site for reasons of occupational health and safety;
- Quantify the nuisance risk to the surrounding environment;
- Set up dust monitoring network of at least:
  - One dust bucket in each of the four main wind directions, and
  - One dust bucket south-east of the plant (for the prevailing wind), and
  - One each to the west-northwest, and west-southwest of the plant to determine the deposition rates during the easterly winds.

The dust deposited in these buckets should be analysed for metals to determine the impacts of the tailings on downwind receptors.

12.4 Natural Vegetation / Flora

Impacts

- Vegetation cover is very sparse on the mine site and all natural vegetation should be regarded as important for conservation. However, the only greatest biodiversity concern at risk are the Lithops ruschiorum populations near the mine site that may be affected by extended exploration and any resultant mining beyond that which is currently proposed.
- Alien invasive plants may be introduced and the existing Prosopis trees may spread.

Management Measures

- Design layout to minimize the footprint of all activities within previously disturbed areas;
- Create staff awareness of the need to avoid the Lithops populations;
- If any Lithops become affected in future, timeous consideration should be given to transplanting these to a safe location;
- Alien invasive plants need to be eradicated before mine development. A mixture of Garlon and diesel painted on the stems is effective.

Monitoring / Planning / Further Investigation

- If any new exploration or mining targets are identified, then further botanical mapping will be needed;
- Lithops communities should be monitored periodically for damage;
- Monitoring and eradication of any new infestations of alien plants is necessary.
12.5 Fauna (Invertebrates, Reptiles, Birds and Mammals)

Impacts

- Exposure to soil contaminated by metals may be harmful to fauna, especially invertebrates. Metals may bio-accumulate up the food chain so that predatory reptiles, birds and mammals may be adversely affected;
- Road kills of slow moving animals such as chameleons and nocturnal birds and animals;
- Poaching of wildlife or killing of animals such as snakes;
- Honey bees are attracted to water in the desert and may be dangerous to people;
- Avoid leaving food out or allowing animals any access to human’s food. For example hyaenas that get access to human food can become “problem” animals that become dangerous and may have to be shot;
- Large birds, especially Bustards, are frequently killed by collisions with power lines (Pallett, pers comm., and Shaw, 2013).

Management Measures

- Implement mitigations as for soils and air quality;
- Create awareness amongst employees and drivers;
- Speed limits (20 km/hr) and drivers to avoid slow moving animals, and birds at night;
- Prohibit poaching or killing of wildlife, including reptiles (snakes included) as part of the contracts of employees;
- Avoid leaving containers with water or cool drinks open;
- Never feed animals. Discourage scavengers, including the use of animal-proof rubbish bins;
- Game fencing around retention ponds that contain contaminated water to prevent animals from drinking this water;
- Attach bird deflectors to the power line during refurbishment of the line (Shaw, 2013).

Monitoring / Planning / Further Investigation

- Monitoring as for soils and air quality regarding metals contamination;
- Monitoring road kills and any other issues arising in regard to fauna, and keep a record of problems so that solutions can be sought.

12.6 Groundwater Levels

Impacts

- Groundwater is of poor quality and low yield, so it does not comprise a significant resource except for drilling water. Impacts on groundwater levels are of little concern.

Management Measures

- In regard to groundwater levels no mitigation is considered to be necessary.

Monitoring / Planning / Further Investigation

- Monitoring of groundwater levels in monitoring boreholes is recommended to confirm the expected low level of impact;
12.7 Groundwater Quality, Impacts from installations: offices, workshops, ablutions, chemical & fuel stores, waste collection/treatment and refuelling

**Impacts**

- Groundwater quality can be affected from a number of sources: -
  - Fuel installations,
  - Storage, movement and handling of hazardous chemical reagents,
  - Leakage or overflow from sewage/domestic wastewater system.

**Management Measures**

- Engineering design and adequate sizing of all installations to ensure containment; e.g. bunding, lining of refuelling tanks and sites;
- Operation according to strict management and controls to prevent spillage;
- Keep cleanup kits available and ready for use in case of any spillage;
- Establish emergency response procedures;
- Ensure compliance with MAWF permitting requirements.

**Monitoring / Planning / Further Investigation**

- Monitor groundwater quality
- SLR has suggested drilling of additional monitoring boreholes (see groundwater quality, below) and possible numerical modelling.
- Refer to SLR (Aug 2013) and SLR (Oct 2013) for further details of groundwater conditions and recommendations.

12.8 Groundwater Quality (Seepage from Tailings)

**Impacts**

- The tailings will contain some of the chemical reagents, metals and water – even after as much water has been recovered as possible. Seepage through the tailings and underlying marbles, of water containing chemicals and metals, presents a risk to groundwater quality. The marbles may have a buffering effect to reduce the risk to groundwater. The main pathway for groundwater contamination is expected to be fractures in the marbles as the marbles, which are otherwise of low permeability.
- Claridge (pers comm.) explained that Epoch has been commissioned by NRR to undertake geochemical work to determine the risk of acid generation and resulting mobilisation of metals in the tailings, and to determine the degree of buffering that will occur due to the underlying marbles. Following this study, decisions can be made on the management measures necessary to prevent groundwater contamination.

**Management Measures**

- Place tailings only on the marble outcrop (as proposed);
- Avoid fractured bedrock;
- If fractured bedrock cannot be entirely avoided, two options are available: -
  - Possible grouting of fractures if necessary; and
  - Possible lining of tailings if necessary;
- Design and operation of the tailings to prevent overflowing;
- Collection and recycling of supernatant / tailings liquor;
- Trimming off tailings after closure to prevent ponding and reduce infiltration;
- Cover the entire tailings with a layer of crushed marble waste rock.

**Monitoring / Planning / Further Investigation**

- Geophysics study to identify any fractures in bedrock;
- Groundwater monitoring during operations to detect any changes in groundwater quality;
- SLR has suggested drilling of additional monitoring boreholes (see groundwater quality, below) and possible numerical modelling.
- Refer to SLR (Aug 2013) and SLR (Oct 2013) for further details of groundwater conditions and recommendations.

**12.9 Groundwater Quality (Acid Rock Drainage)**

**Impacts**

- Sulphide minerals in the ore may result in acid rock drainage locally, although this may be buffered to a degree by the host marbles.

**Management Measures**

- Refer to measures under Section 2.8 above; and
- Further investigation to determine the need for and nature of any additional mitigations.

**Monitoring / Planning / Further Investigation**

- As mentioned above, an Acid Rock Drainage study will be conducted by Epoch to ascertain local conditions with regard to mining processes and investigate buffering effects of host marbles. Epoch’s report is expected to be completed by the end of December 2013 (Claridge, pers comm)
- Groundwater monitoring to identify any problems, with mitigation designed in response to the monitoring results.
- Refer to SLR (Aug 2013) and SLR (Oct 2013) for further details of groundwater conditions and recommendations.

**12.10 Surface Water: Volume of Runoff**

**Impacts**

- Retention dams are needed to intercept contaminated water from the mine site. The intercepted water should be pumped out for use in the plant. This will have only a
minor impact on downstream runoff. The retention dams need to remain in place after mine closure.

Management Measures

- No mitigation is considered necessary for runoff volumes.

Monitoring / Planning / Further Investigation

- Refer to the hydrological report SLR (Nov 2013) and SLR (Oct 2013) for details of surface water conditions and recommendations.

12.11 Surface Water Quality

Impacts

- Contamination of rainfall runoff is possible from the following sources:
  - Lubricants and fuels from machinery and vehicles, and refuelling installations,
  - Possible chemical spills,
  - Metals in dust,
  - Overflows or spillages from sewage systems,
  - Poor management and containment of solid or liquid waste systems.

Management Measures

- Control all risks at source through design for containment, management;
- Regular clean up of crushed ore and dust accumulations;
- Design and construction of stormwater retention dams sufficient for at least the 1: 50 year rainfall event;
- Pump out water and use it in the process, if possible;
- If any water needs to be released it must first be treated according to MAWF permit requirements;
- Retain dams after mine closure.

Monitoring / Planning / Further Investigation

- Accurate survey in order to design stormwater management system;
- Further detailed design of stormwater management system;
- Engineering design of collection channels and retention ponds, including sizing for the 1: 50 year rainfall event with sufficient freeboard;
- Design of system for pumping and re-use of water in the process;
- Refer to the hydrological report SLR (Nov 2013) and SLR (Oct 2013) for details of surface water conditions and recommendations.

12.12 Solid & Liquid Waste (including sewage)

Impacts

- The context of the National Park makes all disposal of waste in the Park unacceptable;
- Waste may attract scavengers resulting in conflicts with humans, or injury or fatalities to animals;
- Litter is unsightly and poses risks to animals (e.g. plastics) if eaten; Bottles, wire and other scrap may trap animals and cause injury or death;
- Fire can result in loss of grazing in years when grass is abundant.

**Management Measures**

- Waste shall not be buried or burned within the Park at all. The only exception may be a high temperature incinerator with appropriate safety specifications;
- A priority should be given to recycling via companies that collect recyclables (e.g. glass, metals, paper and plastic);
- All temporary storage bins must be secure against animals, birds and wind;
- The design and management of facilities for treatment and disposal of sewage should make use of technologies that are tried and proven in Namibian conditions. Maintenance of such systems must be to a very high standard. Treated water should be recycled via the processing plant. No water shall be disposed of to the environment;
- General waste that cannot be recycled should be sent to the Municipal waste disposal site at Swakopmund. The Swakopmund Municipality requires that NRR must apply to dispose there as they are outside the Municipal area.

**Monitoring / Planning / Further Investigation**

- Engineering design of the infrastructure and management systems;
- Regular internal monitoring by NRR to ensure compliance with procedures and maintenance.

**12.13 Chemical Reagents and Hazardous Waste**

**Impacts**

- Hazardous chemicals will be used in the processing plant. Some will be returned to the process in water that is recovered from the tailings, while some will remain in the tailings - that cannot be mitigated;
- Any hazardous chemicals that may get into the environment pose a threat to living organisms and possibly humans.

**Management Measures**

- Hazardous substances are strictly regulated in regard to their import, transport, storage, use and disposal. NRR must ensure that they comply with all relevant legislation.
- All hazardous waste must be sent to a licensed Hazardous Waste Disposal facility such as that at Walvis Bay. A manifest must accompany each load and all relevant legislation must be complied with.
- Any lubrication oils and used hydraulic fluids, if they are not recyclable, should also be sent to a licensed hazardous waste facility.

**Monitoring / Planning / Further Investigation**

- It is recommended that a specialist company be employed to advise on, manage, transport and dispose of hazardous waste.
- Refer to Envirolex (2012)
12.14 Explosives

Impacts

- The risks posed by potential accidents involving the use of explosives are obvious enough – risks to people and to infrastructure, road users etc.;
- In the unlikely event of accidental explosions occurring, there could be secondary impacts if any facilities involving hazardous substances were affected.

Management Measures

- Comply with all legislation relating to explosives, for example in the transport, storage, use of and disposal of explosives;
- In designing the layout, transport routes and storage facilities of the mine, take into account the secondary risks and impacts of accidental explosion at stores or along transport routes at the mine – particularly the risks to installations involving hazardous chemicals;
- Ensure rigorous compliance with all legislated procedures involving explosives.

Monitoring / Planning / Further Investigation

- Regular internal inspections regarding procedures and compliance with regulations.

12.15 Electricity demand

Impacts

- The electricity demand of the mine will, in a small way, aggravate the shortage of power in Namibia and southern Africa. Therefore every effort should be made to conserve power where possible.

Management Measures

- Use of solar water heating;
- Energy efficient machines, lights and appliances;
- Design of energy efficient buildings to reduce the need for air conditioning;

Monitoring / Planning / Further Investigation

- Design stage considerations;
- Monitoring and improvement of consumption during operations.

12.16 Electricity supply infrastructure

Impacts

- Potential proliferation of unnecessary tracks;
- Risks to large birds;
- Unnecessary visual impacts post closure of the mine.
Management Measures

- Use a single access track for construction and maintenance;
- Consider combining the power line and pipeline corridors and use one track for both;
- Attach bird deflectors on the conductors (Shaw, 2013);
- Remove all infrastructure following mine closure.

Monitoring / Planning / Further Investigation

- Take the above into account during the design stage.

12.17 Water demand

Impacts

- Water resources are always an issue in the Erongo Region. Therefore every effort must be made to conserve water where possible.

Management Measures

- Thickening of tailings before disposal to tailings dam;
- Design to optimize the recovery of water from the tailings;
- Design sewage treatment system for efficiency.

Monitoring / Planning / Further Investigation

- Design stage considerations.

12.18 Water supply infrastructure

Impacts

- Disturbance of the substrate;
- Visual impacts;
- Tracks.

Management Measures

- Consider combining pipeline with power line corridor and using a single access track for both;
- Remove all infrastructure following mine closure.

Monitoring / Planning / Further Investigation

- Monitor compliance by construction contractor.
12.19 Visual Aspects

Impacts

- The most important long term impact is the tailings dump. The existing one is a dark colour that contrasts strongly with its light surroundings.

Management Measures

- After mine closure, trim off tailings to make a more natural looking landform; and
- Cover the entire tailings with a 300mm layer of waste rock (marble). This thickness is subject to sufficient waste marble being available. If not, a reduced thickness could be considered for visual impacts in combination with prior use of stabiliser products to control dust emissions;
- Other infrastructure will be removed.

Monitoring / Planning / Further Investigation

- Planning for mine closure, and stockpiling of the waste rock etc.

12.20 Road Traffic

Impacts

- Approximately 2 trucks per day will transport product to the port of Walvis Bay, and a buses will transport staff from Swakopmund and possibly Walvis Bay for each shift, three shifts per day. This will result in a very minor increase in traffic, but the roads are dangerous especially in fog.

Management Measures

- Restrict heavy vehicles to off-peak traffic times; and
- All vehicles should drive with lights on when visibility is poor;
- Driver education and awareness;
- Maintenance of vehicles.

12.21 Socio-economic Aspects

Impacts & Benefits

- The mine will employ approximately 106 people over a short period (expected 7 years);
- Benefits to outsourced suppliers;
- Benefits of training in technical skills;
- Movement of workers around the country may disrupt families and often has consequences for the spread of HIV/AIDS. This can also be detrimental to the mining company when trained staff are lost to the disease;
- Workers face risks of accident at the mine and plant, as well as road accidents;
- Workers also face health risks from inhaling dust, from the metals in that dust, from noise, etc. Occupational health and safety is not covered in this EIA and EMP.
Management & Enhancement

- Provide training to staff to optimize their performance and their employability after mine closure;
- Consider housing allowances as part of salary packages to encourage staff to secure home ownership;
- The mine has a short expected lifespan. Prepare staff from the time of first interviews for final retrenchment, include providing advice on financial planning and the value of home ownership;
- Consider training of young students at NIMT, Arandis – as an investment in human resources to benefit Namibia after mine closure;
- Provide education on HIV/AIDS from induction onwards;
- Develop emergency response procedures.
- Employ occupational health and safety (OHS) specialists to ensure compliance with relevant legislation including the Labour Act, and to ensure that the health issues of staff are managed and monitored.

Monitoring / Planning / Further Investigation

- Plan training and educational programmes;
- Plan social benefit projects;
- Identify risks and plan for potential emergency scenarios;
- Monitoring of OHS issues by independent specialists.

12.22 Relationship with the Directorate of Parks & Tourism

Impacts & Benefits

- The Directorate of Parks and the Wardens of the Erongo Region are the key Interested & Affected Parties. Parks can be significantly disadvantaged by poor planning or poor environmental management by the mine. On the other hand there may be opportunities for NRR to assist Parks in some ways, in addition to fulfilling their environmental responsibilities.

Management & Enhancement

- Maintain open and regular communication with Parks officials and wardens;
- Consider and discuss opportunities to assist Parks in a spirit of good neighbourliness.

12.23 Environmental Monitoring Plan

The EIA (Sections 8 & 9) and EMP have identified many issues that need to be included in a comprehensive monitoring programme.

Annual environmental performance assessments by an independent, qualified environmental practitioner, are necessary to assess compliance with this EMP.
12.24 Environmental Awareness Plan

An environmental awareness plan needs to be developed for NRR to achieve the following objectives:

- To create awareness of the environmental issues amongst employees, contractors and transport drivers;
- To ensure that employees have the necessary understanding to comply with the environmental management measures in this EIA and EMP;
- To provide skills training to employees and contractors;
- To evaluate the skills of employees based on environmental performance, interviews and other means;
- To provide for re-training / refresher training where performance or knowledge is clearly inadequate;
- To provide a system of recording of training provided to individuals;
- Periodic re-assessment of training needs, particularly with regard to new developments, newly identified issues and impacts and associated mitigation measures.

12.25 Procedures for Environmental Emergencies

Objectives

The objective of the Environmental Emergency Preparedness and Response Procedure is to identify and prepare for potential accidents and emergency situations that can have an impact on the environment. Preparedness facilitates rapid and effective response to environmental emergencies.

Responsibilities

North River Resources will be responsible for all aspects of environmental management and compliance with this EMP. NRR should appoint a Mine Manager who will be responsible for the day-to-day monitoring and enforcement of environmental management. Alternatively NRR may appoint an Environmental Manager to fulfil this responsibility.

In any event a designated individual who is capable and committed must carry the responsibility for environmental management. His responsibilities should include:

- Responding to any environmental emergency;
- Ensuring that sufficient financial and human resources are available at short notice to implement emergency procedures;
- Identification of potential environmental emergencies;
- Pro-active response to avert potential environmental emergencies;
- Testing, where practical, the proposed response plans;
- Investigating any environmental impacts following any emergency and recording all relevant data and procedures undertaken;
- Ensuring periodical review, and if necessary revision of procedures to prevent recurrence of the emergency situation;
- Distribution of all standard procedure to all relevant mine managers;
- Ensure compliance with the recommended environmental management measures (in the EIA and EMP) for mitigation of impacts on a routine basis;
o Ensure that the Environmental Monitoring Plan, including independent monitors, is implemented according to schedule.

**Dealing with Environmental Emergencies**

Potential environmental emergencies are identified by the Environmental Manager based on legal requirements, knowledge of the mining environment and understanding of the Environmental Impact Assessment and EMP, and experience of previous emergency situations.

In the event of an emergency, the following procedure shall be followed: -

- Notify the following people: -
  - the relevant Warden of the Dorob National Park / Erongo Parks;
  - the office of the Environmental Commissioner in Windhoek;
  - in the event of pollution, notify the Directorate of Water Affairs (MAWF);
  - any neighbours if the pollution occurs on a public road;
  - any other authorities that may be affected (e.g. Swakopmund or Walvis Bay if affected); and

- Take steps immediately to limit the spread of pollution;
- Take samples of the pollutants, affected water and affected soil (as applicable) for chemical analysis;
- Implement clean up actions. These may be directed by external parties such as a fire brigade, private contractors, or government departments.
- Inform the relevant authorities when the necessary response has been fully effected and the situation remediated.

**12.26 Compliance Monitoring – Internal and Independent**

NRR must be committed to continuous monitoring and assessment of their own operations to ensure compliance with the EIA, Environmental Management Plan and all environmental legislation. Documentation of any instances of non-compliance should be made with a record of what measures have been implemented to prevent recurrence of the issue at hand.

In addition, it is recommended that compliance monitoring should be carried out twice per year by an independent, qualified environmental practitioner.

The Compliance Monitoring Report should specifically deal with: -

- The adequacy of NRR's own monitoring and recording on a continuous, daily basis during the operation of the mine;
- The methodology used for compliance monitoring;
- The results - degree of compliance with the recommendations of the EIA and EMP;
- Recommendations on how to improve environmental performance in cases of non-compliance;
- Identification of any inadequacies in the EMP itself and recommended amendments to the EMP (involving discussion with the Client).
13.1 Mine Closure Process

Given the sensitive nature of the project and location in the Dorob National Park, the following formal process is recommended.

Step 1: Inform relevant authorities of proposed mine closure

- Hold meetings with the relevant Authorities to discuss the proposed mine closure process and to ensure alignment with their requirements before the work commences;
- At least the following authorities should be involved – MET (Environmental Commissioner’s office), Directorate of Parks (Windhoek) and Chief Warden, Erongo Region (Swakopmund); Ministry of Mines & Energy;
- Included in the discussions, amongst other environmental issues, should be the question of post closure land use and whether any existing facilities can be used by Parks.

Step 2: Risk assessments

- Conduct workshops to identify all potential environmental risks associated with the mine closure process;
- These workshops must involve the client (NRR) and their managers and mine engineers, Environmental Scientist and specialist consultants as needed;
- Risks should be classified in some way according to the significance of the issue concerned.

Step 3: Draft Mine Closure Plan

- A draft Closure Plan should be compiled that explains what steps will be taken to protect the environment;
- The Plan must include a summary of the requirements of the authorities;
- It should include any monitoring requirements post closure if necessary;
- The draft Plan must be circulated to the authorities and any other key I&APs for input and comment.

Step 4: Approval of Mine Closure Plan

- Once the relevant Authorities and I&APs have approved the Mine Closure Plan, it will be submitted to the authorities for approval.

Step 5: Implementing the Mine Closure Plan

- Once approved by the Authorities, the Mine closure Plan will be implemented.
13.2 Closure Plan Objectives

The Closure Plan must address the environmental issues identified:

- in this EIA and EMP;
- any issues arising from the specialist monitoring during operations;
- any other environmental issues emerging during the operations stage; and
- any issues arising from the Steps 1-3 outlined above.

The overall rehabilitation goals of the Closure Plan should include but not necessarily be limited to the following:

- Ensure a safe, stable and non-polluting situation;
- Trim slopes to reduce erosion and replace stockpiled topsoil;
- Address any issues of drainage so that clean water flows to natural watercourses, while mine contact water is lead to retention ponds from where it can evaporate;
- Remove all surface infrastructure that has no beneficial post closure use;
- Establish bio-diverse floral communities where practically possible;
- Remove threats to wildlife, birds etc and ensure that the area is habitable to fauna as befits a National Park;
- Remove all hazardous waste to a licensed disposal facility;
- Remove fences and re-integrate the mining area into the surroundings. Excepted that it will probably be desirable to retain the stormwater retention ponds and the fences around them;
- Address any health and safety issues as may be remaining on the site;
- Restore the site to be aesthetically acceptable, with particular attention to reducing the visual impacts of the tailings;
- Prepare employees well in advance for retrenchment.

The Closure & Rehabilitation Plan will include at least the following activities:

**Underground & Shafts**

- Ensuring that backfilling of waste is secure will be ongoing during operations and upon closure of the mine;
- Cast reinforced concrete slabs over the shafts at the surface before covering with waste rock (marble) and soil. This is safer than fencing, which will corrode in due course and is less able to keep animals and people out.
- Secure the entrance of the mine against unauthorised entry.

**Infrastructure**

- Remove all buildings, plant, equipment, concrete slabs, fixings and machinery from site for safe and legal disposal, giving due consideration to recycling whatever can be recycled;
- Remove the pipeline and power line unless they have some beneficial use after mine closure, and in consultation with Namwater and ErongoRED respectively;
- Remove all rubble and waste to an approved landfill site;
- Rip up haul roads and access roads that are no longer required and ensure that scars on hillsides are removed;
- Rip up any areas that were compacted (e.g. beneath concrete slabs).
Hazardous substances

- Hazardous waste shall not be left on site or disposed on in the mine.
- Hazardous waste should have been removed to a licensed disposal site on a regular basis during operations, so there should be no build up of hazardous waste. At mine closure any remaining chemicals shall be removed and disposed of to an approved waste facility;
- Clean up possible sources of contamination of water;
- Any areas of soil that are contaminated by hazardous chemicals should be cleaned up. This should also be carried out immediately any spills occur during operations and not left till the end of the project.

Tailings

- Trimming of the dry tailings storage facility to prevent ponding of water and remove hard lines for reasons of visual impacts;
- Cover the entire tailings with a layer of broken waste rock (marble), ideally 300mm thick, to reduce erosion and reduce visual impacts. The purpose it to prevent dust containing metals from being removed by wind and water from the tailings, and to achieve visual blending with the surroundings;
- To the extent that is practically possible, ensure that the final form and appearance resembles the natural landforms and blends with them visually.

Water issues and Retention ponds

- Maintain any diversion channels leading to retention ponds so that they continue to operate effectively for many years after closure. Even if they overflow in events greater than the 1: 50 year magnitude, the retention dams will still trap silt that contains metals;
- Retention ponds should remain in place so that they can intercept rainfall runoff from the site for many years after mine closure. Game fencing around retention ponds should probably be retained to prevent animals from drinking contaminated water, until water tests show that water quality has reached acceptable standards for wildlife;
- Sample and test surface water to determine water quality, levels of salts, metals, and other possible contaminants, and compare with water standards for livestock / wildlife consumption;
- Review groundwater monitoring data and determine the need for any remedial measures.

Trimming of cut slopes, replacing of Soil stockpiles and erosion prevention

- Where it was necessary to remove soil before construction, e.g. for buildings and foundations, the soil must be replaced and graded to give a natural appearance;
- Where ground has been made uneven, e.g. by cut-and-fill for the purpose of levelling, the slopes must be reinstated to their natural slope angle and made to look as natural as possible;
- Reinstate disturbed ground to emulate the surrounding surface topography;
- Eliminate any unsafe steep slopes;
- All areas must be free draining – i.e. eliminate any ponding of rainwater;
- After trimming and shaping, the available topsoil must be replaced, spread over the reinstated areas. Be mindful of the risks of soil erosion – for example, naturally
exposed bedrock will probably not retain soil during rainfalls and should probably be left exposed;
  o Ensure that drainage lines created on the rehabilitated surface will not scour or result in gulley erosion.

Sweeping of tracks in the EPL
  o It is standard practice within EPLs in Namibian Parks to sweep tracks that are no longer required, leaving only those main tracks that are approved by the Parks authorities.

Biodiversity
  o Eradicate any alien invasive plants that have established or spread. For example there are alien *Prosopis* trees on the site at present;
  o It may be possible to plant some of the local indigenous species where there is sufficient depth of soil.

Consultation with Directorate of Parks
  o Maintain regular communications with the Parks authorities.
During the public participation programme, a concern was expressed to ensure that funds would be available for rehabilitation in the event of project failure, bankruptcy, or default by the mining company.

North River Resources has indicated a willingness to establish a trust fund, in a separate account that will be protected from claims in the event of bankruptcy, and that will be available for rehabilitation in any event.

An amount will be lodged in the trust fund annually, based on a dollar per tonne of ore mined. In order to arrive at the appropriate $/t figure, the amount required for rehabilitation needs to be calculated. This should be done during the engineers during the design stage. During design, the affected ground areas, and surface area of the final tailings facility can be determined – for example.

As an approach to determining the amount that is needed in the trust fund, and the annual contributions to it, it is recommended that the requirements of the South African Minerals and Petroleum Resources Development Act (Act 28 of 2002) - (MPRDA) Guidelines for the Calculation of Quantum for Rehabilitation be used.
REFERENCES


SLR (September 2012) Quarterly Review September 2012 Sampling of Monitoring Boreholes at EPL-2902

SLR (December 2012) Quarterly Review December 2012 Sampling of Monitoring Boreholes at EPL-2902

SLR (March 2013) Quarterly Review March 2013 Sampling of Monitoring Boreholes at EPL-2902

SLR (June 2013) Quarterly Review June 2013 Sampling of Monitoring Boreholes at EPL-2902


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We would like to express our appreciation to all those Interested and Affected Parties who participated in the Public Meetings and made their concerns known to us.